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RESEARCH ARTICLE

Does vertical integration increase product quality?

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Abstract

Numerous product quality scandals are caused by low-quality inputs. When input quality is not perfectly observed by downstream firms, upstream firms often have moral hazard problems. If vertical integration does not directly eliminate the moral hazard problems, does vertical integration still improve product quality? If so, under which conditions? We find that given the precision of monitoring technology used by downstream firms, when the level of public monitoring is very high or very low, downstream firms have no incentive to integrate upstream firms; when the level is intermediate, downstream firms have incentives to integrate and vertical integration increases product quality.

Keywords Vertical integration · Asymmetric information · Supply chain · Product quality · Property right

JEL Classification L15 · L23 · D82 · D86 · Q12 · Q18

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1 Introduction

Many product quality scandals are caused by poor-quality ingredients supplied by upstream firms. For instance, in the 2008 Chinese milk scandal, upstream suppliers adulterated raw milk with melamine, which ruined the product quality of downstream processors; in the 2013 European horse meat scandal, retailers lost huge amounts of profit due to their suppliers adulterating beef with horse meat; and in 2014, a supplier provided expired beef and chicken to McDonald's and KFC in China, which caused them a reputation and profit loss. In fashion industry, child labor inputs can do a lot of damage to the reputation of downstream retailers, however, child labor cannot be easily monitored by downstream retailers.[1] Since downstream firms have less information on the true quality of their inputs than their suppliers due to imperfect monitoring or prohibitively high costs of implementing perfect monitoring (Gibbons 2005; Lafontaine and Slade 2007), their suppliers may cheat them by providing low-quality inputs, which is a typical moral hazard problem.

To address this moral hazard problem, some firms integrate their suppliers. If vertical integration means that the downstream firm has a lower cost to monitor the upstream firm's action, or even replaces the upstream firm to make the decision about quality provision, vertical integration could improve product quality (Hennessy 1996; Vetter and Karantininis 2002; Lu et al. 2012). However, such integration will not necessarily eliminate moral hazard problems if the principal-agent relationship still exists in the integrated firm. In practice, large integrated firms often hire managers to be responsible for producing inputs for their final products. Hart et al. (1997) and Hart (2003) point out that while vertical integration with hired managers does not change the information asymmetry between the upstream and the downstream firm, it does change the bargaining power of each party due to the change of ownership of a property. Reimer (2006) also observes that vertical integration in the pork industry does not eliminate the moral hazard problem of the integrated supplier. We studied whether vertical integration still helps to improve product quality when vertical integration does not change the information asymmetry between the upstream and the downstream firm.

We find that, even though vertical integration does not eliminate moral hazard problems, it still can improve product quality via a price mechanism. To illustrate this mechanism, imagine a relationship between an upstream and a downstream firm. Suppose the upstream firm can produce either a low-quality input for the downstream firm at no cost or a high-quality input at some cost and the final product quality is fully determined by its input quality. The downstream firm has an imperfect test technology that gives a false report sometimes when the input quality is low. For low-quality inputs, the upstream firm has positive outside options because other downstream firms may value input quality less. The presence of outside options weakens the upstream firm's incentives to provide high-quality inputs (McMillan and Woodruff 1999; Hansman et al. 2020). While vertical integration does not change the information asymmetry, it gives the downstream firm ownership of the inputs, so the downstream firm can set any price for inputs tested to be of low-quality and forbid the upstream firm from selling inputs outside. Here, vertical integration can be interpreted as the exclusive dealing

[1] We are grateful to a referee for pointing out this motivating example.

contract (Besanko and Perry 1993), one that can only be implemented via vertical integration. The property right of the inputs enlarges the contract space, in which the integrated downstream firm can set a lower price for a low-quality input than before. Hence, vertical integration reduces the cost of producing a high-quality product for the downstream firm. This result is in line with what Holmstrom and Milgrom (1991) demonstrate, that muting incentives over low-quality production is necessary to ensure that the upstream firm is engaged in high-quality production.

