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By Anil Arya and Brian Mittendorf

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Input Markets and the Strategic Organization of the Firm

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Abstract

Organizational structure of firms is an important topic that has been widely discussed in virtually all management disciplines. The typical view of firm organization emphasizes enhancing efficiency by fully aligning incentives of all participants to achieve a common objective. Over the years, research in accounting, economics, and marketing has stressed how competition in output markets can alter this view. More recently, there has been an emphasis on how a firm's concurrent participation in input markets, wherein strategic supplier considerations are in play, can further alter the traditional view of organizational structure. This monograph seeks to synthesize such results and present the key considerations and conclusions that can be gleaned from this research. In doing so, the monograph emphasizes implications for accounting but also stresses the inherent interconnectivity with issues in industrial organization, strategy, and regulation.

1

Introduction

The strategic organization of firms has long been a prominent issue in management. Perspectives on firm organization are diverse, coming from many fields including economics, finance, marketing, operations, and organizational behavior. In each case, however, organizational design cannot be fully appreciated without an eye on accounting. After all, with decentralized organizations comes the necessity of measuring the success of separate business units. Such measurement calls upon the accountant to undertake a difficult task — creating independent measures of activity and performance for inherently interdependent business units. Such accounting measures, which form the crux of managerial accounting, require an appreciation of interconnectedness, both horizontal (among different operating segments) and vertical (among upstream and downstream segments).

The traditional view of accounting is one of the developing measures to track exogenous transactions. Over the years, however, accounting research has consistently stressed that the measurement system itself is part of the endogenous interlinkages that lead to such transactions. A case in point is the measurement of profitability for vertically related business units. Such measurements depend on the chosen transfer

prices. But, of course, a firm's transfer pricing policy alters incentives of its divisions which, in turn, alters the transactions they undertake in the first place.

In accordance with such endogenous interlinkages, research in a variety of fields has shown that not only are internal relationships altered by performance measurement and compensation choices, but so are external relationships. Prominent examples include the strategic choice of incentive pay stressed in Fershtman and Judd (1987) and Sklivas (1987); the strategic use of transfer pricing in Alles and Datar (1998); strategic consequences of relative performance evaluation in Aggarwal and Samwick (1999); and strategic self-sabotage to soften competitive response in Sappington and Weisman (2005). In these research streams, a unifying theme arises stressing that the strategic view of firm organization and the measurement of the performance of various firm components are inextricably linked.

That said, research stressing the importance and ramifications of strategic considerations on firm organization is primarily focused on a firm's strategic relationship vis-a-vis output market competitors. Recent research, however, has widened the focus to the role of organizational structure on strategic relationships in input markets. It is this stream of research that the present monograph seeks to synthesize. In doing so, we classify the role of input markets on organizational design into two arenas: (a) Section 2 of this monograph examines how a firm's participation as a buyer in input markets affects existing perspectives of organizational design; and (b) Section 3 examines how a firm's participation as a seller in input markets alters prevailing views of organizational design.

In terms of a firm's role as a buyer in input markets, the presence of strategic considerations is unmistakable. Beginning with Spengler (1950), the consequences of supplier pricing on supply chain efficiency have been extensively studied and discussed. In various realms, strategic means of achieving coordination have been documented. For example, the use of quantity discounts (Jeuland and Shugan, 1983) or two-part tariffs (Moorthy, 1987) can help alleviate strained supply relationships, as long as such measures survive the scrutiny of anti-trust regulators. The creation of a direct sales channel

(Tsay and Agrawal, 2004), use of product returns (Pasternack, 1985), employment of more intricate quantity flexibility or revenue-sharing contracts (Tsay, 1999; Cachon and Lariviere, 2005), and enhanced market segmentation (Villas-Boas, 1998) have also been presented as strategic consequences of self-interested input supply.[1]

The question addressed in the present monograph is how strategic firm organization and accounting measurements affect and are affected by such prevalent concerns of relying on an external input supplier. In this vein, we first address work on accounting issues, notably transfer pricing and measuring segment profitability. Section 2.1, based on Arya and Mittendorf (2007), discusses the consequences of external input supply for the transfer prices that govern internal input supply.

Traditional studies of external input supply ignore the presence of internal input supply; similarly, most studies of transfer pricing sidestep consideration of external input suppliers. Yet, the joint use of internal and external input supply is widespread. For example, computer manufacturers typically develop products that contain both their own hardware components and software provided by external parties. When both internal and external sources of inputs are relied upon, the typical views of each are altered. In particular, when the internal supply source is viewed alone, a centralized structure is preferred. Yet, when both supply sources are considered jointly, it is shown that a decentralized organization that employs transfer prices above marginal cost is preferred.

