# Mergers and Investment

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# Motivation

- Claim in the industry is that merger increases firm investments:
    - Scale economies will reduce cost of infrastructure and stimulate investments in 4G (e.g., Telefonica/Eplus).
    - Or push the merged entity to increase its quality and contest leader (e.g., H3G/O2).
- Recent lobbying by mobile companies: consolidation necessary to invest in infrastructure.
    - Currently, too little profits; merger increases profits by giving firms the money they need to invest.
    - Ambiguous link between competition and investments.

# Literature

- Vast related literature on competition and innovation (old topic, going back to Schumpeter and Arrow): Aghion, Bloom, Blundell, Griffith, and Howitt (2005) on U-shaped relationship.
- Static oligopoly: Vives (2008) and Lopez and Vives (2015) analyze relationship between competition and investment in a variety of settings (more on this below).
- Dynamic oligopoly: among others, Mermelstein, Nocke, Satterthwaite, and Whinston (2015) analyze role of scale economies in a setting with two firms bargaining over a merger.

# Literature

- Vives' (2008) most relevant case for mergers is restricted entry case. (Baseline: simultaneous investment ($x_i$) and price choices ($p_i$).)
- When $n$ increases, per firm investment $x_i$ decreases:
  - $n$ rises $\rightarrow$ residual demand decreases $\rightarrow$ $x_i$ decreases.
  - $n$ rises $\rightarrow$ demand elasticity increases $\rightarrow$ $x_i$ increases.
  - First effect dominates.
- However, both $nx_i$ and that $x_i/(p_i q_i)$ tend to increase.
- Helpful, but missing w.r.t mergers: (1) asymmetries; (2) effects on prices and CS; (3) $x_M > x_1 + x_2$.
- Also, this exercise captures both a change in competition (ex-ante) and appropriability (ex-post).

# Outline

1. We study effects of merger and NSA (Network Sharing Agreement) on investment and prices in a model with price and investment decisions. NSA: only investment decisions taken cooperatively.

   Both simultaneous and sequential (first investment then price) cases.

2. Leading scenario: cost-reducing investment. Discuss quality-improving investment.
3. Illustrate results using specific models: Häeckner's (2000) linear-quadratic utility function.

# Results

- *Simultaneous case:* unless strong spillovers, merger reduces investment and raises prices.

  The NSA is constrained efficient setting.
- *Sequential case:* absent spillovers, merger raises prices. It lowers investment and industry quantity if investment are strategic complements.

  NSA tends to reduce investment with respect to the benchmark case.
- NSA and merger comparison is unclear: for given prices, lower investment with NSA, but the NSA leads to lower prices than the merger.

# Simultaneous investment and price choices

- Consider $n$ symmetric firms simultaneously choosing cost-reducing investments and prices. Standard regularity assumptions.

$$\max_{p_i, x_i} \,(p_i - c(x_i))q_i(p) - F(x_i).$$

- The FOCs for the 'stand-alone' (no merger) case are:

$$p_i : \; q_i(p) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c(x_i)) = 0 \tag{1}$$

$$x_i : \; -\frac{\partial c(x_i)}{\partial x_i} q_i(p) - \frac{\partial F(x_i)}{\partial x_i} = 0 \tag{2}$$

- Note that the higher the output the larger the investment.

# Economies of scope and spillovers

- Assume both the merger and the NSA generate scope economies.
- We model them by assuming that marginal cost of production decreases with own and other insider investment:

$$c_i(x_i, x_k) = c(x_i + \lambda x_k).$$

- With $c' < 0$ and $c'' \geq 0$.
- $\lambda$ is the (voluntary) spillover.

# A merger between firms $i$ and $k$

- Firms $i$ and $k$ solve

$$\max_{p_i, x_i, p_k, x_k} (p_i - c(x_i + \lambda x_k))q_i(p)$$
$$+(p_k - c(x_k + \lambda x_i))q_k(p) - F(x_i) - F(x_k).$$

- The FOCs for the merger case are:

$$p_i : q_i(p) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c(x_i + \lambda x_k)) + \frac{\partial q_k(p)}{\partial p_i}(p_k - c(x_k + \lambda x_i)) = 0$$
$$x_i : -\frac{\partial c(x_i + \lambda x_k)}{\partial x_i} q_i(p) - \lambda \frac{\partial c(x_k + \lambda x_i)}{\partial x_i} q_k(p) - \frac{\partial F(x_i)}{\partial x_i} = 0$$

- Outsiders' FOCs the same with and without merger.
- When compared to pre-merger, investment and price FOCs of the insiders change due to spillovers.