Whether the downstream firm integrates the upstream firm depends on the relation between the private monitoring and the public monitoring. In our study, private monitoring and public monitoring work in the same direction to induce high-quality products. To some degree, one substitutes the other. However, these two kinds of monitoring focus on two different stages of production. The private monitoring is targeted on the input quality and the public monitoring on the final product quality. The substitution effect is different from that of Vetter and Karantininis (2002), where the private and the public monitoring are both targeted on the input quality.

We find vertical integration occurs only when the level of public monitoring is intermediate. When the level of public monitoring is too high or too low, the upstream firm produces high-quality or low-quality inputs respectively, no matter whether integrated, which makes vertical integration not profitable. When the level of public monitoring is intermediate, the integrated upstream firm shifts production from low-quality to high-quality, which makes vertical integration profitable.

Similarly, if the level of public monitoring is not too low, the interest of the downstream firm in vertical integration may vary with its level of private monitoring. Compared to a low level of private monitoring, a high level of private monitoring may lead the downstream firm to induce the upstream firm to produce high-quality inputs but less likely to integrate. Advancing the private monitoring technology could substitute vertical integration to improve product quality, providing a rationale for the observation that increased use of information technology is associated with substantial decreases in vertical integration (Hitt 1999). Our findings provide a perspective to understand why firms may take different approaches to deal with the moral hazard problem of their suppliers.

Our study advances the literature on the relation between vertical integration and product quality. First, we provide a new explanation for why vertical integration could improve product quality. Existing studies demonstrate vertical integration improves product quality via changing the bargaining power of the upstream and the downstream firm over the surplus of quality upgrading (Hart et al. 1997; Hart 2003), facilitating transfers of knowledge between producers and suppliers (Atalay et al. 2014), or muting the incentives on providing low-quality inputs in a multitask environment (Holmstrom and Milgrom 1991; Holmstrom and Tirole 1991). In our model, vertical integration gives the downstream firm a right to replace the market to price low-quality inputs, empowering the downstream firm to weaken the upstream firm's incentives to produce low-quality inputs if desired, leading to product quality upgrading.

Second, our study offers insight into conditions under which product quality can be positively associated with vertical integration. Empirical studies record contradicting evidence on whether vertical integration improves product quality. While Michael (2000) and Jin and Leslie (2009) find integration improves product qual-

ity, Bradach (1998) and Kosová et al. (2013) observe there is no quality difference between integrated and non-integrated firms. This contradiction is probably caused by not controlling the levels of private and public monitoring. Since firms have different reasons to choose vertical integration (Coase 1937; Bresnahan and Levin 2012; Gibbons 2005; Lafontaine and Slade 2007; Hansman et al. 2020), high-quality products are not necessarily associated with vertical integration. Our study offers the conditions on private and public monitoring under which vertical integration improves product quality. With these conditions in mind, consumers know when to believe product quality is positively associated with vertical integration.

The rest of the paper proceeds as follows. The next section introduces the model, which is analyzed in Sect. 3. The conclusions are presented in Sect. 4.

2 Model

We investigate whether vertical integration improves product quality. We assume that a downstream firm buys inputs from an upstream firm and turns them into final products with a one-to-one production technology. The production technology implies the quality of final products is fully determined by input quality.

The upstream firm can produce either a low-quality input with zero cost or a high-quality input with cost C. For a low-quality input, the upstream firm has a positive outside option S, which comes from the fact that other firms may value a low-quality input more than the cost of it. There are two reasons for the positive outside option. One reason is that other firms might have different production technology to use this low-quality input to produce other goods. For instance, eggs that are not so fresh cannot be used to make Steak Tartare, but they can be used for baking because the freshness of eggs do not impact the quality of baked goods too much. The other reason is that other firms might have a lower moral standard on the input. For instance, textiles produced by child labor or forced labor might be purchased by cloth manufactures who hold lower standards of human right protection. While input quality cannot be directly observed by the downstream firm, it can infer the input quality via an imperfect test. When the quality of an input is high, the test is always correct; when the quality is low, the test has a probability of $t \in (0, 1)$ to report it low but a probability of $1-t$ to report it high. We call this test private monitoring and say the level of private monitoring is high if t is big. Besides the downstream firm's private monitoring, a public agency tests the quality of final products. This test is also imperfect in the sense that it always reports high-quality products correctly but reports low-quality products correctly with a probability of $q \in (0, 1)$. We call this test public monitoring and say the level of public monitoring is high if q is big. If a product is tested to be high-quality, consumers would like to pay $R > 0$ for it and otherwise 0. We assume consumers' willingness to pay for a high-quality product exceeds its cost, $R > C$, which implies producing high-quality products is socially desirable.