The intuition for this result comes from the fact that the firm seeks to convey a low willingness to pay for inputs provided by external parties. While higher costs and greater inefficiencies can be one means of doing so, a firm finds it much more attractive to employ higher pseudo-costs. That is, transfer prices above marginal cost create a circumstance where the firm's procurement division behaves as if it has excessive costs without the firm actually having to incur such excessive costs in a real sense. This posture, in turn, convinces the external supplier to cuts its own price, thereby benefiting the firm. While in

[1] For a review of the literature on supply chain coordination and the myriad of contracting solutions, see Lariviere (1998).

isolation the view of the decentralized firm with high transfer prices seemingly paints the picture of inefficiency, it turns out that painting this picture is itself a sign of firm efficiency. In effect, the results underscore the notion that modest internal frictions in a firm can serve as an effective brake on exploitative external parties.

Turning to segment profitability considerations, Section 2.2 addresses implications of a reliance on external input supply for the measurement of the performance of divisions located in distinct output markets. As detailed in Arya and Mittendorf (2010c), a firm's use of an externally generated input for diverse internal segments introduces complexity in the profit measurement of each individual segment. Circumstances of this sort are widespread: large grocery chains engage in central procurement of inputs but track profits of individual retail stores; Apple uses externally purchased flash memory for a variety of its products (iPod, iPhone, iPad); retailers make wholesale purchases which are distributed through both traditional brick-and-mortar outlets as well as online retail arms; etc. In such circumstances, it is demonstrated that the traditional accounting for segment profits understates the performance of low-margin segments and overstates performance of high-margin segments. Intuitively, the presence of low-margin segments helps convey a lower ability to pay to suppliers which, in turn, creates downward pressure on wholesale prices. The benefit of such low wholesale prices is borne primarily by the more svelte high-margin segments. In other words, traditional accounting of segments fails to incorporate the latent subsidy underperforming segments provide to overperforming segments. This viewpoint, firmly rooted in supply-side strategic complementarity across segments, has an analog in the realm of demand-side complementarity. That is, while the ideas of loss leaders, predatory pricing, and freebie marketing (e.g., the use of cheap or even free razors to capture captive consumers for blade lines) have long been discussed as key demand-side considerations, the appreciation of related supply-side complementarities is in its infancy.

To further develop the ramifications of strategic input supply, in Section 2.3 we pivot away from issues of accounting measurement to issues of industrial organization. In Section 2.3.1, we note that the reliance on an external supplier may in fact create a demand for the

firm to promote modest external competition via judicious licensing to rivals. In particular, Arya and Mittendorf (2006b) show that when a firm relies on an external supplier for key inputs, it can use licensing with royalty fees to create a de facto surrogate with inherently lower ability to pay for external inputs. Not only do royalties serve to lower the surrogate's willingness to pay, but they also serve as a means through which such wholesale pricing gains are siphoned back to the firm. As such, input markets change the traditional views of firms' willingness to foster (and even create) output market rivalries.

Even when output market rivalries are inevitable, Section 2.3.2 discusses how the presence of an external supplier can change a firm's strategic posturing. As demonstrated in Arya et al. (2008a), the organization of a firm in terms of the make-or-buy decision is altered by a rival's reliance on an external supplier. In effect, given a rival relies on a particular supplier, a firm's decision to internally make an input creates a de facto strategic partnership between the rival and its supplier. This alliance manifests itself in the supplier offering lower input prices to support its sole customer's desire to extract a greater share of the output market (and, by proxy, help the supplier profit more in the input market). If, instead, the firm opts to procure inputs from the external supplier, the firm undercuts the supplier–rival partnership since now both the firm and rival are customers of the supplier. As a consequence, the supplier responds by boosting the rival's input price. The strategic benefit of raising the rival's input price can justify a firm's reliance on a common supplier even when the firm can make inputs at a price below the prevailing external input price.

Though each of the above circumstances focuses on a firm's role as a buyer in input markets, the influence of input market on strategic organization of firms also extends to a firm's role as a seller in input markets, which forms the basis for Section 3 of this monograph. Firms' concurrent roles as sellers in both input and output markets have been studied in economics (e.g., Gallini and Lutz, 1992; Dutta et al., 1995), marketing (e.g., Kalnins, 2004; Vinhas and Anderson, 2005), and operations (e.g., Chiang et al., 2003; Tsay and Agrawal, 2004). The practical importance of this issue has reached a fever pitch with the proliferation of manufacturer-direct online sales arms concurrent with

traditional retail channels (e.g., Tedeschi, 2005). The issue of interest herein, which has only garnered interest in recent years, is how such industrial structures affect and are affected by strategic organization of firms.

