The Double-Edged Sword of Vertical Integration: Navigating Value Capture, Transaction Costs, and Information Flows

Leonardo M. Kluppel
Ohio State University

Abstract:

The traditional transaction cost perspective helps us understand how governance structures impact dyadic transaction costs by focusing on the possibility of ex-post holdup. Still, it usually neglects the impact of such decisions on other agents. This paper uses value capture theory to investigate how vertical integration impacts the firm's ability to extract rents from other agents in the market. Integration solves the ex-post holdup costs within a dyad, causing an increase in the integrated firm's ability to appropriate value from other firms. This higher bargaining ability makes independent firms less willing to share information with the integrated organization. The findings bridge the gaps between organizational design, innovation, and information transfer, offering strategic management insights and revealing new research directions.

INTRODUCTION

Vertical integration remains a vital and complex strategic decision for organizations, as it fundamentally shapes information flow, innovation, and value creation within markets. The decision between managing transactions through the market or internally represents a central concern for businesses navigating an intricate and dynamic landscape. While Transaction Cost Theory (TCT) has provided insights into these decisions (see Cuypers et al. (2021) for a review), its focus has predominantly been on transaction integration within a transacting dyad, often sidelining the influence of external players. This paper seeks to address this gap by exploring how vertical integration alters the incentives for information sharing between firms in both downstream and upstream markets, and the consequential effects of these changes on the broader market environment.

This study presents a model that illustrates how vertical integration impacts transactional outcomes, moving beyond traditional transaction characteristics such as specificity, uncertainty, and frequency. By utilizing value capture theory (Brandenburger and Stuart, 2007, 1996), this paper unravels the dual nature of vertical integration. On the one hand, integration decreases transaction costs, enabling the integrated firm to engage in contractual exchanges that were previously too costly. On the other hand, it enhances the firm's capacity to extract rents from other firms, potentially leading other market participants to limit collaboration with the integrated firm. While TCT has acknowledged the cost-reducing aspect of integration since its inception, it has often overlooked the broader implications of this phenomenon on the behavior of other market participants.

More specifically, this paper explores the transformative effects of vertical integration on information-sharing incentives between firms in downstream and upstream markets. These

changes are vital, as knowledge spillovers play a key role in innovation-driven value creation. (Bloom, Schankerman, and Van Reenen, 2013; Hall, Mairesse, and Mohnen, 2010). Although previous research has analyzed information transfer within integrated units (Ahuja and Katila, 2001; Cassiman *et al.*, 2005; Makri, Hitt, and Lane, 2010), it has often neglected how vertical integration influences the integrated firm's ability to access externally produced knowledge. This paper fills this gap by scrutinizing the shift in information-sharing behavior among non-integrated downstream firms when an upstream supplier opts for vertical integration.

A critical dimension of this paper's exploration lies in the intricate interplay between organizational structure and firm capabilities. Responding to a call by Argyres and Zenger (2012), we demonstrate through our model how different organizational structures give distinct incentives for producers to share and create information. These different incentives lead to heterogeneity in firms' knowledge sets, consequently shaping future firm capabilities. This nuanced understanding contributes to the growing discourse on the role of internal organization in innovation and value creation.

Building upon existing literature that has begun to expand the Transaction Cost Theory approach (e.g., Bigelow and Argyres, 2008; Jacobides, Knudsen, and Augier, 2006; Kang, Mahoney, and Tan, 2009) this paper contributes a unique perspective by analyzing the nuanced consequences of vertical integration on information sharing within the market. We specifically emphasize the endogenous costs of vertical integration and demonstrate how it can simultaneously foster internal collaboration while deterring external information sharing, responding to the exogenous hierarchical costs assumption critique (Gibbons, 2005).

Finally, the findings of this paper provide both academic and practical insights. For scholars, it offers a refined understanding of vertical integration's dual nature, bridging the gap

between the traditional TCT view and the broader market implications. For practitioners — particularly managers considering vertical integration — this study underlines the strategic importance of comprehending the complex interplay between integration, information exchange, and market dynamics. The practical implications extend to areas such as technological adoption and the shaping of future firm capabilities.

TRANSACTION COST ECONOMICS

Traditional TCT Assumptions and Logic

Traditionally, TCT derives its predictions by analyzing each transaction from a contractual point of view (Williamson, 2010). Since contracts are an imperfect tool to guarantee cooperation, reliance on them opens the possibility for firms to take actions that are individually beneficial but socially destructive (i.e., haggling over appropriable quasi-rents). By bringing the transaction inside the firm, the parties can settle the conflicts using fiat, a decision-making process where a manager resolves disputes, avoiding contractual disagreements.

The possibility for inefficient haggling is linked to three sets of assumptions. The first set of assumptions involves the transaction characteristics. Traditional TCT focuses on asset specificity, uncertainty, and frequency as the crucial attributes determining the severity of the holdup issue (Williamson, 1985). Highly specific assets offer opportunities for haggling as they lose value outside the relationship. High uncertainty complicates contract drafting, and increased frequency multiplies haggling opportunities. The empirical literature has found strong support for the link between asset specificity and transaction internalization, while the role of uncertainty and frequency have much less support (David and Han, 2004).

The second set of assumptions aims at understanding the agents' behavior. Inefficient haggling becomes a credible threat when agents are boundedly rational, limited in their ability to

collect and evaluate data, and are willing to exploit contractual gaps for individual gains (e.g., Cuypers, Ertug, and Hennart, 2015; Luo, 2005; Zhou and Poppo, 2010). Those behavioral assumptions include the acknowledgment that agents might take advantage of contractual gaps to haggle. This exploitation can arise from self-interest with guile (Williamson, 1975) or changes in priorities and overcommitment (Verbeke and Greidanus, 2009).