In short, the game proceeds as follows. First, given the private monitoring, the downstream firm provides a take-it-or-leave-it offer to the upstream firm, this offer stipulates a pair of prices, (P_H, P_L), for inputs tested to be high-quality and low-quality. Second, if the upstream firm accepts this offer, the downstream firm gets

inputs according to the contract and turns them into final products. Third, a public agency tests the quality of final products and informs consumers of the results. Finally, consumers make purchase decisions.

3 Analysis

3.1 Benchmark: non-integration

We first consider the situation where vertical integration is not available. The downstream firm can offer a contract to induce the upstream firm to produce a high-quality or a low-quality input. Given the stipulated prices (P_H, P_L), the upstream firm has the following payoffs.[2] The upstream firm's profit under non-integration is denoted by π_{nu} and we know

$$\pi_{nu} = \begin{cases} P_H - C & \text{if a high-quality input is produced} \\ (1-t)P_H + tP_L & \text{if a low-quality input is produced} \end{cases}$$

To induce the upstream firm to produce a high-quality input, the price difference between two kinds of inputs must be large enough, i.e. $P_H - P_L \geq \frac{C}{t}$. Since the upstream firm has an outside option S for the input tested to be low-quality, the downstream firm must offer $P_L = S$ and $P_H = S + \frac{C}{t}$ to induce it to produce a high-quality input. When a high-quality input is produced, the profits for the downstream and the upstream firm are denoted by π_{nd}^h and π_{nu}^h. We know

$$\pi_{nd}^h = R - P_H = R - S - \frac{C}{t} \tag{1}$$

and

$$\pi_{nu}^h = P_H - C = S + \frac{C}{t} - C \tag{2}$$

respectively. To induce the upstream firm to produce a low-quality input, the downstream firm will simply offer $P_H = P_L = S$. Let π_{nd}^l and π_{nu}^l denote the profits of the downstream and the upstream firm respectively when a low-quality input is produced. We know

$$\pi_{nd}^l = (1-q)\,R - S \tag{3}$$

[2] We assume out the possibility that the downstream firm can write a contract with the upstream firm based on the test results of final product quality. As, in most situations, the final product quality is not only influenced by the input quality but also by the downstream firm's effort that is often not observed by the upstream firm. Hence, the downstream firm also has a moral hazard problem if the payment to the upstream firm is based on the test of the final product quality. In the double moral hazard situation, the contract based on the final product quality is unlikely to be accepted. Even though in our simple model the downstream firm does not influence the final product quality, we still assume that the downstream firm can only write the contract based on the result of his private test on the input quality.

and

$$\pi_{nu}^{l} = S \tag{4}$$

From Eq. (3), we can see the downstream firm may earn a lot by selling low-quality products to consumers when the level of public monitoring is low.

Different contracts induce different input quality. To decide which contract to offer, the downstream firm compares its profit of inducing a high-quality input with that of inducing a low-quality input. The comparison gives us $\pi_{nd}^{h} \geq \pi_{nd}^{l}$ if and only if $q \geq \frac{C}{tR}$. The comparison can be summarized as follows.

Proposition 1 *Under non-integration, there is a cutoff value for public monitoring, $q_n^* = \frac{C}{tR}$. When the level of public monitoring is higher than the cutoff, i.e., $q > q_n^*$, high-quality products are produced; otherwise, low-quality products are produced.*

A lower level of private monitoring t yields a higher cutoff $q_n^* = \frac{C}{tR}$. For a given value of public monitoring q, a higher cutoff $q_n^* = \frac{C}{tR}$ is associated with a larger likelihood of low-quality goods being produced. If t is smaller than $\frac{C}{R}$, the cutoff $q_n^* > 1$ and the downstream firm always produces low-quality goods. We are not interested in this scenario, thus we assume that $\frac{C}{tR} < 1$. Proposition 1 means strong public monitoring induces high-quality products under non-integration.