As with Section 2, Section 3 begins with a discussion of ramifications for the preeminent managerial accounting topic of transfer pricing. In particular, Section 3.1 revisits the strategic role of transfer pricing when the internal input supplier also serves as an external input supplier. Importantly, such external input supply eventually finds its way to competition with the output produced internally. That is, while the presence of and participation in external input markets is well studied in the transfer pricing literature (e.g., Hirshleifer, 1956; Baldenius and Reichelstein, 2006; Arya and Mittendorf, 2008), only recently has such research considered the role such externally sold inputs play in eventual output market competition for internally generated outputs. In the parlance of industrial organization, the interest here is to examine transfer pricing when the firm is a vertically integrated producer (VIP). To elaborate, Arya et al. (2008c) consider how a firm's role as a VIP affects and is affected by transfer pricing. That is, as a VIP, a firm's inputs sold externally become competing products for the outputs produced internally.

In this case, the VIP seeks to balance its profits in wholesale markets (external input supply) and its profits in retail markets (external output supply), where such markets are inherently linked. Under a centralized structure, the firm finds such balance difficult to achieve. After all, once wholesale demand is satisfied, the firm may find itself overly aggressive in retail competition. We say "overly aggressive" since its wholesale customer can rationally foresee such a competitive response and will be less willing to pay a premium in the wholesale market. This undesirable retail posture is consistent with empirical studies of territorial encroachment (e.g., Kalnins, 2004). As such, a savvy firm will seek to find means to convince its wholesale customer that it will not excessively cannibalize the retail market.

It is this desire to convey a softer competitive posture in the retail market that creates a demand for decentralization. A decentralized organization that employs transfer prices above marginal cost gives the

firm a credible means to convince its wholesale customer that its own retail arm will not excessively undercut the customer's retail margins. Doing so of course costs the firm to an extent in the retail market, but such losses are more than compensated for in wholesale profit gains. Interestingly, and in contrast to existing theoretical work on transfer pricing policies, the preferred transfer pricing terms can be realized by a well-designed negotiation process even when the central planner does not have access to all relevant information about the relative attractiveness of the wholesale and retail markets.

The concurrent participation in wholesale and retail markets also has implications for segment profit calculations even in the absence of transfer pricing and/or decentralization. In particular, Section 3.2 identifies that if a centralized firm were to conduct both retail and wholesale operations as a VIP, the seemingly distinct segments exhibit a key interdependency. If the retail arm suffers efficiency setbacks, such changes have distinct reverberations on wholesale operations. The reduced retail efficiency emboldens retail rivals which, in turn, boosts wholesale demand. For this reason, reduced efficiency at the retail level results in lower retail profits but also higher wholesale profits. The net effect may actually be an increase in overall firm profits, suggesting that modest retail inefficiency may be something a well-organized firm will turn a blind eye to. Connecting this to the key forces identified in Section 3.1, a common theme arises in that both point to upsides of retail weakness. Decentralization and transfer pricing represent a unique way to achieve this weakness, as they do so with higher pseudo-costs instead of actual costs. As such, the use of transfer pricing to achieve wholesale market objectives achieves such goals without imposing substantial real costs.

The retail firm's added role as an input supplier also has ramifications beyond accounting measurement to industrial organization, which forms the focus for Section 3.3. In Section 3.3.1, we revisit the traditional question of time-to-market. The usual view is that there is a strong strategic advantage for a firm when it is a Stackelberg leader in the retail market. The well-studied Stackelberg game has been used to explain a variety of practices including investments in logistics, point-of-sale information networks, and streamlined distribution systems (Kulatilaka and Perotti, 2000). In the case of

dual participation in retail and wholesale markets as a VIP, however, the traditional Stackelberg advantage is reversed. Though Stackelberg leadership offers an opportunity to drive out competition, doing so only magnifies the concerns of encroachment on wholesale customer territory. As a Stackelberg follower, however, the VIP provides its wholesale customer a means through which it can gain a retail advantage. Further, this means requires the wholesale customer to procure additional wholesale units. It is this spillover to wholesale markets that can favor a slower time to market, despite the concomitant (but relatively muted) retail downside.

Joint participation in input and output markets can alter even the most widely held views of industrial organization and regulation. Perhaps the most fundamental result in modeling of retail competition is the notion that price (Bertrand) competition is much more competitive than quantity (Cournot) competition. This common view has been shown to be robust to a variety of modeling perturbations (e.g., Singh and Vives, 1984; Okuguchi, 1987; Vives, 2005). As shown in Arya et al. (2008b), and summarized in Section 3.3.2, the presence of a VIP adds a distinct wrinkle to the standard view.