The third set of assumptions deals with the institutions governing both contracts and fiat. Although not discussed much, formal and informal institutions provide the boundaries of each organizational tool. Contracts are dependent on the judiciary to be enforced as well as constrained by law and culture. The same is true for the powers afforded by fiat even though its boundaries are different. Transactions within the firm have particular characteristics, such as the duty of employees to comply to all reasonable employer commands and the presumption of information sharing by the employee (Masten, 1988).

This type of analysis covers the benefits of integration, but it does not illuminate the costs of organizing transactions within firms. A common assumption in the TCT literature is that the costs of bureaucracy are independent from the sources of transactions costs (Gibbons, 2005). However, this paper goes beyond traditional TCT by revealing an often-overlooked intrinsic cost of integration: the decrease in other firms' incentives to share information.

The theoretical framework proposed in this paper offers insights into the heterogeneity of vertical integration observed across firms within the same industry. A commonly noted limitation of TCT is its implicit suggestion that firms within an industry, experiencing similar transaction environments, should opt for similar integration decisions (Leiblein and Miller, 2003; Leiblein, Reuer, and Dalsace, 2002). However, markets typically exhibit a broad spectrum of vertical integration strategies among participants.

Previous research attributes this diversity to the product differentiation strategies employed by integrated firms, fostering two sustainable market positions (Argyres and Bigelow, 2010; Kapoor, 2013). Another perspective emphasizes the greater innovative output of vertical structures during periods of systemic innovation, even though this may be associated with high costs (Helfat and Campo-Rembado, 2016). These factors allow for the coexistence of different structures in equilibrium, depending on expectations about the frequency of systemic innovations.

The model presented here posits that optimal organizational structure is contingent on expectations about the location of important information. While vertical integration can enable access to information within the target firm, it may simultaneously exclude the supplier from information flows originating from independent producers. Consequently, the vertical integration decision needs to take into account the dispersion of critical information. If such information is spread across multiple producers, vertical integration with a single producer might curtail the supplier's access to information from other producers. Hence, differing managerial expectations about information distribution may lead to varied choices of organizational structure.

Additionally, the model predicts that vertically integrated firms are likely to adopt new technologies more frequently within the downstream market, even when their product quality is lower. This increased adoption does not directly elevate profits via enhanced market share but empowers the supplier to extract greater value from downstream firms. Thus, vertical integration may involve adopting technologies in markets previously overlooked by the producer when operating independently.

Lastly, the model suggests that independent producers may exhibit less interest in improving inputs after a vertical integration event. Prior to integration, an independent producer might have had the opportunity to appropriate a portion of the value produced by sharing

information with the supplier. Post-integration, this potential for value appropriation decreases significantly, potentially diminishing the producer's incentive to invest in generating such knowledge.

Contracting in the Innovation Process

While the traditional TCT framework provides valuable insights into the general contracting landscape, its application to the innovation process presents unique challenges and opportunities. Innovation, by its very nature, is fraught with uncertainties, complexities, and often involves the exchange of highly specialized knowledge. This intricate process involves various interrelated transactions, particularly information sharing and adoption of new technologies or practices. To understand the impact of integration on innovation, the paper describes in more detail those two transactions.

Information sharing. The importance of outside knowledge for the innovation effort is well known (Aghion and Jaravel, 2015; Agrawal *et al.*, 2014; Cohen and Levinthal, 1990; Knott, Posen, and Wu, 2009). For this reason, the model assumes that a firm must acquire information from an outside agent in order to innovate.

More specifically, this paper assumes that downstream producers have important information that can be used by upstream suppliers to improve the quality of the supplier's product (i.e., the information allows the supplier to build an improved input). This information flow is ubiquitous, as revealed by literature on informational sources for innovation. Alcacer and Oxley (2014) show that suppliers learn from supplying to knowledgeable producers, highlighting the importance of such information flows. Moreover, a survey conducted by Arora, Cohen, and Walsh (2016) documented that almost half of the innovators report using external sources (such as suppliers and customers) for their most important innovation, a finding bolstered by the European

Community Innovation Survey (Eurostat, 2008), showing that innovative enterprises classified suppliers as an important source of information more often than competitors, private R&D labs, universities, and consultants. Also, the literature has highlighted the importance of information brought from outside the firm to the firm's innovation efforts (von Hippel, 1988, 1998; Huckman and Pisano, 2010; Thomke and von Hippel, 2002).

While information exchange is crucial in strategic decision-making, it is fraught with contractual complications. Due to its intrinsic nature, the value of information often becomes apparent only after its revelation, as posited by Arrow (1962). This dynamic leads to contractual hazards, as the information recipient may be tempted to renege on the initial agreement after the information exchange. The model captures this fundamental issue by positing a non-contractible information sharing cost.

Adoption costs. After upstream suppliers innovate and make the new input available, downstream producers must adopt the new input into their product. Examples of such adoption costs include costs to retool the manufacturing line, purchase complementary inputs, and train employees to handle the new input. Additional costs may be associated with ensuring that the new input works with current processes, changes in quality control, and marketing expenses to advertise the new input's benefits to the final consumer.

Given the difficulty of predicting which investments and changes in processes are required to make efficient use of an input the firm has never used before, adoption costs are likely to be uncertain and thus hard to predict. Furthermore, some of those costs are related to learning how to master the new input, making those costs sunk (Hall and Khan, 2003). Also, due to the uniqueness of firms' resources, routines, and history, adoption investments are likely specific to the producer,

and possibly specific for each market that introduces the new input. Given those characteristics, adoption costs have the traits of a non-contractible cost[1].

Beyond the Dyadic Approach

Building on the traditional TCT's emphasis on transaction characteristics such as asset specificity, uncertainty, and frequency, this paper introduces a novel perspective that extends beyond the typical dyadic approach. Unlike most traditional TCT papers that focus on two agents, this new approach considers broader market dynamics and integration strategies within an industry.

