

# MPRA

Munich Personal RePEc Archive

## **Protecting weak suppliers in endogenous vertical structure**

Tsuritani, Ryosuke

15 September 2024

Online at <https://mpra.ub.uni-muenchen.de/122071/>  
MPRA Paper No. 122071, posted 25 Sep 2024 06:52 UTC

# Protecting Weak Suppliers in Endogenous Vertical Structurer\*

Ryosuke Tsuritani<sup>†</sup>

September 15, 2024

## Abstract

In a vertical market, the price of the final good is high if a seller has strong bargaining power. Thus, a policy that strengthens the bargaining power of sub-suppliers may be desirable from a fairness perspective while undesirable from an efficiency perspective. We consider a vertical market with one sub-supplier, focal supplier, and manufacturer. The focal supplier purchases inputs from the sub-supplier and sells its products to the manufacturer. Suppliers' selling prices are determined through Nash bargaining. We find that although suppliers' vertical separation induces triple-markup inefficiency in vertical relations, if the focal supplier has weak bargaining power over the manufacturer or strong bargaining power over the sub-supplier, the suppliers have the incentive to remain separated. This is because suppliers' vertical separation may be a price-increasing commitment and transfer the bargaining surplus from the manufacturer to the suppliers. Therefore, a policy that strengthens the bargaining power

---

\*I am grateful to Tomomichi Mizuno for his helpful and valuable comments. This study was supported by Japan Science and Technology Agency SPRING, Grant Number JPMJSP2148.

<sup>†</sup>Graduate School of Economics, Kobe University, 2-1 Rokkodai, Nada, Kobe, Hyogo 657-8501, Japan.  
e-mail: [tsuritanir@gmail.com](mailto:tsuritanir@gmail.com)

of sub-suppliers may also be justified from an efficiency perspective because it may encourage vertical integration.

KEYWORDS: Vertical market; Vertical integration; Three-tier supply chain; Bargaining; Subcontracting Act

JEL Classification: D42; L23; L40

# 1 Introduction

From a fairness perspective, competition authorities in many countries seek to protect suppliers with weak bargaining power from monopolization or abuse of a dominant position. In Japan, manufacturers and suppliers with strong bargaining power are often subject to sanctions based on recommendations of the Subcontracting Act for using unfair trade practices against suppliers with weak bargaining power.<sup>1</sup> According to the Annual Report of the Japan Fair Trade Commission in June 2024, 13 recommendations were issued and 8,268 cases of guidance were provided based on the Subcontract Act.<sup>2</sup> Examples of practices for which recommendations were issued in FY2023 include the reduction of subcontracting payments in the manufacture and sale of automotive parts and unjust demands for the provision of economic benefits in the sale of power semiconductors.

From an efficiency perspective, protecting weak suppliers may be undesirable for consumers and society because, without such protection, strong manufacturers and suppliers could cut the margins of weak suppliers and alleviate the marginalization problem. A representative remedy for such a marginalization problem is vertical integration. In reality, however, although such legal protection for weak suppliers exists, supply chains are vertically separated and multi-tiered in some industries, such as the Japanese automotive industry. For instance, Toyota Motor Corporation, a leading Japanese automaker, has a more than ten-tier supply chain (Elliott et al. 2022; McLain 2021).<sup>3</sup> Toyota’s suppliers have long been separated from their sub-suppliers, and thus, the multiple margin distortion has persisted.

Our study aims to answer the following questions: Why are some supply chains multi-tiered even if the legal protection for weak suppliers exists? How does this legal protection affect the incentives related to upstream vertical integration? What are the welfare implications of this legal protection? To answer these questions, we consider a simple three-tier

---

<sup>1</sup>For more details, see [https://www.jftc.go.jp/en/legislation\\_gls/subcontract.html](https://www.jftc.go.jp/en/legislation_gls/subcontract.html).

<sup>2</sup>For more details, see <https://www.jftc.go.jp/en/pressreleases/yearly-2024/June/240618.html>.