To elaborate, under Cournot competition, a VIP takes its rival's quantity as given when choosing its own retail quantity. In other words, the VIP ignores wholesale profit when choosing retail quantities. The result is much more intense competition than the firm would like. In contrast, under Bertrand competition, only the rival's retail price is taken as given when the firm chooses its own strategic posture (i.e., retail price). As a result, the VIP realizes that a decrease in its own retail price to gain advantage over its competition will inevitably reduce wholesale demand for its inputs. As a result, the firm is less willing to cut its retail price. The end result is that with a VIP, the retail market is less competitive under Bertrand competition. Further, this muted competition translates into lower consumer surplus and total surplus, suggesting that if regulators are seeking to promote efficiency in imperfectly competitive markets, the low hanging fruit may actually lie in markets characterized by price competition.

Taken together, the various results noted above paint a more nuanced picture of a well-organized firm with effective accounting

measurement than reflected in conventional wisdom. Relative to the strong emphasis on how output markets alter views of strategic firm organization, an appreciation for how input markets alter these views is in its early stages. Nonetheless, the work summarized herein provides a broad view of both the scope and scale of such ramifications.

One last note before we begin with the particulars. By intention, this monograph is focused on research for which we have been (at least a subset of) the authors. This focus on our own research is not intended to reflect that we believe it is the most important, only the most familiar. To the best of our abilities, we have discussed related literature in the field and tied the papers focused on here with others that are related. Despite our sincere efforts in this regard, we suspect we have overlooked some related papers of which we are unaware. For this, we offer our deepest regrets in advance.

With the above caveat duly noted, the monograph proceeds as follows. Section 2 examines how participation as a buyer in input markets can change views of optimal firm organization. Section 2.1 investigates decentralization and preferred transfer pricing; Section 2.2 studies segment profit measurement; and Section 2.3 details ramifications for industrial organization. Section 3 examines how participation as a seller in input markets alters views of strategic firm organization. Section 3.1 revisits decentralization and transfer pricing; Section 3.2 looks at segment profit measurement; and Section 3.3 examines implications for industrial organization. Section 4 then concludes the monograph while providing a discussion of additional considerations and unanswered questions.

2

Organizational Design When a Firm is a Buyer in Input Markets

In this section, we provide a retrospective of existing research that identifies implications of being a buyer in input markets for a firm's preferred organizational structure. In particular, we first examine the topic of transfer pricing. We then discuss how input market participation can alter views of segment profitability. Finally, we consider some implications of input market participation for traditional views of industrial organization.

2.1 Decentralization and Transfer Pricing

Transfer pricing is, perhaps, the quintessential managerial accounting topic. The textbook view of transfer pricing is roughly as follows. For a variety of reasons such as limited information, diverse incentives, or costly information processing, firms must rely on decentralization to achieve their objectives. This, in turn, creates a transfer pricing friction: a downstream division internalizes its own pseudo-cost (the transfer price) and not the firm's true cost. To alleviate this friction, a firm should focus on setting transfer price equal to the firm's opportunity cost, which, absent constrained capacity, is generally equal to its marginal cost.

Accounting research has consistently demonstrated that this view fails to appreciate the nuances of a firm's relationship with external parties and that a more holistic view can better explain the prevalence of decentralization. For example, if firms face price competition in output markets, preferred transfer prices can deviate from opportunity cost; further, due to the induced strategic effects, the transfer pricing arrangement can make it such that the firms prefer a decentralized structure absent the typical reasons. This point is highlighted in Alles and Datar (1998), Hughes and Kao (1998), Goex (2000), and Narayanan and Smith (2000), among others. In effect, with decentralization and transfer prices above marginal costs, firms engage in tacit collusion: a high transfer price enables each firm to convey a higher final good price and, thus, dampen inter-firm competition. The ability to utilize high prices to create a cooperative retail environment is due to strategic complementarity of prices in the final good market. If, on the other hand, output markets are characterized by quantity competition, strategic substitutability of final good quantities leads the firm to employ decentralization but instead make use of transfer prices below marginal cost to drive out competitors (e.g., Goex and Schiller, 2006).

The point we emphasize here, as presented more fully in Arya and Mittendorf (2007), is that participation in input markets too can justify both decentralization and the use of transfer prices that deviate from marginal cost. Interestingly, the preferred transfer price is above marginal cost regardless of the nature or extent of output market competition; also, the optimal transfer price can be replicated under a judiciously arranged negotiated transfer pricing arrangement.

To elaborate, consider a streamlined model in which a firm, denoted firm 1, faces no competition in the sale of its product. Denoting the firm's quantity produced by q_1, consumer demand for its product is represented by a linear, downward-sloping (inverse) demand function $p_1 = a - q_1$, where p_1 is the retail price of firm 1's product.