The majority of traditional TCT papers focus on two agents, comparing a world with two independent firms with a world where those firms are integrated (Panels A and B in Figure 1). The theoretical prescriptions are derived by comparing the equilibrium behavior in these two scenarios, implicitly assuming that the rest of the relevant variables are kept fixed. From that point of view, Panels A, C, and E in Figure 1 should be equivalent because the transaction characteristics between Supplier 1 and Producer 1 remain constant (i.e., those firms are independent in those scenarios).

Figure 1 about here

However, we demonstrate that the situation depicted in Panel E is fundamentally different from Panel C. Since integration between Supplier 1 and Producer 2 eliminates inefficient haggling, the integrated firm can extract more rents from the non-captive firm (Producer 1) by forcing an increase in downstream competition. Because of that ability, independent producers will be more reticent to share information with the integrated firm, uncovering an endogenous price of integration.

Empirical Consequences

The model predicts that information flows from producers to suppliers should decrease after a supplier integrates by entering the downstream market. Although this is an important empirical prediction, it is not unique. The disruption of information from producers after integration is also predicted in the literature studying third-party information leakage (Hernandez, Sanders, and Tuschke, 2015). From that perspective, independent producers will share less information with integrated suppliers because they fear the supplier will leak the information to the integrated producer. Since integration increases information exchange within the integrated firms, information disclosed to the integrated supplier could leak more easily to the integrated producer. This phenomenon has been studied in the context of supply chains (Anand and Goyal, 2009; Tan, Wong, and Chung, 2015), outsourcing (Baccara, 2007), venture capital (Pahnke *et al.*, 2015), partnerships (Katila, Rosenberger, and Eisenhardt, 2008), and R&D alliances (Zhang *et al.*, 2019).

However, in contrast with the literature on third-party information leakage, the model presented here predicts information disruption even if there is no opportunity for information to leak to another producer (since the information is useful only to a supplier by the model's assumption). Thus, one could empirically separate those observations by probing situations where firms enjoy high intellectual property protection or when producers invest in technology domains that are not similar technologically. In that sense, the model predicts information disruption is more common than third-party information leakage would suggest.

The difficulties faced by Flextronics (Huckman and Pisano, 2010) illustrate how vertical integration can change the willingness of other agents in the market to share information with an integrated firm. Flextronics was an OEM cell phone manufacturer that produced according to

designs provided by its customers. Although Flextronics customers were direct competitors, they decided to share those designs with a common OEM; this is despite the fact that some of that information could help Flextronics improve its manufacturing process – an improvement that could benefit all its customers. In 2001, Flextronics decided to manufacture phones based on its own designs. Although the experience of designing a phone was successful from a production point of view, the possibility of commercialization was a threat to Flextronics' existing business relationships. This case suggests that once Flextronics vertically integrated into the design space, existing customers felt uneasy about sharing information contained in the designs in the same way as before.

Another example is the spinoff of the unit that manufactures motherboards by the hardware electronic manufacturer Asustek after it decided to enter the market for low-cost notebooks. A piece in the *Financial Times* (Tsui and Waters, 2009) highlights the idea that notebook manufacturers were less willing to share information with Asustek's motherboard manufacturing unit after Asustek's vertical integration: "Computer makers who use Asustek's customized motherboards inevitably impart proprietary technical know-how and business intelligence with each order, and they fear that would give an unfair advantage to Asustek's computer business." This example shows that firms are reticent to share information to a vertically integrated firm, and that disintegration can be a way to harness that knowledge.

MODEL

The application of value capture theory in our model offers a new lens to understand the dynamics of information sharing and adoption in the innovation process. Value capture theory, as introduced by Brandenburger and Stuart (2007, 1996), calculates how much value each firm

expects to gain in equilibrium and has been chosen for its applicability in capturing the constraints in value determined by competition among agents.

Competition imposes two conditions on the equilibrium value distribution: feasibility and stability (Ryall and MacDonald, 2004). Feasibility requires that the sum of values distributed to players be no higher than the total value created. Stability means that, given the value distribution, there is no subset of players that can do better when they break from the main coalition. The set of all distributions that satisfy both feasibility and stability is the core set, characterized by an interval between a core lower bound (CLB) and a core upper bound (CUB)[2]. The core captures the value distribution that balances the benefits of collaboration with the competitive pressures that might drive firms apart.

Player i's added value is calculated as the difference in value created by all players minus the value created by the coalition of all players excluding player i. Therefore, added value is a measure of how much value player i brings to the game. Feasibility and stability jointly imply that no player can receive more than its added value in equilibrium (Brandenburger and Stuart, 1996), so that player's CUB cannot be higher than its added value.

Basic Model

The fundamental structure of our model involves three distinct firms: an upstream supplier (firm S) and two downstream producers (firms P1 and P2). These downstream producers purchase inputs from the supplier, transforming them into a final product that they sell in two independent markets (M1 and M2).

When a producer j assembles a product using input of quality k in market m, it creates a final product with value $V_j^k(m)$. Each market has demand for only one final product[3] and participants get zero outside value.

The final product's value will depend on whether the producer uses a high-quality input and if that producer adapts its production line to use the high-quality input. The standard quality input can be upgraded to a high-quality version if the supplier S receives information from a producer. Since producers are familiar with the input use and are in close contact with final consumers, they have suggestions on how to change the input to create better final products. For now, assume that only producer P1 has information (the case when both producers are informed is considered later).