<sup>3</sup>To obtain resilience from supply chain disruptions such as the Great East Japan Earthquake, Toyota investigated the details of its supply chain. This investigation revealed to Toyota that its supply chain had more than ten tiers (Elliott et al. 2022; McLain 2021).

supply chain consisting of a manufacturer ( $M$ ), a focal supplier ( $F$ ), and a sub-supplier ( $S$ ). Since automakers and focal suppliers typically have strong bargaining power vis-à-vis their supplier, the linear input prices in each tier are determined by Nash bargaining.

We find that if  $M$ 's bargaining power is strong,  $F$  and  $S$  have no incentive to integrate. This is a new mechanism of vertical separation. The intuition is as follows: When  $M$ 's bargaining power is strong,  $M$  lets  $F$  choose a price close to  $F$ 's marginal cost. Since upstream vertical separation increases  $F$ 's marginal cost, it becomes a commitment that raises  $F$ 's selling price and transfers the bargaining surplus from  $M$  to the suppliers. Therefore,  $S$  has an incentive to remain separated from  $F$  to increase its profit.

We also find that the legal protection for weak suppliers (i.e., the increase in  $S$ 's bargaining power) has an ambiguous effect on the consumer surplus and social welfare. When  $M$ 's bargaining power is weak, the legal protection for weak suppliers may promote their vertical integration, improving consumer surplus and social welfare. This protection alleviates multiple margin distortion in such scenarios. Conversely, when  $M$ 's bargaining power is strong, the legal protection for weak suppliers usually increases the suppliers' joint profit. In this case, this protection increases  $S$ 's bargaining power, exacerbating multiple margin distortion.

Many studies have analyzed how the vertical structure is determined in competitive environments (Bonanno and Vickers 1988; Chen 2001; Pagnozzi and Piccolo 2012; Choi and Lee 2017; Macho-Stadler et al. 2021). These studies show that vertical separation may be a price-increasing commitment under the downstream price competition. However, only a few studies show that vertical separation is profitable even in a downstream monopoly: Laussel (2008) and Matsushima and Mizuno (2013) derive such results considering a two-tier supply chain with complementary inputs. They show that vertical separation prevents suppliers from exerting monopoly power. By contrast, we derive such results considering a three-tier supply chain without downstream competition and complementary inputs. We show that suppliers' vertical separation may be a price-increasing commitment and transfer the bargaining surplus from  $M$  to the suppliers.

Few studies analyze the focal supplier's incentives for vertical integration and separation in a three-tier supply chain: [Lin et al. \(2014\)](#) analyzes these incentives with [Salop \(1979\)](#)'s spatial differentiation model, and [Li and Chen \(2020\)](#) with a vertical differentiation model. These two studies analyze downstream competition without input price bargaining, which is the main driver of our results.

The remainder of the paper is organized as follows. Section 2 details the model. Sect. 3 analyses the incentives of upstream vertical separation and the policy implication of protecting weak suppliers. Sect. 4 concludes the paper.

## 2 The model

Consider a three-tier supply chain consisting of a manufacturer  $M$ , a focal supplier  $F$ , and a sub-supplier  $S$ .  $F$  purchases raw materials from  $S$  at material price  $w_S$ , and processes and delivers them to  $M$  at  $F$ 's input price  $w_F$ .  $M$  produces one unit of the final goods with one unit of the input. The inverse demand for the final goods is linear:  $p = 1 - q$ , where  $p$  and  $q$  are the price and quantity of the final goods, respectively. We assume that all firms' marginal cost for production is zero. Then,  $M$ 's,  $F$ 's and  $S$ 's profits are

$$\pi_M = (1 - q - w_F)q, \quad \pi_F = (w_F - w_S)q, \quad \pi_S = w_Sq. \quad (1)$$

If  $F$  integrates  $S$ , the integrated supplier maximizes the following profit:

$$\pi_I = w_Fq. \quad (2)$$

Consumer surplus is  $CS = \frac{1}{2}q^2$  and industry profits is  $PS = \pi_M + \pi_F + \pi_S$ .