# Effects of the merger

- Absent spillovers ($\lambda = 0$), and under some regularity assumptions:
  - Prices of the insiders increase.
  - Prices of outsiders increase (by strategic complementarity).
  - The insiders' outputs decrease, the outsiders' outputs increase, but aggregate output decreases.
  - From FOCs: investment proportional to output, so insiders' investments decrease, outsiders' investment increase and total investment decreases.
- Therefore, consumer surplus decreases.
- With spillovers ($\lambda > 0$), trade-off: investment increase compared to benchmark (given prices). If high spillovers, prices can decrease.

# A NSA between firms $i$ and $k$

- Firms $i$ and $k$ maximize joint profits when choosing investments, individual profits when choosing prices.
- The FOCs for the NSA case are:

$$p_i : q_i(p) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c(x_i + \lambda x_k)) = 0$$

$$x_i : -\frac{\partial c(x_i + \lambda x_k)}{\partial x_i} q_i(p) - \lambda \frac{\partial c(x_k + \lambda x_i)}{\partial x_i} q_k(p) - \frac{\partial F(x_i)}{\partial x_i} = 0$$

- The investment FOCs of the insiders are as in the merger; the price FOCs as in the status quo (except for the spillover).

# Effects of the NSA

- With simultaneous moves, the NSA (weakly) dominates (for any $\lambda \geq 0$) both benchmark and merger:
  - NSA-members internalize the effect of the spillover when setting their investment.
  - This increases investment given prices.
  - At the same time, prices are lower than in the benchmark due to the spillover ($dp_i/d\lambda < 0$), and lower than in the merger because no internalization of insiders' profits when setting prices.

# Summary with simultaneous moves

- Unless there are strong economies of scope/spillovers, the merger reduces investment and raises prices.
- With strong enough spillovers, the merger increases investment and this effect may outweigh the detrimental price effect.
- However, the NSA always dominates both the merger and the benchmark.

# Sequential investment and price choices

- Consider $n \geq 3$ symmetric firms sequentially choosing cost-reducing investments and prices.

$$\max_{p_i, x_i} (p_i - c(x_i))q_i(p) - F(x_i).$$

- The FOCs for the 'stand-alone' (no merger) case are:

$$p_i: \; q_i(p) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c(x_i)) = 0$$

$$x_i: \; -\frac{\partial c(x_i)}{\partial x_i} q_i(p) - \frac{\partial F(x_i)}{\partial x_i} + (n-1)\frac{\partial q_i(p)}{\partial p_j}\frac{dp_j}{dx_i}(p_i(x) - c(x_i)) = 0$$

- Third term negative: firm $i$ anticipates that investments reduce *all* prices, hence $x_i$ will be lower than in simultaneous case ($dp_j/dx_i < 0$).

# A merger between firms $i$ and $k$

- Firms $i$ and $k$ solve

$$\max_{p_i, x_i, p_k, x_k} (p_i - c(x_i))q_i(p) + (p_k - c(x_k))q_k(p) - F(x_i) - F(x_k).$$

- The FOCs for the price set by firm $i$:

$$p_i : q_i(p) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c(x_i)) + \frac{\partial q_k(p)}{\partial p_i}(p_k - c(x_k)) = 0$$

- Merger raises prices for given investments.

# A merger between firms $i$ and $k$

- The FOCs for the investment set by firm $i$:

$$x_i : -\frac{\partial c(x_i)}{\partial x_i} q_i(p) - \frac{\partial F(x_i)}{\partial x_i}$$
$$+(n-2)\frac{dp_j}{dx_i}\left[\frac{\partial q_i(p)}{\partial p_j}(p_i(x) - c(x_i)) + \frac{\partial q_k(p)}{\partial p_j}(p_k(x) - c(x_k))\right] = 0$$

  For $j \neq i, k$.