3.2 Integration

We now consider the situation where vertical integration is available. In our model, vertical integration has two crucial implications. First, it does not eliminate the information asymmetry on input quality between the upstream and the downstream firm. After integration, the downstream firm still cannot perfectly observe input quality. Given the monitoring technology is still imperfect, the moral hazard problem continues. Second, under vertical integration, the downstream firm is the owner of inputs produced by the integrated upstream firm, thus has a right to decide how to price these inputs. In particular, it can set any price for an input tested to be low-quality after integration.

When vertical integration is available, the first stage of the game we have described changes to the following: given its private monitoring, the downstream firm provides a take-it-or-leave-it offer to the upstream firm, which stipulates whether there is a vertical integration or not, and what corresponding prices (P_H, P_L) are for inputs tested to be high- and low-quality. The rest remains as before. According to the level of public monitoring, we have two cases under vertical integration.

3.2.1 Case 1: The level of public monitoring is high, i.e., $q > q_n^*$.

From Proposition 1, we know under non-integration when the level of public monitoring is high enough such that $q > q_n^*$, high-quality inputs are produced and the upstream firm earns a profit $\pi_{nu}^{h} = S + \frac{C}{t} - C$. Hence, to accept vertical integration, the upstream firm must earn no less than it, resulting in the participation constraint.

Under integration, to induce a high-quality input, the downstream firm must set its price such that $P_H \geq P_L + \frac{C}{t}$, which is the incentive compatibility constraint. Though the downstream firm can set $P_L = 0$ because it has the ownership of the input under integration,[3] however, due to the participation constrain it must then at least offer $P_H = S + \frac{C}{t}$. Let π_{id}^h denote the profits of the integrated downstream firm for producing high-quality products. We have

$$\pi_{id}^h = R - P_H = R - S - \frac{C}{t}. \tag{5}$$

To induce a low-quality input, the downstream firm offers a contract $P_H = P_L = S + \frac{C}{t} - C$. Let π_{id}^l denote the profits of the integrated downstream firm for producing low-quality products. We have

$$\pi_{id}^l = (1-q)R - P_L = (1-q)R - S - \frac{C}{t} + C. \tag{6}$$

By comparing equation (5) with equation (6), we have $\pi_{id}^h > \pi_{id}^l$ since $q > q_n^* = \frac{C}{tR}$. Hence the downstream firm will induce the upstream firm to produce a high-quality input under integration.

Lemma 1 *When the level of public monitoring is high, $q > q_n^* = \frac{C}{tR}$, the downstream firm will induce the upstream firm to produce high-quality inputs under integration.*

This result illustrates that when the level of public monitoring is high, the integrated downstream firm behaves the same as under non-integration, inducing the upstream firm to produce high-quality inputs. In this situation, vertical integration does not change product quality.

3.2.2 Case 2: The level of public monitoring is low, i.e. $q < q_n^*$.

From Proposition 1, we know under non-integration when the level of public monitoring is low enough such that $q < q_n^*$, low-quality inputs are produced and the upstream firm earns a profit $\pi_{nu}^l = S$. Hence, to accept vertical integration, the upstream firm must earn no less than it, which results in the participation constraint. To induce a high-quality input, the downstream firm must set $P_H \geq P_L + \frac{C}{t}$, which is the incentive compatibility constraint. Under integration, the downstream firm can reduce the price for low-quality input to $P_L = 0$. In this case, to induce a high-quality input, the downstream firm sets $P_H = \max\{\frac{C}{t}, S + C\}$. Let π_{id}^h denote the profits of the integrated downstream firm for producing high-quality products. We have

$$\pi_{id}^h = R - \max\{\frac{C}{t}, S + C\} \tag{7}$$

[3] Even though the downstream has a right to freely price an input tested to be low-quality, it cannot set a negative price because of the limited liability of the upstream firm.