The  $F$ 's input price  $w_F$  and  $S$ 's input price  $w_S$  are determined by Nash bargaining. The bargaining pair  $(M, F)$  maximizes the following generalized Nash product  $\phi_M$  over  $w_F$ :

$$\phi_M = \beta_{MF} \log \pi_M + (1 - \beta_{MF}) \log \pi_j, \quad j = F \text{ or } I \quad (3)$$

where the bargaining powers of  $M$  and  $F$  are  $\beta_{MF} \in (0, 1)$  and  $1 - \beta_{MF}$ , respectively. If  $F$  and  $S$  separate, the bargaining pair  $(F, S)$  maximizes the following generalized Nash product  $\phi_S$  over  $w_S$ :

$$\phi_S = \beta_{FS} \log \pi_F + (1 - \beta_{FS}) \log \pi_S, \quad (4)$$

where the bargaining powers of  $F$  and  $S$  are  $\beta_{FS} \in (0, 1)$  and  $1 - \beta_{FS}$ , respectively. We assume that all firms' outside options in these bargainings are zero. For simplicity, we will refer to the bargaining between  $M$  and  $F$  as *downward bargaining*, and the bargaining between  $F$  and  $S$  as *upward bargaining*.

The model contains four stages. In stage 1,  $F$  and  $S$  decide whether to integrate. Vertical integration occurs if and only if integrated suppliers' profit is (weakly) larger than the sum of  $F$ 's and  $S$ 's profits under vertical separation (i.e.,  $\pi_I \geq \pi_F + \pi_S$ ). In stage 2, if  $F$  and  $S$  separate,  $S$  negotiates with  $F$  over input price  $w_S$  and provides inputs to  $F$ . If  $F$  and  $S$  integrate, this stage is skipped. In stage 3,  $F$  negotiates with  $M$  over  $F$ 's input price  $w_F$ . In stage 4,  $M$  chooses its output to maximize its profit. We solve the model using backward induction.

## 3 Analysis

### 3.1 Calculating Equilibrium

In stage 4, given  $F$ 's input price  $w_F$ , the manufacturer  $M$  maximizes its profit  $\pi_M$ . The first-order condition leads to

$$p = \frac{1 + w_F}{2}, \quad q = \frac{1 - w_F}{2}, \quad \pi_M = \frac{(1 - w_F)^2}{4}. \quad (5)$$

In stage 3, the manufacturer  $F$  negotiates with  $M$  over the  $F$ 's input price  $w_F$ . Given (5), the first-order condition of (3) leads to

$$w_F = \frac{1 - \beta_{MF} + (1 + \beta_{MF})w_S}{2}, \quad \pi_I^* = \frac{1 - \beta_{MF}^2}{8}, \quad (6)$$

where the superscript  $*$  represents the optimal value. We confirm that upstream vertical separation increases  $F$ 's optimal selling price  $w_F$  in stage 3.

In stage 2, if  $F$  and  $S$  separate,  $F$  negotiates  $S$  over the input price  $w_S$ . Given (5) and (6), solving the first-order condition of (4), we obtain  $S$ 's optimal input price  $w_S^*$  and  $F$ 's ( $S$ 's) equilibrium profit under upstream vertical separation  $\pi_F^S$  ( $\pi_S^S$ ) respectively:

$$w_S^* = \frac{1 - \beta_{FS}}{2}, \quad \pi_F^* = \frac{(1 - \beta_{MF}^2)(1 + \beta_{FS})^2}{32}, \quad \pi_S^* = \frac{(1 + \beta_{MF})(1 - \beta_{FS}^2)}{16}. \quad (7)$$

We observe that  $M$ 's bargaining power  $\beta_{MF}$  does not affect  $w_S^*$ .