To unlock the full potential of a high-quality input for a particular market, a producer must incur an infinitesimally small market-specific adoption cost. If this cost is not paid, the use of a high-quality input adds no extra value. The value created when using a standard input or without paying the adoption cost for market m is $V_j^0(m)$. Conversely, if a high-quality input is used, and the producer pays the adoption cost, it results in a value of $V_j^1(m)$ where $V_j^1(m) > V_j^0(m)$.

Without loss of generality, let's assume that P1 is the high-quality producer in market M1, leading to$V_1^k(1) > V_2^k(1)$. In contrast, P2 is the high-quality producer in M2. To simplify notation, the market indicator will be omitted for market M1 so that $V_j^k \equiv V_j^k(1)$.

Equilibrium. Given the assumption of market independence and the symmetrical structure of the model, the equilibrium can be determined by computing each player's core set for each market. We will proceed to solve the model for the market M1. The solution for the other market is symmetric.

In market M1, the equilibrium features producer P1 as the only active producer since it produces the highest value and only one final product is demanded. The core sets within this market can be defined as follows:

Proposition 1: The equilibrium core sets for market M1 are:

- Zero for producer P2.
- $[0, V_1^1 - V_2^0]$ for producer P1.
- $[V_2^0, V_1^1]$ for supplier S.

These propositions are derived in the appendix. The equilibrium features adoption of the high-quality input only by producer P1 because increasing the value of P1's product also increases its added value (CUB) while P2 does not benefit from selling a better product. Since the presence of a high-quality input raises P1's CUB, P1 is better off sharing information with supplier S to enable the creation of the superior input. The equilibrium for market M2 will mirror this, with P2 adopting the high-quality product while P1 will not.

Out of equilibrium adoption. Though P1's adoption in market M1 increases the supplier's CUB, the supplier would ideally want both producers to adopt in market M1, as this would boost its CLB. The intensified competition stemming from market-wide adoption would empower the supplier to augment the value of coalitions outside the equilibrium. As shown above, adoption by both producers is out of equilibrium because P2 is not interested in adopting in market M1 since it will not get any value out of it.

The supplier could try to write a contract to incentivize producer P2 to also adopt in market M1. This contract, however, will suffer from inefficient ex-post haggling since adoption costs are uncertain, sunk and producer specific as argued. Given those characteristics, Producer P2 has an incentive to invest as little as possible in market M1 adoption while the supplier has incentives to downplay P2's adoption costs and withhold any payment once P2 pays the adoption cost. These contracting costs protect producer P1 from increased competition in market M1.

Vertical integration. Suppose then that S and P2 create an integrated firm (SP2) and again focus on market M1. In this case, the core sets are the following:

Proposition 2: The equilibrium core sets for market M1 are:

- $[0, \mathrm{V}_1^{\mathrm{k}} - \mathrm{V}_2^{k}]$ for producer P1.
- $[\mathrm{V}_2^{k}, \mathrm{V}_1^{\mathrm{k}}]$ for integrated firm SP2.

Where k can be either zero or one.

The crucial difference from the disintegrated scenario is that the integrated firm SP2 will also adopt in market M1 via its internal downstream since its CLB and CUB are increasing in the quality of the input. The market-wide adoption decision happens the opportunity for holdup between S and P2 is eliminated due to fiat.

Given that SP2 will adopt, P1 must decide if it should send the information or not. If the new input benefits the final product manufactured by SP2 more than P1's offering, producer P1 is worse off by transferring its information because a high-quality input would lead to a decrease in P1's CUB[4].

In summary, it seems that the transaction costs of information transfer between P1 and S have increased following integration. This result is surprising if the transaction between P1 and S

is analyzed using a traditional TCT framework because the transaction characteristics between P1 and the supplier unit S remain constant between the two scenarios. More specifically, while the information sharing transaction becomes harder to complete between producer P1 and the supplier, the transaction uncertainty, asset specificity, and frequency stay the same in both scenarios.

This result shows that integration comes with an intrinsic tradeoff, and thus addresses a long standing critique of TCT's reliance on exogenous costs of integration (Gibbons, 2005). Integration allows the integrated firm to extract more rents from P1 due to the fiat power between S and P2. The direct consequence of the ability to sidestep inefficient haggling between S and P2 is that it decreases P1's incentives to share information with the integrated firm.

Extension

The basic model above is extended to contain three main changes in the game rules. First, the cost of information transfer will increase to $t > 0$. Indeed, the presence of a discrete cost shows that disintegration will lead to inefficiencies, as is standard in the TCT literature. Second, the model will assume that both producers have non-overlapping information. If one of the producers sends information to the supplier, producer j can create a final product with quality $\mathrm{V_j^1}$. If both producers send information, then producer j can create a final product with quality $\mathrm{V_j^2} > \mathrm{V_j^1}$. It is also useful to define the change in the final product value when producer j adopts a high-quality input on market M as $\Delta \mathrm{V_j^k}(M) = \mathrm{V_j^{k+1}}(M) - \mathrm{V_j^k}(M)$. As before, define $\Delta \mathrm{V_j^k} \equiv \Delta \mathrm{V_j^k}(1)$ to alleviate the notational burden.

Third, the model in this section will use confidence indexes to account for the player's bargaining ability in pure bargaining situations. The use of confidence indices allows us to model "extra-competitive forces" (Ryall and Sorenson, 2007) and thus capture the impact of players'

perceived bargaining ability and informal institutions such as culture and reciprocity norms on the equilibrium. Confidence indexes are numbers from one to zero that measure each player's ability to appropriate value given the equilibrium core. More specifically, if we define player i's CLB and CUB as $\underline{\pi_i}$ and $\overline{\pi_i}$ respectively, then player i's expected value captured is $\pi_i = (1-\alpha_i)\underline{\pi_i} + \alpha_i\overline{\pi_i}$ where $\alpha_i \in [0,1]$ is player i's confidence index. The concept of confidence index is commonly used in the value capture literature to characterize equilibrium (Bennett, 2013; Bridoux and Stoelhorst, 2014; Chatain and Plaksenkova, 2019; Chatain and Zemsky, 2011; Grennan, 2014)[5].