To make its product, the firm relies on one internally generated input and one input that is provided by a supplier. We normalize the production process such that one unit of the final product requires one unit of each input. The internally generated input and the externally generated input are each produced at zero marginal cost.

Given this basic setup, we next investigate firm 1's profits under both centralized and decentralized regimes. Under centralization, the firm maintains control over production decisions and seeks to maximize firm-wide profit. Under decentralization, an upstream division is provided decision-making authority over production and pricing of the internal input, while a downstream division is charged with conversion and sale of the final output. In this case, trade among divisions is governed by a transfer pricing arrangement, and each makes decisions to maximize its own division's profit.

Input Market Pricing and Centralization

Under centralization, the sequence of events is as follows. First, the supplier sets its wholesale price, w. Then, given the wholesale price, the firm chooses its input (and output) quantity, q_1. Finally, the supplier is paid and retail demand is realized. Figure 2.1 summarizes the timeline of events.

To identify the (unique subgame perfect) equilibrium under centralization, we work backwards in the game. Given a supplier (wholesale) price w, the firm chooses q_1 to maximize its profit in the final product market. That is, firm 1 solves[1]:

$$\underset{q_1}{Max}[a - q_1]q_1 - wq_1. \tag{2.1}$$

Solving the first-order condition of Equation (2.1) yields equilibrium quantity as a function of the supplier price in the centralized setup,

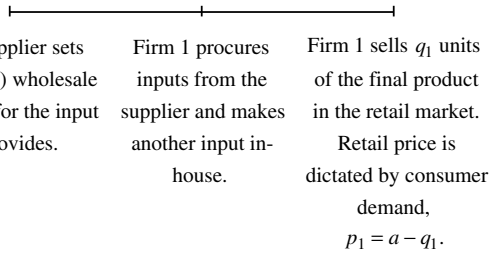


Fig. 2.1 Timeline under centralization.

[1] Throughout the monograph, we presume a is sufficiently large that prices and quantities derived using the first-order approach are positive.

denoted $q_1^C(w) = [a - w]/2$. Given this, the supplier sets its price to solve:

$$\underset{w}{Max}\, wq_1^C(w) \Leftrightarrow \underset{w}{Max}\, w[a - w]/2. \tag{2.2}$$

The first-order condition of Equation (2.2) with respect to w yields $w^C = a/2$, the optimal price set by the supplier for the externally provided input under centralization. Substituting w^C for w in $q_1^C(w)$ yields equilibrium firm production levels, $q_1^C = a/4$. Substituting these in Equation (2.1) yields profit for firm 1 under centralization, $\Pi_1^C = a^2/16$. As one should expect, the supplier sets price above marginal cost ($w^C > 0$), and the firm responds by procuring less than what it would have had the supplier charged its marginal cost ($q_1^C(w^C) = a/4 < q_1^C(0) = a/2$). This is the familiar double marginalization problem. In light of this, we next identify the outcome under decentralization.

Input Market Pricing and Decentralization

The commonly discussed downside of decentralization is that it creates another manifestation of double marginalization, this one engendered by transfer pricing. In particular, upstream divisions, bent on boosting their own performance, seek transfer prices above marginal cost. In response, downstream divisions, focused on their divisional bottom line, have incentives to underprocure upstream inputs.

While the temptation to think that adding a second double marginalization problem can only make matters worse for the firm is a natural one, this argument ignores interactions between the intra- and inter-firm supply channels. We next outline such interactions. To see the real effects of transfer pricing arrangements, consider the simple policy of delegated transfer pricing: just as (and concurrent with) the outside supplier, the upstream division announces a per unit transfer price, t, and given both the internal and external prices, the downstream division chooses the number of units, q_1, to purchase. Besides being simple, this formulation is equivalent to the commonly employed standard-cost transfer pricing; in this case, the upstream division is, in essence, unconstrained in establishing standards.

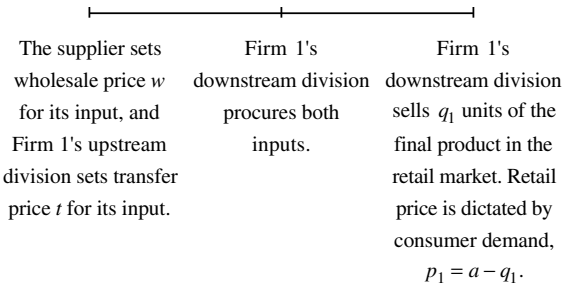


Fig. 2.2 Timeline under decentralization.

More precisely, under decentralization, the sequence of events is as follows. First, the external supplier and the internal supplier each concurrently determine their input prices, w and t, respectively. Then, given the prevailing input prices, the downstream division chooses its input (and output) quantity, q_1. Finally, the supplier is paid, retail demand is realized, and divisional profit figures are determined. Figure 2.2 summarizes the timeline of events.