To induce a low-quality input, the downstream firm offers $P_H = P_L = S$. Let π_{id}^l denote the profits of the integrated downstream firm for producing low-quality products. We have

$$\pi_{id}^l = (1-q)\,R - S. \tag{8}$$

Under integration, the downstream firm prefers inducing a high-quality over a low-quality input when $\pi_{id}^h > \pi_{id}^l$, which implies $q > \max\{\frac{1}{t} - \frac{S}{C}, 1\}\frac{C}{R}$. Let q_i^* denote $\max\{\frac{1}{t} - \frac{S}{C}, 1\}\frac{C}{R}$. Notice that $q_i^* = \max\{\frac{1}{t} - \frac{S}{C}, 1\}\frac{C}{R} < \frac{1}{t}\frac{C}{R} = q_n^*$. We have the following result.

Lemma 2 *When the level of public monitoring is low, $q < q_n^* = \frac{C}{tR}$, there exists a smaller cutoff value $q_i^* = \max\{\frac{1}{t} - \frac{S}{C}, 1\}\frac{C}{R}$. If the level of public monitoring is below the cutoff, the integrated downstream firm will induce the upstream firm to produce low-quality inputs and otherwise it will induce high-quality inputs.*

While this result illustrates when the level of public monitoring is too low, the integrated firm continues producing low-quality products, when the level is intermediate, vertical integration improves product quality.

3.3 The choice on integration

To decide whether to integrate the upstream firm, the downstream firm will compare its profit under integration with that under non-integration. From Proposition 1, Lemma 1 and Lemma 2, we know which product quality will be offered in different situations. Once we know the downstream firm's choice on product quality, we know its profits. By comparing its profits, we know its choice on integration. With the restriction that $\frac{C}{tR} < 1$, we summarize the results above by the following proposition.[4]

Proposition 2 *When the level of public monitoring is intermediate, $q \in [q_i^*, q_n^*]$, the downstream firm will integrate the upstream firm and switch from low-quality production to high-quality production; when $q > q_n^*$, the downstream firm has no incentive to integrate and produce high-quality products regardless of integration; when $q < q_i^*$, the downstream firm also has no incentive to integrate and produce low-quality products regardless of integration.*

Figure 1 illustrates the above proposition. To understand the proposition, it is useful to explore the inequality $q_i^* < q_n^*$. Under non-integration, to induce a high-quality input, the downstream firm should set $P_H = S + \frac{C}{t}$ such that it satisfies the incentive compatibility condition and the participation constrain. We can decompose the price for a high-quality input into three parts, i.e., $P_H = S + C + \frac{(1-t)C}{t}$. The first part is the price for a low-quality input, which is the outside option S under non-integration. The second part is the production cost of a high-quality input. The third part is the information rent that is strictly decreasing in t. Intuitively, a weaker private monitoring

[4] Without this restriction, one may observe another special case, in which $q_n^* > 1$ but $q_i^* < 1$. The downstream firm integrates and produces high-quality products when $q > q_i^*$.

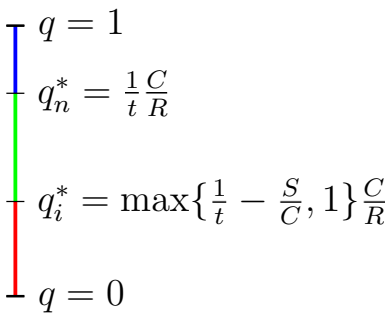

Fig. 1 Illustration of Proposition 2

brings about a greater information rent, which is associated with a higher cost of incentives. Under vertical integration, the production cost of a high-quality input and the information rent remain the same as before, but the price for a low-quality input could be reduced to zero, in principle which makes it cheaper to induce a high-quality input.