First, consider the model without integration. Proposition 3 summarizes the equilibrium for market M1.

Proposition 3: The expected equilibrium values for market M1 are:

- Zero for producer P2.
- If $t \leq \alpha_{P1}\Delta V_1^{k^*}$:
  - $\alpha_{P1}\left(V_1^{k^*+1} - V_2^0\right) - t$ for producer P1.
  - $\alpha_S V_1^{k^*+1} + (1-\alpha_S)V_2^0$ for supplier S.
- If $t > \alpha_{P1}\Delta V_1^{k^*}$:
  - $\alpha_{P1}\left(V_1^{k^*} - V_2^0\right)$ for producer P1.
  - $\alpha_S V_1^{k^*} + (1-\alpha_S)V_2^0$ for supplier S.

Where $k^* \in \{0,1\}$ is producer $P2$'s choice to send information to S, given the conditions on market $M2$.

The first difference from the basic model is the possibility of inefficient information transfer in the disintegrated case. Efficiency requires that information is sent whenever the cost of transmitting information is less than the increase in total value created ($t \leq \Delta V_1^{k^*}$) but, since producer P1 only appropriates part of the increase in value, it won't send information that has

transfer costs between $\alpha_{P1}\Delta V_1^{k^*}$ and $\Delta V_1^{k^*}$. This inefficiency is a direct result of the lack of contractability between agents; a typical result of TCT models.

The second difference is the role of $P1$'s confidence index on the equilibrium. If extra-competitive forces are such that $P1$ expects to appropriate values closer to its CLB (i.e., if α_{P1} is close to zero), then the information transfer transaction becomes harder, showing that bargaining ability can have a large impact on transactions costs that go beyond asset specificity, uncertainty, and frequency.

To characterize the equilibrium completely, we need to solve for market $M2$. As shown in the appendix, the supplier will get full information only if $t \leq \alpha_{P1}\Delta V_1^1$ and $t \leq \alpha_{P2}\Delta V_2^1(2)$ simultaneously. The first inequality describes the condition for $P1$ to send information given that $P2$ decide to send information while the second characterizes $P2$'s choice given $P1$'s decision.

Vertical integration. Again, suppose then that S and P2 create an integrated firm (SP2). The reason for such integration might be to unlock information from firm $P2$, since the integrated equilibrium features efficient internal information transfer. Indeed, if α_{P2} is very low, the supplier will have difficulties accessing information contained in an independent $P2$ for the reasons discussed above. The equilibrium for the vertically integrated market is shown in Proposition 4.

Proposition 4: The expected equilibrium values for market M1 are:

- If $t \leq \alpha_{P1}\left[\Delta V_1^{k^*} - \Delta V_2^{k^*}\right]$:
  - $\alpha_{P1}\left(V_1^{k^*+1} - V_2^{k^*+1}\right)$ for producer P1.
  - $\alpha_{SP2}V_1^{k^*+1} + (1 - \alpha_{SP2})V_2^{k^*+1}$ for firm SP2.
- If $t > \alpha_{P1}\left[\Delta V_1^{k^*} - \Delta V_2^{k^*}\right]$:
  - $\alpha_{P1}\left(V_1^{k^*} - V_2^{k^*}\right)$ for producer P1.
  - $\alpha_{SP2}V_1^{k^*} + (1 - \alpha_{SP2})V_2^{k^*}$ for firm SP2.

Where $k^* \in \{0,1\}$ is producer $P2$'s choice to send information to S.

Proposition 3 shows that, before integration, P1's decision to share information depended only on the impact of the new input on $P1$'s value. After integration, the value of information sharing for producer P1 decreases by the impact of high-quality input adoption by SP2, increases the inefficiency of information transfer. This is because firm SP2 will adopt in market M1 even though it will not sell in that market to increase SP2's value capture. This arrangement is possible due to the integrated firm's ability to enforce adoption.

In this integrated scenario, the incentives for the integrated $P2$ to send information to the upstream unit increases for two reasons. First, before integration, the independent $P2$ cared only about market $M2$. The firm $SP2$ also gains profits from increases in the integrated $P2$'s final product quality in market $M1$ due to the increased competition in that market. Second, the integrated firm appropriates all the value created in market $M2$, making information sharing from an integrated $P2$ more frequent.

The incentives for $P1$ to share information are now lower than the integrated case for the same reason presented in the basic model. Producer $P1$ knows that $SP2$ will adopt in market $M1$ to increase value capture, leading to a decrease in $P1$'s value capture due to input innovation. This decrease can be so severe that input innovations are prejudicial to $P1$, leading to a complete stop in information sharing from producer $P1$. The thresholds for information sharing are shown in the appendix.

Integration vs. disintegration

There are two aspects that need to be taken into consideration when firms decide whether to integrate or not: value capture and information flows. The integration between firms ensures that both parties earn enough ex-post rents to guarantee that all efficient information transfer is done. This solution circumvents the usual issues caused by holdup that are emphasized in the TCT

literature. The integration between a supplier and a low-quality producer[6] increases the value capturing of the integrated firm because it changes the high-quality producer's outside option. This increase in value capture caused by the closure of outside options is a common takeaway in the value capture literature. This paper shows that these two ideas can be conflicting, leading to less information sharing in equilibrium.

In analyzing integration and disintegration, the model reveals how information flows adapt to the organizational structure of the firms involved. Integration redirects information from independent downstream entities, consolidating it within integrated units. This pattern emerges more clearly when we examine multiple markets, each dominated by a unique firm.