Again, we work backwards in the game to determine the equilibrium. Given w and t, the downstream division chooses q_1 to maximize its division profit, solving:

$$\underset{q_1}{Max}[a - q_1]q_1 - [w + t]q_1. \tag{2.3}$$

Solving the first-order condition of Equation (2.3) yields the equilibrium quantity under decentralization as a function of the supplier price and the transfer price, $q_1^D(w,t) = [a - w - t]/2$. This serves as the induced demand function for the firm's upstream division and the supplier. The supplier and the upstream division simultaneously choose w and t, respectively, to maximize their own profits. The supplier's problem is in Equation (2.4), and the upstream division's problem is in Equation (2.5):

$$\underset{w}{Max}\, wq_1^D(w,t). \tag{2.4}$$

$$\underset{t}{Max}\, tq_1^D(w,t). \tag{2.5}$$

Jointly solving the first-order conditions of Equations (2.4) and (2.5) yields $w^D = a/3$ and $t^D = a/3$, the equilibrium pricing of the supplier

and the upstream division, respectively. Substituting these in $q_1^D(w,t)$ yields the equilibrium firm production level, $q_1^D = a/6$. Finally, substituting this in Equation (2.1) yields firm 1 profit of $\Pi_1^D = a^2/12$. As with centralization, the supplier again sets price above marginal cost ($w^D > 0$), and the downstream division responds by procuring less than what it would have had the supplier charged its marginal cost ($q_1^D = a/6 < q_1^D(0,t^D) = a/3$). Not only this, but the upstream division also sets a transfer price above marginal cost, further depressing production levels. Thus, the problem of double marginalization is magnified by decentralization. We next compare the outcomes under centralization and decentralization to determine the firm's preferred organizational structure.

Centralization vs. Decentralization and Optimal Transfer Pricing

At first glance, it appears that decentralization only does harm by magnifying concerns of double marginalization. This view is borne out by noting firm 1's depressed production levels under decentralization, $q_1^D < q_1^C$. A mitigating factor is that the ensuing weakness of the firm forces the supplier to soften its pricing. In other words, by creating some internal strife, the firm convinces its supplier that it will be more sensitive to supplier pricing. The result is that $w^D < w^C$. Lower supplier pricing can actually make it beneficial to introduce an internal supply chain distortion in the presence of an external supply chain distortion. Comparing profits, $\Pi_1^D = a^2/12 > \Pi_1^C = a^2/16$. Hence, Proposition 2.1.

Proposition 2.1. When the firm relies on both internally and externally generated inputs, decentralization yields higher firm profit.

A simple cost–benefit analysis reflects the two effects of a decentralized structure. First, there is the cost of decentralization: having a transfer price above marginal cost artificially reduces production. Holding supplier price constant (at w^C), the net cost to the firm of such production loss is:

$$([a - q_1^C]q_1^C - w^C q_1^C) - ([a - q_1^D]q_1^D - w^C q_1^D) = \frac{a^2}{144}. \qquad (2.6)$$

The offsetting benefit of decentralization is that a fractionalized firm convinces the supplier of a lower willingness to pay. In particular, holding production level constant (at q_1^D), the savings from a lower supplier price amount to:

$$(w^C - w^D)q_1^D = \frac{a^2}{36}. \tag{2.7}$$

Clearly, the benefit in Equation (2.7) exceeds the cost in Equation (2.6). In particular, the difference between Equations (2.7) and (2.6), $\frac{a^2}{48}$, is precisely the difference between Π_1^D and Π_1^C. In effect, the firm benefits from a sort of "self-sabotage" in that it introduces inefficiencies that prove helpful (e.g., Sappington and Weisman, 2005). However, the firm falls short of real sabotage, instead opting for "paper sabotage" — it benefits not from directly increasing costs but instead by increasing the internal accounting charge.

Figure 2.3 presents a pictorial representation of the cost–benefit tradeoff. In the figure, the area $A + D$ equals Π_1^C; the y-axis coordinates correspond to the firm's contribution margin per unit and the x-axis coordinates reflect the number of units. Similarly, the area $B + D + C$ equals Π_1^D. Hence, a shift from centralization to decentralization entails a change in profit of $C - (A - B)$. The area C reflects the benefit of decentralization due to the supplier price falling from w^C to w^D. The area $(A - B)$ reflects the cost of decentralization due to the production level falling from q_1^C to q_1^D; A is adjusted by B since restricted supply does provide an ancillary benefit to the firm of being able to obtain a higher price in the final product market.

