Mergers and Investment

Massimo Motta\textsuperscript{1} Emanuele Tarantino\textsuperscript{2}

\textsuperscript{1} European Commission, UPF \& Barcelona GSE

\textsuperscript{2} University of Mannheim \& MaCCI

EAGCP @Brussels

1 December 2015
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

- Static oligopoly: Vives (2008) and Lopez and Vives (2015) analyze relationship between competition and investment in a variety of settings (more on this below).
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 $x_i/(p_iq_i)$ 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.


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:

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

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

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

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

- 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 \(i\):

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

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:

\[
p_i : \quad q_i(p, x) + \frac{\partial q_i(p, x)}{\partial p_i} (p_i - c) = 0 \quad (3)
\]

\[
x_i : \quad \frac{\partial q_i(p, x)}{\partial x_i} (p_i - c) - \frac{\partial F(x_i)}{\partial x_i} = 0 \quad (4)
\]

- 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 account 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 Häckner (2000), take

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

- \( \gamma \in [0, 1) \) 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

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

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.