In the case of disintegrated suppliers, they have access to suboptimal information from all market leaders, gaining a broad but imperfect view of the market landscape. Conversely, integration allows a supplier to obtain efficient, high-quality information from one producer. Yet, this advantage comes at a cost as it simultaneously reduces the information obtained from other downstream firms, leading to a concentration of information sources.

This concentration can profoundly affect a firm's capability to perceive the true state of the market. Disintegration might be preferable if independent downstream firms offer diverse, imperfect insights, as a supplier can aggregate these sources through market governance. However, if integration occurs, the supplier risks losing this diversity since independent firms may be less incentivized to share information. In situations where downstream firms' information is highly correlated, integration may present a viable strategy, enabling the supplier to get information from one firm without significant loss.

CONCLUSION

While the TCT literature has come a long way, understanding the impact of vertical integration on external agents remains nascent. This paper illustrates that the propensity for specific transactions depends critically on agents' integration levels, even with constant transaction characteristics.

Our findings underscore that integration's fiat power facilitates not only internal information flow but also greater rent extraction from market agents. The side effect of the increased bargaining strength is that independent agents are less willing to share information. By doing that, we demonstrated that vertical integration has an intrinsic cost, addressing the critique that TCT relies on the existence of an exogenous and independent cost in using and maintaining the hierarchy (Gibbons, 2005).

The practical insights of this model offer vital lessons for managers considering vertical integration. Understanding the underlying reasons for inefficient information flow, and the influence of integration on information sharing incentives can inform strategic decision-making.

Additionally, our model can help shed light on why firms may fail to adopt new technologies (Dosi, 1982; Henderson and Clark, 1990; Utterback and Acee, 2005). The choice of organizational structure is shown to influence the firms' sources and quantity of information. Suboptimal governance choice can lead to too little information from important sources, leading to delays in recognizing new market trends and adopting new technologies.

Finally, we respond to the call to unite internal organization and firm capabilities (Argyres *et al.*, 2012) , showing how distinct structures lead to heterogeneous knowledge sets, setting the stage for future firm abilities. These insights not only contribute to the existing literature but open

new avenues for research, integrating concepts of organizational design, innovation, and information transfer.

REFERENCES

Aghion P, Jaravel X. 2015. Knowledge Spillovers, Innovation and Growth. *The Economic Journal* **125**(583): 533–573.

Agrawal A, Cockburn I, Galasso A, Oettl A. 2014. Why are some regions more innovative than others? The role of small firms in the presence of large labs. *Journal of Urban Economics* **81**: 149–165.

Ahuja G, Katila R. 2001. Technological acquisitions and the innovation performance of acquiring firms: A longitudinal study. *Strategic management journal* **22**(3): 197–220.

Alcácer J, Oxley J. 2014. Learning by supplying. *Strategic Management Journal* **35**(2): 204–223.

Anand KS, Goyal M. 2009. Strategic Information Management Under Leakage in a Supply Chain. *Management Science* **55**(3): 438–452.

Antras P. 2005. Property rights and the international organization of production. *American Economic Review* **95**(2): 25–32.

Argyres N, Bigelow LS. 2010. Innovation, Modularity, and Vertical Deintegration: Evidence from the Early U.S. Auto Industry. *Organization Science* **21**(4): 842–853.

Argyres NS, Felin T, Foss N, Zenger T. 2012. Organizational Economics of Capability and Heterogeneity. *Organization Science* **23**(5): 1213–1226.

Arora A, Cohen WM, Walsh JP. 2016. The acquisition and commercialization of invention in American manufacturing: Incidence and impact. *Research Policy* **45**(6): 1113–1128.

Arrow K. 1962. Economic welfare and the allocation of resources for invention. In *The rate and direction of inventive activity: Economic and social factors*. Nber: 609–626. Available at: http://www.nber.org/chapters/c2144.pdf.

Baccara M. 2007. Outsourcing, information leakage, and consulting firms. *Rand Journal of Economics* **38**(1): 269–289.

Bennett VM. 2013. Organization and Bargaining: Sales Process Choice at Auto Dealerships. *Management Science* **59**(9): 2003–2018.

Berry S, Gaynor M, Morton FS. 2019. Do Increasing Markups Matter? Lessons from Empirical Industrial Organization. *Journal of Economic Perspectives* **33**(3): 44–68.

Bigelow LS, Argyres N. 2008. Transaction costs, industry experience and make-or-buy decisions in the population of early U.S. auto firms. *Journal of Economic Behavior & Organization* **66**(3–4): 791–807.

Bloom N, Schankerman M, Van Reenen J. 2013. Identifying Technology Spillovers and Product Market Rivalry. *Econometrica* **81**(4): 1347–1393.

Brandenburger A, Stuart H. 2007. Biform Games. *Management Science* **53**(4): 537–549.

Brandenburger AM, Stuart HW. 1996. Value-based Business Strategy. *Journal of Economics & Management Strategy* **5**(1): 5–24.

Bridoux F, Stoelhorst JW. 2014. Microfoundations for stakeholder theory: Managing stakeholders with heterogeneous motives. *Strategic Management Journal* **35**(1): 107–125.

Cappelli V, Chatain O. 2021. Generalized Biform Games.

Cassiman B, Colombo MG, Garrone P, Veugelers R. 2005. The impact of M&A on the R&D process. *Research Policy* **34**(2): 195–220.

Chatain O, Plaksenkova E. 2019. NGOs and the creation of value in supply chains. *Strategic Management Journal* **40**(4): 604–630.

Chatain O, Zemsky P. 2007. The Horizontal Scope of the Firm: Organizational Tradeoffs vs. Buyer-Supplier Relationships. *Management Science* **53**(4): 550–565.

Chatain O, Zemsky P. 2011. Value creation and value capture with frictions. *Strategic Management Journal* **32**(11): 1206–1231.

