Mergers in Vertical Markets with Complementary Inputs

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CRETE 2025

Many industries across different sectors use multiple complementary inputs for the production of final goods.

Final product manufacturers can source the required inputs from the upstream units of their competitors, from external input suppliers and/or produce them in-house.

For example, Apple and Samsung keep in house their product design while Apple buys chips and screens for its i-phone from Samsung and essential inputs for the transmission of data from Qualcomm.

Introduction

Motivation

Mergers among firms producing complementary inputs is also a common business practice.

Consider the case of the semiconductor industry:
In 2006, AMD (Advanced Micro Devices) acquired ATI Technologies.
In 2010, Intel acquired McAfee (manufacturer of computer security technology).

In the smartphone market:
In 2016, Foxconn (electronics contract manufacturer) acquired Sharp.
In 2022, Murata Manufacturing (a producer of ceramic passive electronic components, such as capacitors and Surface acoustic wave (SAW) filters) acquired Resonant Inc (a leading company in RF filter design).

All the above mentioned examples share some of the following features:

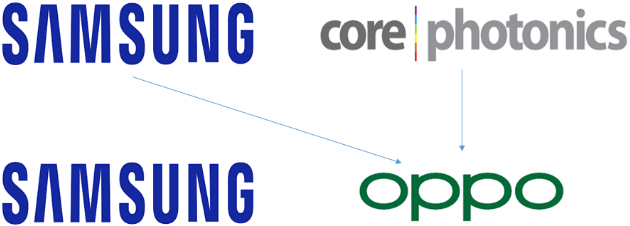
1) Complementary Inputs
2) One of the firms in the market is vertically integrated (produces at least one input in-house)
3) Sourcing/Outsourcing an input from a rival firm and/or an external firm
4) M&A of complementary input suppliers where one of them is already in the downstream market

Is there a case that combines all of the above features?

Samsung supplies Oppo with OLED display panels.

Introduction

Motivation



Samsung supplies Oppo with OLED display panels. Oppo purchased camera zoom lenses from Corephotonics (a company specializing in computational optics and the mobile market).

Introduction

Motivation

In 2019, Samsung acquired Corephotonics and continued to supply Oppo with panels that improved imaging capabilities - with better zoom, increased effective resolution and broader dynamic range.

- Do complementary input suppliers have incentives to merge?
- How does the merger affect both the vertically integrated and the separated downstream firms?
- Is such a merger welfare-enhancing?

- *Literature on Mergers with Complementary Inputs:*

Downstream market is not modelled: Choi (2008), Quint (2014), Etro (2019)
Downstream market is monopolized: Matsushima and Mizuno (2013), Kopel et al. (2017), Kitamura et al. (2018)

- *Literature on Vertical Merger and Vertical Contracting:*

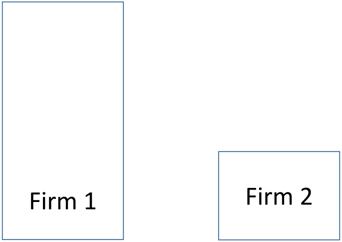
Chen (2001), Reisinger and Tarantino (2015, 2019)

Contribution of this paper:

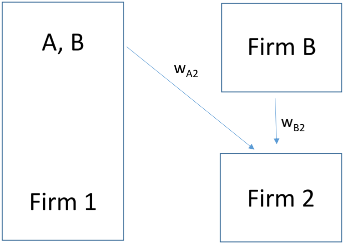
- One of the input suppliers is vertically integrated
- Downstream competition

Model

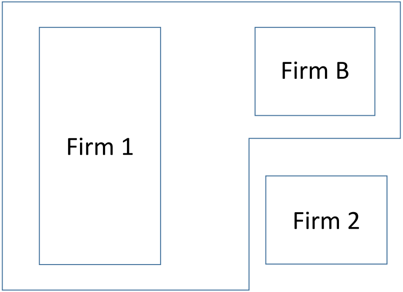
Initial Market



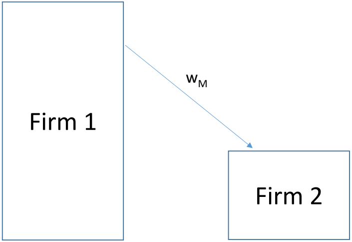
Two final good manufacturers, firms 1 and 2. Each firm produces a differentiated final good. Producing one unit of final product requires two inputs, one unit of input A and one unit of input B.