However, to persuade the upstream firm to accept integration, the downstream firm has to guarantee the upstream firm the same profit as under non-integration. Hence, vertical integration is a preferred option only when the joint profits of the upstream and the downstream firm increase after integration. This increase comes from quality upgrading. The upgrading cannot happen when the level of public monitoring is beyond q_n^* because under this condition the non-integrated firms already produce high-quality products and there is no room to improve product quality. This upgrading may happen when the level of public monitoring is below q_n^*, under this condition the non-integrated firms produce low-quality products.

Since the upstream firm only earns a profit S under non-integration when the level of public monitoring is below q_n^*, it will accept integration if its profit under integration is no less than S. In this case, to induce the upstream firm to produce a high-quality input under integration, the downstream firm could pay a price $P_H = C + \max\{\frac{(1-t)C}{t}, S\}$. Notice that unlike the non-integration case, P_H, as well as the cost of incentives $(\max\{\frac{(1-t)C}{t}, S\})$, is now not necessarily decreasing in t, at least not decreasing for a high t. Comparing it with the price paid for a high-quality input under non-integration, we find that the downstream firm still has to pay the production cost of a high-quality input, but it pays the maximum between the information rent and the outside option value instead of the sum of them. To induce the upstream firm to produce a low-quality input under integration, the downstream firm pays the same price $P_L = S$ as under non-integration. In this situation, for the integrated downstream firm, the cost of quality upgrading is the price difference between a high-quality and a low-quality input, i.e., $C + \max\{\frac{(1-t)C}{t} - S, 0\}$, which does not vary with the level of public monitoring. However, the benefit of improving product quality, i.e. qR, increases with the level of public monitoring. Hence, only when the level of public monitoring is higher than the cut-off q_i^*, integration is a preferred option for the downstream firm. When the level of public monitoring is lower than the cut-off, it is not worth integrating and the non-integrated firms produce low-quality products.

It is also worthwhile to look at some comparative static of Proposition 2 with respect to q and t. For given values of private monitoring t and outside option S, when we increase the level of public monitoring q from a very low point, the downstream firm switches from producing low-quality to high-quality products. The downstream firm definitely integrates the upstream firm if the level of public monitoring q is moderate but has no interest in integration if it is very high or very low. A downstream firm with a certain level of private monitoring may choose differently on integration in different countries because the levels of public monitoring differ. This result explains why a firm with the same level of private monitoring may integrate in a country but not in another.

An increase in t makes q_n^* strictly lower and q_i^* weakly lower. When t approaches to 1, the interval $[q_i^*, q_n^*]$ shrinks, which implies integration is less likely to improve product quality. Consider a given value of public monitoring q that is not too low,[5] in the interval $[q_i^*, q_n^*]$ for instance. With an improvement of private monitoring t, the integrated downstream firm may find integration is not attractive anymore because now it can induce the upstream firm to produce high-quality products without the help of vertical integration. In this sense, private monitoring substitutes vertical integration. If downstream firms have different levels of private monitoring, they may take different decisions on integration even though they face the same level of public monitoring. This result explains why in an industry with the same level of public monitoring some firms vertically integrate but the others do not.

4 Conclusion

This paper investigates the relationship between vertical integration and product quality. Under the assumption that vertical integration does not eliminate moral hazard problems, we provide conditions under which vertical integration still can improve product quality. This improvement comes from downstream firms having a larger contract space compared to the non-integration situation. When the upstream firm's outside option of low-quality input is positive, there is room for the downstream firm to to enlarge the contract space via integration.

Under above assumptions, we find that there exist two cut-off values of the public monitoring. When the public monitoring level is in between, downstream firms have incentives to integrate upstream firms to produce high-quality products. When the public monitoring level is higher than the high cut-off value, downstream firms have no incentive to integrate but still produce high-quality products. When the public monitoring level is lower than the low cut-off value, downstream firms have no incentive to integrate and produce low-quality products. These findings provide a new perspective to understand why vertical integration may help quality upgrading.