Cohen WM, Levinthal DA. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly* **35**(1): 128–152.

Cuypers I, Ertug G, Hennart J-F. 2015. The effects of linguistic distance and lingua franca proficiency on the stake taken by acquirers in cross-border acquisitions. *Journal of International Business Studies* **46**(4): 429–442.

Cuypers IRP, Hennart J-F, Silverman BS, Ertug G. 2021. Transaction Cost Theory: Past Progress, Current Challenges, and Suggestions for the Future. *Academy of Management Annals* **15**(1): 111–150.

David RJ, Han S-K. 2004. A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal* **25**(1): 39–58.

Dosi G. 1982. Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy* **11**(3): 147–162.

Eurostat. 2008. Highly important source of information for innovation during 2006-2008. *Community Innovation Survey*. Available at: https://ec.europa.eu/eurostat/databrowser/product/page/INN_CIS6_SOU [7 October 2020].

Gans J, Ryall MD. 2017. Value capture theory: A strategic management review. *Strategic Management Journal* **38**(1): 17–41.

Gibbons R. 2005. Four formal(izable) theories of the firm? *Journal of Economic Behavior & Organization*, Theories of the Firm **58**(2): 200–245.

Grennan M. 2014. Bargaining Ability and Competitive Advantage: Empirical Evidence from Medical Devices. *Management Science* **60**(12): 3011–3025.

Hall BH, Khan B. 2003. Adoption of New Technology. In *New Economy Handbook*, Jones DC (ed). Academic Press.

Hall BH, Mairesse J, Mohnen P. 2010. Measuring the Returns to R&D. *Handbook of the Economics of Innovation* **2**: 1033–1082.

Helfat CE, Campo-Rembado MA. 2016. Integrative Capabilities, Vertical Integration, and Innovation Over Successive Technology Lifecycles. *Organization Science* **27**(2): 249–264.

Henderson RM, Clark KB. 1990. Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly* **35**(1): 9–30.

Hernandez E, Sanders WG, Tuschke A. 2015. Network Defense: Pruning, Grafting, and Closing to Prevent Leakage of Strategic Knowledge to Rivals. *Academy of Management Journal* **58**(4): 1233–1260.

von Hippel E. 1988. *Sources of Innovation*. Oxford University Press: New York, NY. Available at: https://papers.ssrn.com/abstract=2877276.

von Hippel E. 1998. Economics of Product Development by Users: The Impact of "Sticky" Local Information. *Management Science*. INFORMS **44**(5): 629–644.

Huckman RS, Pisano GP. 2010. Flextronics International, Ltd. Harvard Business School Press.

Jacobides MG, Knudsen T, Augier M. 2006. Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. *Research Policy*, Special issue commemorating the 20th Anniversary of David Teece's article, 'Profiting from Innovation', in Research Policy **35**(8): 1200–1221.

Kang M-P, Mahoney JT, Tan D. 2009. Why firms make unilateral investments specific to other firms: the case of OEM suppliers. *Strategic Management Journal*. John Wiley & Sons, Ltd **30**(2): 117–135.

Kapoor R. 2013. Persistence of Integration in the Face of Specialization: How Firms Navigated the Winds of Disintegration and Shaped the Architecture of the Semiconductor Industry. *Organization Science* **24**(4): 1195–1213.

Katila R, Rosenberger JD, Eisenhardt KM. 2008. Swimming with Sharks: Technology Ventures, Defense Mechanisms and Corporate Relationships. *Administrative Science Quarterly* **53**(2): 295–332.

Knott AM, Posen HE, Wu B. 2009. Spillover Asymmetry and Why It Matters. *Management Science* **55**(3): 373–388.

Lee E, Lee J, Lee J. 2006. Reconsideration of the Winner-Take-All Hypothesis: Complex Networks and Local Bias. *Management Science* **52**(12): 1838–1848.

Lee Jeho, Song Jaeyong, Yang Jae-Suk. 2015. Network structure effects on incumbency advantage. *Strategic Management Journal* **37**(8): 1632–1648.

Leiblein MJ, Miller DJ. 2003. An empirical examination of transaction- and firm-level influences on the vertical boundaries of the firm. *Strategic Management Journal* **24**(9): 839–859.

Leiblein MJ, Reuer JJ, Dalsace F. 2002. Do make or buy decisions matter? The influence of organizational governance on technological performance. *Strategic Management Journal* **23**(9): 817–833.

Luo Y. 2005. Transactional characteristics, institutional environment and joint venture contracts. *Journal of International Business Studies* **36**(2): 209–230.

Makri M, Hitt MA, Lane PJ. 2010. Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions. *Strategic Management Journal* **31**(6): 602–628.

Masten SE. 1988. A Legal Basis for the Firm. *Journal of Law, Economics, and Organization* **4**(1): 181–198.

Pahnke EC, McDonald R, Wang D, Hallen B. 2015. Exposed: Venture Capital, Competitor Ties, and Entrepreneurial Innovation. *Academy of Management Journal* **58**(5): 1334–1360.

Ryall MD, MacDonald G. 2004. How Do Value Creation and Competition Determine Whether a Firm Appropriates Value? *Management Science* **50**(10): 1319–1333.

Ryall MD, Sorenson O. 2007. Brokers and Competitive Advantage. *Management Science* **53**(4): 566–583.

Tan KH, Wong WP, Chung L. 2015. Information and Knowledge Leakage in Supply Chain. *Information Systems Frontiers*. Available at: http://link.springer.com/10.1007/s10796-015-9553-6.

Thomke S, von Hippel E. 2002, April 1. Customers as Innovators: A New Way to Create Value. *Harvard Business Review*. Available at: https://hbr.org/2002/04/customers-as-innovators-a-new-way-to-create-value.