The role of transfer pricing in alleviating external input pricing has been shown here under the simple transfer pricing arrangement wherein the upstream division has free reign over prevailing transfer prices. A natural question in this regard is what the firm's preferred transfer price is. That is, suppose the firm could pre-empt any supplier price (acting as a first mover) by announcing an irrevocable transfer price. This would entail the supplier solving Equation (2.4) for the announced t. Solving Equation (2.4) reveals the chosen supplier price is $w^D(t) = [a - t]/2$. Substituting $w^D(t)$, in $q_1^D(w, t)$ enables firm profit

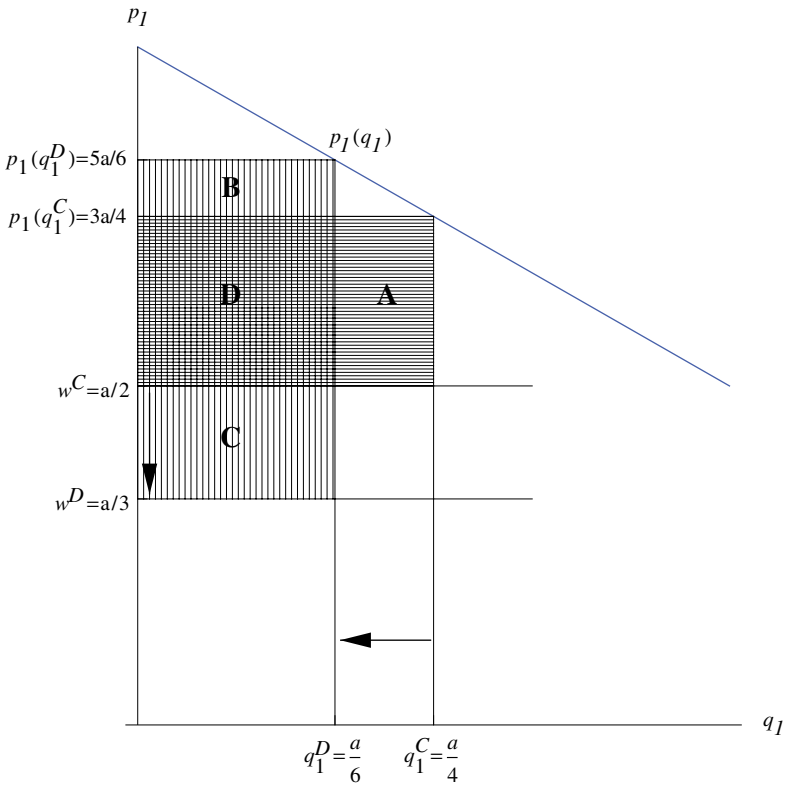


Fig. 2.3 The cost and benefit of decentralization.

to be expressed as a function of t. In this case, the firm solves:

$$\begin{aligned} &\underset{t}{Max}[a - q_1^D(w^D(t),t)]q_1^D(w^D(t),t) - [w^D(t)]q_1^D(w^D(t),t) \\ &\Leftrightarrow \underset{t}{Max}\left[\frac{3a+t}{4}\right]\left[\frac{a-t}{4}\right] - \left[\frac{a-t}{2}\right]\left[\frac{a-t}{4}\right]. \end{aligned} \tag{2.8}$$

Taking the first-order condition of Equation (2.8) yields $t = a/3$. Since this is precisely the transfer price chosen under decentralization (t^D), the presumed arrangement is, in fact, the optimal one. That is, by delegating the decision about the transfer price to the upstream division, the firm is able to replicate its preferred transfer price. Hence, Proposition 2.2.

Proposition 2.2. Under decentralization, the firm's preferred transfer price is replicated under delegated transfer pricing.

Though we have (intentionally) derived Propositions 2.1 and 2.2 here in the simplest possible framework so as to highlight the underlying intuition, Arya and Mittendorf (2007) demonstrate that the key results apply in a more general setting that includes n retail competitors providing differentiated goods, nonzero production costs for both the internally generated and externally generated inputs, and generalized Nash bargaining among the divisions over the prevailing transfer price. Consideration of these factors does introduce additional considerations.

For one, once (Cournot) retail competition is in play, decentralization can again be valuable, but only if competitive pressures are not excessive. The added wrinkle brought by competition is that the firm's reduced production level under decentralization is an invitation for exploitation by competitors. Consistent with this, the greater the substitutability among competing products or the greater the number of competitors, the less attractive decentralization becomes.