Firm 1 produces in-house both inputs A and B at zero marginal cost. Firm 2 purchases input A from firm 1 for a per-unit price w_{A2} and input B from an external supplier, firm B, for a per unit price w_{B2}.



Firm 1 considers merging with firm B in the input market. If the merger takes place, then firm 2 will purchase both required inputs as a bundle by firm 1 at w_M.



The inverse demand function for each firm *i*'s final good is: $p_i(q_i,q_j)=\alpha-q_i-\gamma q_j$ where *i, j =1,2 and i≠j*, $0<\gamma\leq 1$, $\alpha>0$.

Stage 1:
Firm 1 decides whether to merge with firm B or not. Merger takes place only if it is profitable for both firms.

Stage 2:
The input supplier(s) make(s) a take-it-or-leave-it offer over the wholesale price contract.

Stage 3:
The firms in the downstream market set their prices.

In stage 3, firms 1 and 2 face the following maximization problems:

$$
\begin{aligned}
\pi_1(p_1, p_2, w_{A_2}, w_{B_2}) &= p_1\left(\frac{(a-p_1)-\gamma(a-p_2)}{1-\gamma^2}\right) + \\
&\quad w_{A_2}\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right) \\
\pi_2(p_1, p_2, w_{A_2}, w_{B_2}) &= (p_2 - w_{A_2} - w_{B_2})\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right)
\end{aligned}
$$

The resulting equilibrium prices are:

$$
\begin{aligned}
p_1(w_{A_2}, w_{B_2}) &= \frac{a(2-\gamma-\gamma^2)+\gamma(3w_{A_2}+w_{B_2})}{4-\gamma^2} \\
p_2(w_{A_2}, w_{B_2}) &= \frac{a(2-\gamma-\gamma^2)+(2+\gamma^2)w_{A_2}+2w_{B_2}}{4-\gamma^2}.
\end{aligned}
$$

In stage two, firm 1 and firm B determine the input prices by maximizing the following profits:

$$\begin{aligned}
\pi_1(w_{A_2}, w_{B_2}) &= p_1\left(\frac{(a-p_1)-\gamma(a-p_2)}{1-\gamma^2}\right) + \\
&\quad w_{A_2}\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right) \\
\pi_B(w_{A_2}, w_{B_2}) &= w_{B_2}\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right)
\end{aligned}$$

It follows that the equilibrium wholesale prices that maximize the profits of firm 1 and firm B are:

$$\begin{aligned}
w_{A_2}^S &= \frac{a(2+\gamma)(4-2\gamma^2+2\gamma^3-\gamma^4)}{2(12-2\gamma^2-\gamma^4)} \\
w_{B_2}^S &= \frac{a(2-\gamma)(1-\gamma)(2+\gamma)(2+\gamma^2)}{2(12-2\gamma^2-\gamma^4)}.
\end{aligned}$$

Results

Pre-merger case

- $w^S_{A_2} > w^S_{B_2}$

Why?