Tsui E, Waters R. 2009, December 11. Asustek to spin off motherboard arm. *Financial Times*. Available at: https://www.ft.com/content/699416d2-e67a-11de-98b1-00144feab49a.

Utterback JM, Acee HJ. 2005. Disruptive technologies: an expanded view. *International Journal of Innovation Management* **9**(01): 1–17.

Verbeke A, Greidanus NS. 2009. The end of the opportunism vs trust debate: Bounded reliability as a new envelope concept in research on MNE governance. *Journal of International Business Studies* **40**(9): 1471–1495.

Williamson OE. 1975. Markets and hierarchies. *New York* **2630**.

Williamson OE. 1985. The economic institutions of capitalism. *Simon and Schuster*.

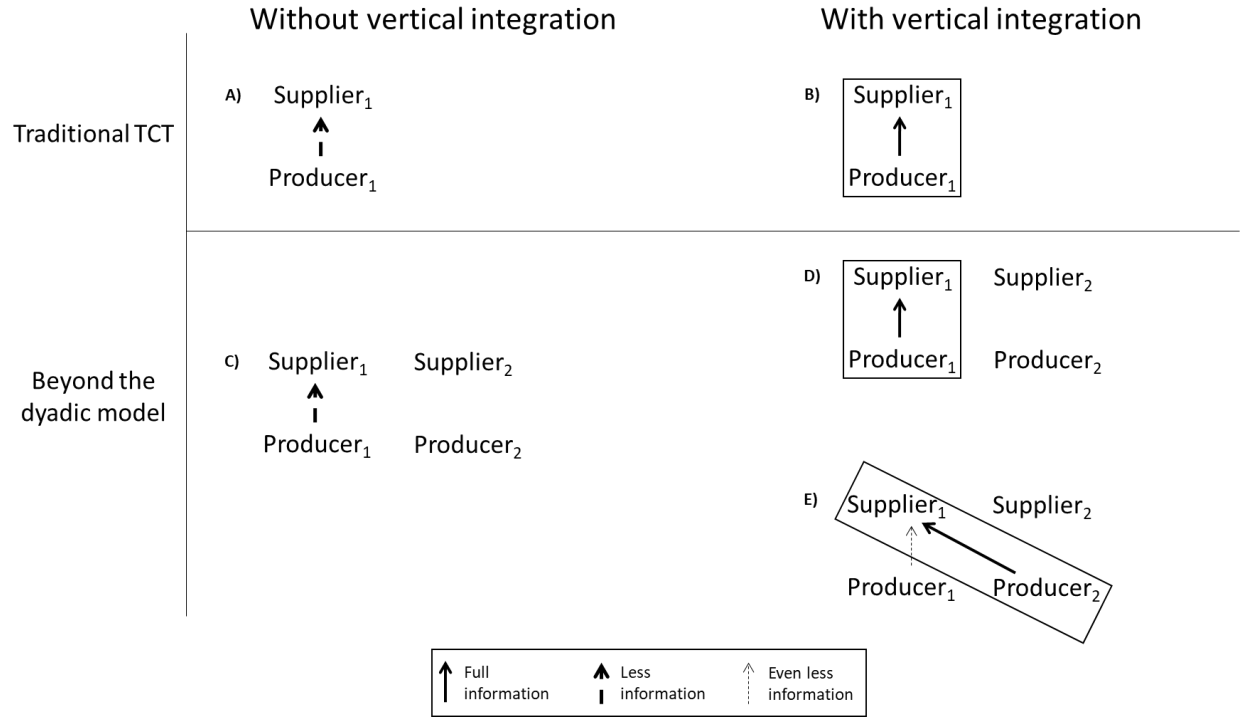
Williamson OE. 2010. Transaction Cost Economics: The Natural Progression. *The American Economic Review*. American Economic Association **100**(3): 673–690.

Zhang J, Jiang H, Wu R, Li J. 2019. Reconciling the Dilemma of Knowledge Sharing: A Network Pluralism Framework of Firms' R&D Alliance Network and Innovation Performance. *Journal of Management*. SAGE Publications Inc **45**(7): 2635–2665.

Zhou KZ, Poppo L. 2010. Exchange hazards, relational reliability, and contracts in China: The contingent role of legal enforceability. *Journal of International Business Studies* **41**(5): 861–881.

FIGURES

Figure 1 – Vertical integration and information sharing beyond traditional TCT.



FOOTNOTES

1 - The non-contractibility of adoption costs is also an assumption in economic models of innovation (see Antras, (2005) for an example). Also, adoption costs are likely sunk ex-post (Hall and Khan, 2003), opening the possibility for haggling.

2 - This is a property of additive games (Gans and Ryall, 2017).

3 - The choice of using only one consumer makes this model more suitable to analysis characterized by a winner-takes-all market. This might be the case when there exists network effects (Lee, Lee, and Lee, 2006; Lee Jeho, Song Jaeyong, and Yang Jae-Suk, 2015). The presence of networks effects is an especially important case, since the recent markup in many industries has been attributed to their existence, especially on digital platforms (Berry, Gaynor, and Morton, 2019).

4 - This is a concavity assumption on the function that determines product value given input quality.

5 - The concept of the confidence index has drawbacks since its use can sometimes yield non-intuitive results, as described in Cappelli and Chatain (2021) and Chatain and Zemsky (2007). Although Cappelli and Chatain (2021) points to issues with the confidence index, they propose a different way to compute confidence indices as a solution. Chatain and Zemsky (2007) highlights conditions on which confidence indices can be interpreted as bargaining power.

6 - The quality of each producer is market dependent, as explained in the model. Producer $P1$ if the high-quality producer in market $M1$ but the low-quality producer in market $M2$.