- Firm $i$ internalizes impact of change of investment on other insider's gross profits. Lower investment for given prices.
- If investments are strategic substitutes, under some conditions total investment will decrease; a fortiori if strat.compl. (This will reinforce the detrimental effect of price increases.)

# A NSA between firms $i$ and $k$

- Under NSA, same FOC as in the benchmark at the pricing stage.
- At investment stage, FOC is

$$x_i : -\frac{\partial c(x_i)}{\partial x_i} q_i(p(x)) - \frac{\partial F(x_i)}{\partial x_i}$$
$$+(n-1)\frac{dp_j}{dx_i}\left[\frac{\partial q_i}{\partial p_j}(p_i(x) - c(x_i)) + \frac{\partial q_k(p)}{\partial p_j}(p_k(x) - c(x_k))\right] = 0$$

For all $j$.

- Firm $i$ internalizes impact of investment on other NSA member (but effect of price decisions are not internalised). For given prices, the (negative) effect on investment is stronger than with the merger.

# A NSA between firms $i$ and $k$

- Under NSA, at the investment stage firm $i$ takes into account also the impact of an increase in its investment on other NSA-member gross profits.
- Under merger, firm $i$ internalizes impact of its own decision on other member gross profits at the pricing stage.
- Therefore, NSA allows firm $i$ to compensate for the fact that it cannot set prices cooperatively. This acts to reduce investment with respect to the merger, for given prices.

# Summary with sequential choices

- Absent economies of scope or spillovers, the merger raises prices. We also discuss conditions under which it lowers investment.
- Differently from the simultaneous case (and absent spillovers), the NSA reduces investment and therefore consumer welfare with respect to the benchmark case.
- Comparison between NSA and merger unclear in general: for given prices, lower investment with NSA, but the NSA leads to lower prices than the merger.

# Quality-increasing investment

- Quality-improving investments, with $q_i = q_i(p, x)$, $q_i$ increasing in $x_i$ and decreasing in $x_{-i}$. Assume no spillovers.

$$\max_{p_i, x_i} (p_i - c) q_i(p, x) - F(x_i).$$

- The FOCs for the 'stand-alone' (no merger) case are:

$$p_i: \; q_i(p, x) + \frac{\partial q_i(p, x)}{\partial p_i}(p_i - c) = 0 \qquad (3)$$

$$x_i: \; \frac{\partial q_i(p, x)}{\partial x_i}(p_i - c) - \frac{\partial F(x_i)}{\partial x_i} = 0 \qquad (4)$$

- Note that the higher the margin the larger the investment.

# A merger between firms $i$ and $k$

- Firms $i$ and $k$ solve

$$\max_{p_i, x_i, p_k, x_k} (p_i - c)q_i(p,x) + (p_k - c)q_k(p,x) - F(x_i) - F(x_k).$$

- The FOCs for the merger case are:

$$p_i : q_i(p,x) + \frac{\partial q_i(p)}{\partial p_i}(p_i - c) + \frac{\partial q_k(p)}{\partial p_i}(p_k - c) = 0$$
$$x_i : \frac{\partial q_i(p,x)}{\partial x_i}(p_i - c) + \frac{\partial q_k(p,x)}{\partial x_i}(p_k - c) - \frac{\partial F(x_i)}{\partial x_i} = 0$$

- 1st FOC: usual merger effect to increase the price.
- 2nd FOC: firm $i$ takes into accoun that $x_i$ reduces $k$'s demand, but a higher price (1st FOC) tends to raise $x_i$. A priori ambiguous.

# Illustrating the effect of a merger

- To illustrate the effects of merger & NSA, study specific oligopolistic models.
- Two ingredients needed: Bertrand competition, asset-based model.
  - Salop's circle model (cost-reducing investment).
  - Vertical product differentiation model (quality-improving).
  - Häeckner (2000) model to consider both types (investment reduces costs or rotates the demand function).
- Network-sharing agreements v. mergers.