In stage 1, the suppliers remain separated if and only if the joint profit of the vertically separated suppliers is larger than the profit of the vertically integrated supplier (i.e.,  $\pi_F^* + \pi_S^* \geq \pi_I^*$ ). From the equations (6) and (7), this condition is equivalent to

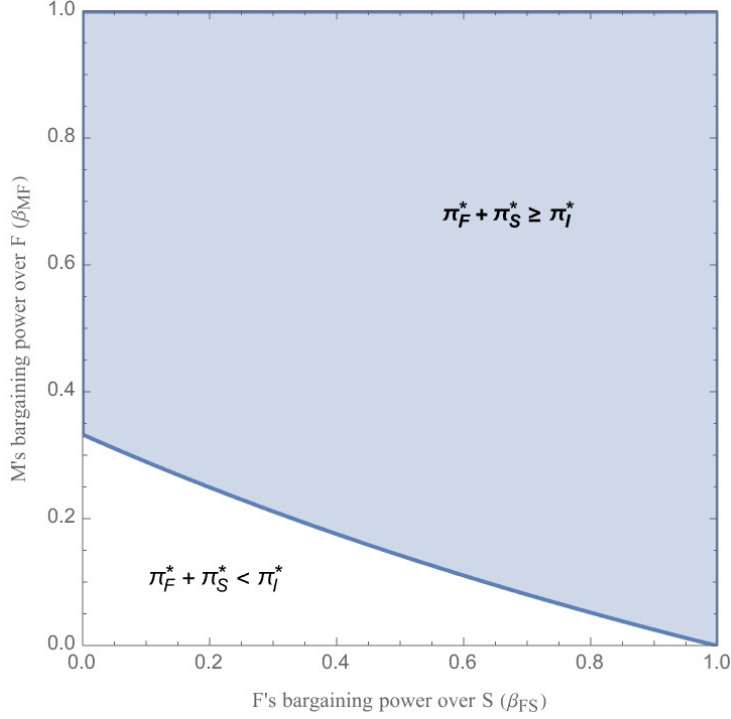
$$\beta_{MF} \geq \frac{1 - \beta_{FS}}{3 + \beta_{FS}}. \quad (8)$$

Figure 1 describes the condition of vertical separation. The vertical axis denotes  $\beta_{MF}$ , and the horizontal axis denotes  $\beta_{FS}$ . The blue region satisfies the inequality (8). From Figure 1, we obtain the following proposition:

**Proposition 1.** *When  $M$ 's bargaining power  $\beta_{MF}$  is strong ( $\beta_{MF} \geq \frac{1 - \beta_{FS}}{3 + \beta_{FS}}$ ),  $F$  and  $S$  remain vertically separated.*

This result suggests that  $M$ 's bargaining power  $\beta_{MF}$  over the  $F$ 's selling price  $w_F$  affects the suppliers' incentive to be vertically separated. We explain this intuition in two steps. First, we focus on  $F$ 's bargaining power in upward bargaining  $\beta_{FS}$ . When  $\beta_{FS}$  is strong,  $S$ 's





**Fig. 1** The Region of Upstream Vertical Separation

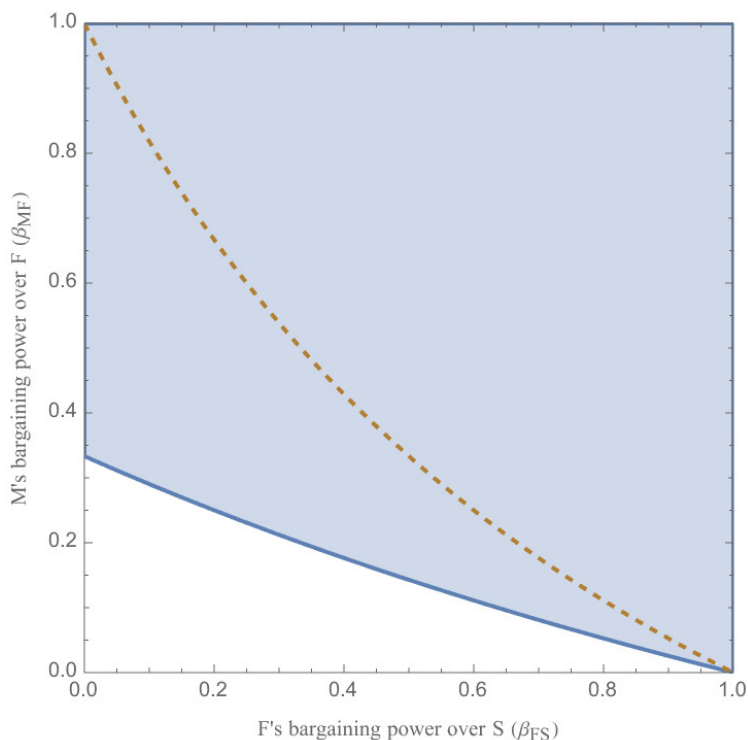
selling price  $w_S$  is low, and the suppliers behave almost identically to the integrated supplier. Indeed, when  $\beta_{FS}$  is one,  $w_S$  is zero, vertical integration and separation are indifferent to suppliers, and thus the blue region in the right edge of Figure 1 is fulfilled. Hence, when  $\beta_{FS}$  is strong, the impact of eliminating the marginalization problem by vertical integration becomes weak. Therefore, we can expect that when  $\beta_{FS}$  is strong, upstream suppliers will likely remain separated.