- Due to raising rival's cost effect (RRC effect), firm 1 sets a higher wholesale price than that of firm B which allows him to increase the input sales that receives from its downstream competitor.
- Firm B charges firm 2 with a lower wholesale price, because it wants to keep the demand up for input B.
- It holds that $\pi^S_1 > \pi^S_2 > 0$

Results

Merger case

In stage 3, firms 1 and 2 set their prices, p_1 and p_2, respectively, in order to maximize their profits:

$$\begin{aligned}
\pi_1(p_1, p_2, w) &= p_1\left(\frac{(a-p_1)-\gamma(a-p_2)}{1-\gamma^2}\right)+w\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right) \\
\pi_2(p_1, p_2, w) &= (p_2-w)\left(\frac{(a-p_2)-\gamma(a-p_1)}{1-\gamma^2}\right)
\end{aligned}$$

Solving the system of the first order conditions, we find:

$$\begin{aligned}
p_1(w) &= \frac{a(2-\gamma-\gamma^2)+3\gamma w}{4-\gamma^2} \\
p_2(w) &= \frac{a(2-\gamma-\gamma^2)+(2+\gamma^2)w}{4-\gamma^2}.
\end{aligned}$$

Results

Merger case

In the second stage, firm 1 sets the input price for its competitor by maximizing its profits
$\pi_1(w) = p_1(w)(\frac{(a-p_1(w))-\gamma(a-p_2(w))}{1-\gamma^2}) + w(\frac{(a-p_2(w))-\gamma(a-p_1(w))}{1-\gamma^2})$. The wholesale price that maximizes this expression is:

$$w^M = \frac{a(8+\gamma^3)}{2(8+\gamma^2)}$$

- $w^M > 0 \longrightarrow$ Some double marginalization will persist under merger
- $\frac{\vartheta w^M}{\vartheta \gamma} > 0$ if and only if $\gamma > 0.65496 \longrightarrow$ when downstream market competition becomes fiercer, firm 1's incentives to decrease firm 2's aggressiveness get stronger.
- $p_1^M < p_2^M \longrightarrow q_1^M > q_2^M > 0 \longrightarrow \pi_1^M > \pi_2^M > 0$

- $\pi_1^M > \pi_1^S + \pi_B^S \longrightarrow$ Merger is always desirable

- $MC_2^S = w_{A_2}^S + w_{B_2}^S > w^M \longrightarrow p_2^S > p_2^M \longrightarrow q_2^S < q_2^M \longrightarrow \pi_2^S < \pi_2^M \longrightarrow$ Firm 2 is always better off with the merger due to the internalization of the double marginalization effect

- In other words, firm 2 is always better off when sources both inputs from one supplier. This is in contrast to Matsushima and Mizuno (2013) where sourcing both inputs from one supplier (non-VI) might be harmful for the downstream monopoly firm.

Welfare Implications

Mergers among complementary input suppliers usually have a positive impact on consumer surplus and on total welfare because of the internalization of the double marginalization effect.

But, here, the RRC effect, although is small, can hurt the consumers. When $\gamma > 0.714648$, the consumer surplus is lower under merger compared to the pre-merger case.

Total welfare is always greater under the merger case, due to the positive impact on firms' profits.

Extensions - Discussion

- *Vertical Merger*

A vertical merger between firm B and firm 2 is not desirable for the merging firms, only for the non-merged firm 1. This is in contrast to the findings of Akgun et al. (2020) who do not consider the existence of a VI firm. Firm 1 would prefer a vertical merger between firm B and firm 2 rather than an upstream horizontal merger. Still, a vertical merger can be harmful for the consumers!

- *Competition in quantities*

Upstream horizontal merger is always desirable for both merging firms and the non-merged firm. It has a positive impact on both consumer surplus and total welfare.

Conclusion

- We have explored the incentives of a vertically integrated firm to merge with a complementary input supplier, transforming the latter into the exclusive input supplier of its direct competitor in the downstream market.
- The vertically integrated firm always has incentives to merge with a separated complementary input supplier.
- The separated downstream firm is better off under an upstream horizontal merger rather than under a vertical merger.
- The merger among complementary input suppliers, when one of them is vertically integrated, can hurt the consumers.

Possible Extensions/Work in Progress

- Firm 1 also sources input B from firm B
- Two-part tariff contract
- Multiproduct firms in the downstream market