There are several potential directions in which the present article could be extended. First, our simple model has the advantage of being simple to study how vertical inte-

[5] When the level of public monitoring q is lower than $\frac{C}{R}$, the downstream firm has no interest in integration regardless of its private monitoring technology. Hence, only when $q > \frac{C}{R}$, the level of private monitoring has a chance to influence the downstream firm's integration choice.

gration affects product quality. But it may be fruitful to investigate a scenario where a downstream firm as a monopolist can choose price directly and influence quality indirectly via a contract with an upstream firm. Following the models in Spence (1975) and Amir et al. (2019), we can study whether the monopolist has a clear cut on quality choice, as well as whether its choice on quality is in line with social planner's choice under non-integration and integration. Second, similar to Spence (1975) it would be interesting to examine our simple model in a regulatory context by looking for optimal public monitoring implementation when such monitoring is costly.

References

Amir, R., Gama, A., Maret, I.: Environmental quality and monopoly pricing. Resour. Energy Econ. **58**, 101109 (2019)

Atalay, E., Hortaçsu, A., Syverson, C.: Vertical integration and input flows. Am. Econ. Rev. **104**(4), 1120–48 (2014)

Besanko, D., Perry, M.K.: Equilibrium incentives for exclusive dealing in a differentiated products oligopoly. RAND J. Econ. pp. 646–667 (1993)

Bradach, J.L.: Franchise Organizations. Harvard Business Press, Harvard (1998)

Bresnahan, T.F., Levin, J.D.: Vertical integration and market structure. Technical report, National Bureau of Economic Research (2012)

Coase, R.H.: The nature of the firm. Economica **4**(16), 386–405 (1937)

Gibbons, R.: Four formal (izable) theories of the firm? J. Econ. Behav. Org. **58**(2), 200–245 (2005)

Hansman, C., Hjort, J., León, G., Teachout, M.: Vertical integration, supplier behavior, and quality upgrading among exporters. J. Polit. Econ. (2020). https://doi.org/10.1086/708818

Hart, O.: Incomplete contracts and public ownership: remarks, and an application to public-private partnerships. Econ. J. **113**(486), C69–C76 (2003)

Hart, O., Shleifer, A., Vishny, R.W.: The proper scope of government: theory and an application to prisons. Q. J. Econ. **112**(4), 1127–1161 (1997)

Hennessy, D.A.: Information asymmetry as a reason for food industry vertical integration. Am. J. Agric. Econ. **78**(4), 1034–1043 (1996)

Hitt, L.M.: Information technology and firm boundaries: evidence from panel data. Inf. Syst. Res. **10**(2), 134–149 (1999)

Holmstrom, B., Milgrom, P.: Multitask principal-agent analyses: incentive contracts, asset ownership, and job design. JL Econ. Org. **7**, 24 (1991)

Holmstrom, B., Tirole, J.: Transfer pricing and organizational form. JL Econ. Org. **7**, 201 (1991)

Jin, G.Z., Leslie, P.: Reputational incentives for restaurant hygiene. Am. Econ. J. Microecon. **1**(1), 237–67 (2009)

Kosová, R., Lafontaine, F., Perrigot, R.: Organizational form and performance: evidence from the hotel industry. Rev. Econ. Stat. **95**(4), 1303–1323 (2013)

Lafontaine, F., Slade, M.: Vertical integration and firm boundaries: the evidence. J. Econ. Lit. **45**(3), 629–685 (2007)

Lu, Y., Ng, T., Tao, Z.: Outsourcing, product quality, and contract enforcement. J. Econ. Manag. Strategy **21**(1), 1–30 (2012)

McMillan, J., Woodruff, C.: Interfirm relationships and informal credit in Vietnam. Q. J. Econ. **114**(4), 1285–1320 (1999)
Michael, S.C.: The effect of organizational form on quality: the case of franchising. J. Econ. Behav. Org. **43**(3), 295–318 (2000)
Reimer, J.J.: Vertical integration in the pork industry. Am. J. Agric. Econ. **88**(1), 234–248 (2006)
Spence, A.M.: Monopoly, quality, and regulation. Bell J. Econ. pp. 417–429 (1975)
Vetter, H., Karantininis, K.: Moral hazard, vertical integration, and public monitoring in credence goods. Eur. Rev. Agric. Econ. **29**(2), 271–279 (2002)