Second, we consider  $M$ 's bargaining power in downward bargaining  $\beta_{MF}$ . If  $M$ 's bargaining power is zero ( $\beta_{MF} = 0$ ),  $F$  could unilaterally set its selling price  $w_F$  without downward bargaining. Thus, considering the reduced game after the final stage is solved, we find that whether  $F$  and  $S$  choose to integrate is equivalent to the well-known result in a two-tier supply chain: To eliminate the double mark-up inefficiency, vertical integration occurs. If  $M$ 's bargaining power is full ( $\beta_{MF} = 1$ ),  $M$  lets  $F$  choose the marginal cost pricing, and thus the profit of the vertically integrated supplier becomes zero. By contrast, if  $F$  and  $S$  separate,  $F$ 's marginal cost is  $S$ 's input price  $w_S$ . Thus,  $S$ 's profit under vertical separation

is more than under vertical integration, and suppliers have an incentive to remain separated. Since the profits are continuous in  $M$ 's bargaining power  $\beta_{MF}$ , there exists the threshold value ( $\hat{\beta}_{MF} \equiv \frac{1-\beta_{FS}}{3+\beta_{FS}}$ ) where vertical separation and vertical integration are indifferent to suppliers.

### 3.2 Upward Bargaining Power Maximizing Suppliers' Joint Profit

Next, we analyze the optimal distribution in the upstream bargaining for  $F$  and  $S$ . Figure 2 describes the vertical separation condition as in Figure 1 (blue region) and the set of bargaining powers that maximizes the total profit of the suppliers (orange dashed line). Summarizing Figure 2, we obtain the following proposition:



**Fig. 2** The Set of Bargaining Powers that Maximizes Suppliers' Total Profit

**Proposition 2.** *To maximize the suppliers' total profits, both  $F$  and  $S$  should have some level of bargaining power in upward bargaining, unless  $\beta_{MF} \in \{0, 1\}$ .*

**Proof.**

We confirm this result from the following first-order condition of the total profits of the separated suppliers.<sup>4</sup>

$$\frac{\partial(\pi_F^S + \pi_S^S)}{\partial\beta_{FS}} = (1 + \beta_{MF})(1 - \beta_{MF} - \beta_{FS} - \beta_{MF}\beta_{FS}) = 0. \Leftrightarrow \beta_{FS} = \frac{1 - \beta_{MF}}{1 + \beta_{MF}}. \quad \square$$

This result implies that the total profits of the upstream separated suppliers are maximized when the surplus in upward bargaining is appropriately distributed. This result is in stark contrast to a simple expectation from previous literature on the vertical market: Since vertical integration could eliminate the multiple margin distortions, upstream vertical integration (i.e.,  $\beta_{FS} = 0$ ) seems to optimize the total profit of the suppliers.