# Illustrating the effect of a merger

- From Häeckner (2000), take

$$U(q_1, ..., q_n, I) = \sum_{i=1}^{n} \alpha_i q_i - \frac{1}{2}\left(\sum_{i=1}^{n} q_i^2 + 2\gamma \sum_{j \neq i} q_i q_j\right) + I.$$

- $\gamma \in [0, 1)$ measures products' substitutability. $\alpha_i$ measures a product $i$'s quality in a vertical sense. One can derive the following demand functions:

$$q_i = \frac{(\alpha_i - p_i)[\gamma(n-2)+1] - \gamma \sum_{j \neq i}(\alpha_j - p_j)}{(1-\gamma)[\gamma(n-1)+1]}.$$

- Note: $\alpha_i$ raises own demand and decreases rivals' demand. It also raises total demand.
- Solve for sequential choice case with $n = 3$. First without then with spillovers.

# Illustrating the effect of a merger

- In the second stage, each firm solves:

$$\max_{p_i} \ \pi_i(p_i, \bar{p}_{-i}) = (p_i - c_i)q_i - F(x_i).$$

- Solving for second-stage equilibrium prices and quantities, we find that gross profits $(\pi(x_i) + F(x_i))$ are

$$\frac{(1+\gamma)\left[(\alpha_i - c_i)(2 + 3\gamma - \gamma^2) - \gamma(1+\gamma)\sum_{j\neq i}(\alpha_j - c_j)\right]^2}{4(2+3\gamma)^2(1+\gamma-2\gamma^2)}.$$

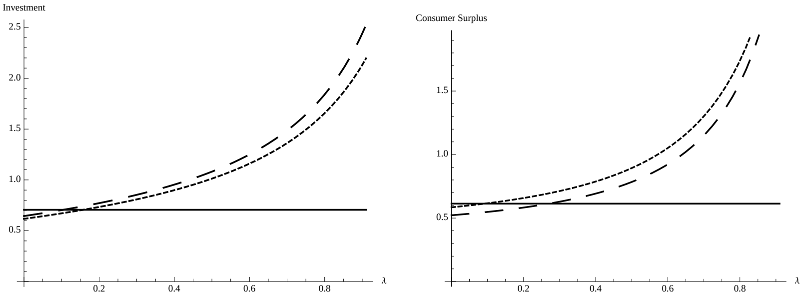
  Thus, assuming that $x_i$ raises $\alpha_i$ equivalent to assuming that it decreases $c_i$.

- We develop case of quality-increasing investment.

# Results without spillovers

- Merging parties reduce investment, outsider increases investment. Overall, total investments decrease.
- Quantity of merging firms decreases, quantity of outsider increases with the merger.
- The merger is profitable for insiders for sufficiently small values of $\gamma$. Whenever the merger is profitable, consumer surplus decreases.
- Total surplus lower with the merger, but for the values of $\gamma$ that are sufficiently large.

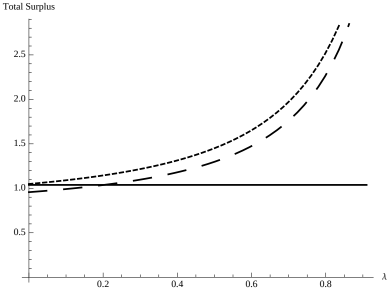
# Results with spillovers




*The solid black line corresponds to the benchmark. The dotted line to the NSA and the dashed line to the merger.*

- From LHS figure, when no spillovers NSA generates lower investment than merger and benchmark.
- Yet, effect on prices and investment combine to make consumer surplus lower with the merger than benchmark and NSA when spillovers are absent.
- NSA lower surplus than benchmark due to strategic effect on investments.

# Results with spillovers




*The solid black line corresponds to the benchmark. The dotted line to the NSA and the dashed line to the merger.*

- Total surplus larger than in the benchmark when large enough spillovers.

# Summary

- In a standard oligopoly model—absent scope economies—the merger leads to lower investment and welfare (same result with Salop or Shubik-Levitan utility functions).
- With scope economies, the merger would raise investment and total welfare. But if a NSA attains the same economies, it would be better.
- Implication: merging parties need to substantiate efficiency claims, claims that consolidation leads to higher investment in general not credible.