Here, we explain intuitively that the optimal bargaining power in upward bargaining  $\beta_{FS}$  is located in the blue region of Figure 2. We focus on the two extreme cases. If  $M$ 's bargaining power in downward bargaining  $\beta_{MF}$  is zero,  $F$  has full control over  $F$ 's selling price  $w_F$ . Thus, the suppliers' joint profit is maximized under upstream vertical integration (i.e.,  $\beta_{FS} = 1$ ). If  $\beta_{MF}$  is one,  $F$  must set the marginal cost pricing (i.e.,  $w_F = w_S$ ). Thus, making  $w_S$  as high as possible (i.e.,  $\beta_{FS} = 0$ ) is the most desirable to maximize the suppliers' joint profit. Since the suppliers' joint profit is continuous in  $\beta_{MF}$ , given  $\beta_{MF}$ , the bargaining power  $\beta_{FS}$  to maximize the suppliers' joint profit is in the blue region, forming an orange dashed right-descending curve in Figure 2.

### 3.3 Legal Protection for Weak Suppliers

Finally, we explore the welfare implications of legal protection for suppliers with weak bargaining power. As mentioned in the introduction, competition authorities in many countries seek to protect these suppliers from practices such as monopolization or abuse of a dominant

---

<sup>4</sup>Note that this maximization problem satisfies the second-order condition as follows:

$$\frac{\partial^2(\pi_F^S + \pi_S^S)}{\partial\beta_{FS}^2} = -\frac{1}{16} (1 + \beta_{MF})^2 < 0.$$

position. We interpret such legal protection as increasing the weak supplier’s bargaining power  $1 - \beta_{FS}$  over its selling price  $w_S$ . The effect of this legal protection appears as shifting from right to left in Figure 1 and 2. We summarize this effect in the following proposition:

**Corollary 1.** *(i) If  $M$ ’s bargaining power is weak, the legal protection for weak suppliers could promote their vertical integration, improving both consumer surplus and social welfare. However, if upstream vertical integration does not occur, since this protection exacerbates the marginalization problem, it reduces consumer surplus and social welfare.*

*(ii) The legal protection for weak suppliers could increase the suppliers’ joint profit.*

**Proof.** See Appendix.

The result (i) in Corollary 1 suggests that this legal protection may be desirable for consumers and society, as it may encourage upstream vertical integration. This result justifies the legal protection of weak suppliers, such as the Subcontracting Act in Japan, from an efficiency perspective.

The result (ii) in Corollary 1 suggests that this legal protection is desirable only for  $S$  and the suppliers’ total profits. We can confirm that the shift from right to left in Figure 2 brings the set of bargaining powers closer to the optimal one (orange dashed curve).<sup>5</sup>

## 4 Conclusion

Using a simple three-tier supply chain model, we investigate the vertical separation incentive in upstream tiers and the welfare implications of the legal protection for weak suppliers. We have shown that when the downstream manufacturer has strong bargaining power over the focal supplier’s input price, firms in the upstream tiers remain separated, to the detriment of consumers and society. This study suggests a new mechanism for vertical separation. It

---

<sup>5</sup>Note that if we interpret the legal protection for weak suppliers as increasing the weak suppliers’ bargaining power  $1 - \beta_{MF}$  and  $1 - \beta_{FS}$ , the effect of this legal protection appears as a shift from the top right to bottom left in Figure 1 and 2, and thus the result (ii) in Corollary 1 holds quantitatively.

helps to understand why multi-tier supply chains exist: Owing to Toyota's strong bargaining power with its suppliers, its supply chain has more than ten tiers.

We also discuss the welfare implications of legal protection for weak suppliers. At first glance, protecting weak suppliers may be undesirable for consumers and society. This is because, without such protection, strong suppliers could cut the margins of weak suppliers and alleviate the marginalization problem. However, our study shows that this legal protection could encourage upstream vertical integration when the manufacturer's bargaining power over the focal supplier's input price weakens. Therefore, the legal protection for weak suppliers has ambiguous effects on consumers and society.

## Appendix

### Proof of Corollary 1

Since the result (ii) is evident from Proposition 2, we prove the result (i). We define the equilibrium consumer surplus and social welfare under vertical integration (separation) as  $CS^I$  and  $SW^I$  ( $CS^S$  and  $SW^S$ ), respectively. From simple calculation, we obtain

$$\begin{aligned} CS^I &= \frac{1}{32} (\beta_{MF} + 1)^2, & SW^I &= \frac{1}{16} (\beta_{MF} + 1) (3 - \beta_{MF}), \\ CS^S &= \frac{1}{128} (\beta_{MF} + 1)^2 (\beta_{FS} + 1)^2, & SW^S &= \frac{1}{64} (\beta_{MF} + 1) (\beta_{FS} + 1) (7 - \beta_{MF} - \beta_{FS} - \beta_{MF}\beta_{FS}). \end{aligned}$$

Comparing these values, we obtain

$$\begin{aligned} CS^I - CS^S &= \frac{1}{128} (\beta_{MF} + 1)^2 (4 - (\beta_{FS} + 1)^2) > 0, \\ SW^I - SW^S &= \frac{1}{128} (\beta_{MF} + 1) (1 - \beta_{FS}) (13 - 3\beta_{MF} - \beta_{FS} - \beta_{MF}\beta_{FS}) > 0. \end{aligned}$$

Since the suppliers choose to integrate in the white region of Figure 1, the legal protection of the weak supplier (i.e., the increase in  $S$ 's bargaining power  $1 - \beta_{FS}$ ) may induce upstream vertical integration, and thus improve consumer surplus and social welfare.  $\square$

## References

- Bonanno, G., & Vickers, J. (1988) Vertical separation. *Journal of Industrial Economics*. 36 (3), 257–265, [10.2307/2098466](https://doi.org/10.2307/2098466).
- Chen, Y. (2001) On vertical mergers and their competitive effects. *RAND Journal of Economics*. 32 (4), 667–685, <https://www.jstor.org/stable/2696387>.
- Choi, K., & Lee, D. (2017) Welfare-improving vertical separation with network externality. *Economics Letters*. 151, 115–118, [10.1016/j.econlet.2016.12.024](https://doi.org/10.1016/j.econlet.2016.12.024).
- Elliott, M., Golub, B., & Leduc, M. V. (2022) Supply network formation and fragility. *American Economic Review*. 112 (8), 2701–2747, [10.1257/aer.20210220](https://doi.org/10.1257/aer.20210220).
- Laussel, D. (2008) Buying back subcontractors: The strategic limits of backward integration. *Journal of Economics & Management Strategy*. 17 (4), 895–911, [10.1111/j.1530-9134.2008.00199.x](https://doi.org/10.1111/j.1530-9134.2008.00199.x).
- Li, W., & Chen, J. (2020) Manufacturer’s vertical integration strategies in a three-tier supply Chain. *Transportation Research Part E: Logistics and Transportation Review*. 135, 101884, [10.1016/j.tre.2020.101884](https://doi.org/10.1016/j.tre.2020.101884).
- Lin, Y., Parlaktürk, A. K., & Swaminathan, J. M. (2014) Vertical integration under competition: Forward, backward, or no integration? *Production and Operations Management*. 23 (1), 19–35, [10.1111/poms.12030](https://doi.org/10.1111/poms.12030).
- Macho-Stadler, I., Matsushima, N., & Shinohara, R. (2021) Organizational structure and technological investment. *Journal of Industrial Economics*. 69 (4), 785–816, [10.1111/joie.12277](https://doi.org/10.1111/joie.12277).
- Matsushima, N., & Mizuno, T. (2013) Vertical separation as a defense against strong suppliers. *European Journal of Operational Research*. 228 (1), 208–216, [10.1016/j.ejor.2013.01.037](https://doi.org/10.1016/j.ejor.2013.01.037).
- McLain, S. (2021) Auto makers retreat from 50 years of ‘just in time’ manufacturing. <https://www.wsj.com/articles/auto-makers-retreat-from-50-years-of-just-in-time-manufacturing-11620051251>, accessed 6 September 2024.
- Pagnozzi, M., & Piccolo, S. (2012) Vertical separation with private contracts. *Economic Journal*. 122 (559), 173–207, [10.1111/j.1468-0297.2011.02471.x](https://doi.org/10.1111/j.1468-0297.2011.02471.x).
- Salop, S. C. (1979) Monopolistic competition with outside goods. *Bell Journal of Economics*. 10 (1), 141–156, [10.2307/3003323](https://doi.org/10.2307/3003323).