A second key consideration arrives under negotiated transfer pricing as reflected in generalized Nash bargaining. In effect, the delegated transfer pricing arrangement above is a special case of bargaining over the prevailing transfer price wherein all bargaining power resides with the upstream division. Arya and Mittendorf (2007) demonstrate that decentralization is also desirable when it is accompanied by negotiated transfer pricing wherein upstream has some (but not all) of the bargaining power. And, as in Proposition 2.2 above, under the firm's preferred assignment of bargaining power, the negotiated transfer price replicates the firm's preferred transfer price. This provides distinct evidence for the efficacy of negotiated transfer pricing, as it serves the role of communicating weakness to an outside supplier, but does so without excessive weakness so long as bargaining rights are properly allocated.

Besides generalizing the model, Arya and Mittendorf (2007) also demonstrate the results are robust to the nature of output market competition (price vs. quantity), the presence of upstream market

competition, and the existence of multiple input buyers. In terms of the nature of output market competition, both scenarios can support decentralization as an optimal organizational structure. As outlined above, with quantity competition, decentralization is preferred provided competition is not too intense. Under price competition, however, the desirability of decentralization arises regardless of either the number of competitors or the degree of product substitutability. In terms of upstream market competition, the desirability of decentralization detailed above remains provided competition is not too intense that it drives supplier prices down so far that there is little upside to conveying a lower willingness to pay to suppliers. Finally, the case of multiple input buyers refers to a circumstance where output market rivals too rely on a supplier and can similarly decentralize to achieve their objectives. In this case, it is demonstrated that the unilateral incentive to decentralize and reduce supplier prices becomes a multilateral incentive. In fact, the incentive is so strong that decentralization is a dominant strategy.

In short, this section demonstrates that a firm wishing to obtain better terms from a supplier may be willing to tolerate potential transfer pricing conflicts and delegate pertinent decisions to division managers. The model presents a scenario that, at first glance, puts decentralization and transfer pricing policy in a bad light. Excessive internal transfer prices only cut into production that is already depressed by excessive supplier pricing. The presence of an external supplier, however, introduces a delicate interaction: distortions in the intra-firm supply chain impact the pricing along the inter-firm supply chain. Forced to pay more than marginal cost even for the internal good, a downstream division exhibits dampened enthusiasm to produce, which, in turn, seeps over to the supplier's pricing. Recognizing that the procuring party is increasingly wary of high prices, the supplier's best response is to curtail price markups so as to induce greater demand. From the firm's perspective, decentralization introduces competing tensions: there is a cost stemming from production distortions brought by internal price markups, but there is also a benefit of reining in external supplier prices. We next consider implications of input market reliance for segment profit measures.

2.2 Measuring Segment Profitability

The desire to generate disaggregate data that provides meaningful measures of profitability at the segment and even customer level is at the crux of intra-firm accounting measurement. In this vein, accounting research and practice have a long history of the development of seemingly perfect performance measures which in the end fail to fully reflect opportunity costs of decisions. Commonly discussed examples include the fact that accounting accruals occur in undiscounted terms and thus fail to reflect the opportunity cost of capital, product line costs do not reflect constrained capacity, and fixed cost allocations potentially induce a "death spiral" (see, for example, Zimmerman, 2003).

The complications introduced by complementarities across segments and customers have not been lost on those both inside and outside the accounting realm. The benefits of having a loss leader product for complementary demand-side effects on other products or incurring sustained losses on a product for competitive posturing (e.g., dumping or predatory pricing) have been well recognized, and practitioners frequently account for such spillover effects in making resource allocation decisions.

In this section, we discuss the results in Arya and Mittendorf (2010c) which shows how input market reliance can create important complementarities that represent unrecognized (or at least underrecognized) opportunity costs of decisions. In particular, even if segment and customer profitability measures perfectly reveal individual market profitability, they do not fully reflect the latent cross-subsidization that can arise when a multi-market firm relies on a supplier for key inputs.

The cross-subsidization stems from the fact that supplier pricing is influenced by the nature of the firm's downstream reach. As a consequence, resource allocation among segments that is based solely on relative profitability fails to fully incorporate the positive supply chain ramifications obtained from serving less profitable markets. The results of incorporating such supply-side effects may provide some justification for firms' seeming reluctance to abandon underperforming segments as well as their apparently insatiable desire to expand to new (possibly unprofitable) markets.

The theme of this analysis lies at the intersection of discussions about accounting measures of market profitability and the need to and means of coordinating supply chain partners. In the realm of profitability measurement, activity-based costing (ABC) has had a substantial impact on a firm's ability to track profits at the segment or customer level (e.g., Cooper and Kaplan, 1988). Through improved cost allocations, these processes are viewed both by academics and practitioners as critical to properly evaluating product line choices, resource allocation across segments, and keep-or-drop decisions (e.g., Goebel et al., 1998; Searcy, 2004; Sopariwala, 2005). At the customer level, ABC and customer lifetime value (CLV) calculations are used jointly to evaluate which customers to serve and target (e.g., Hogan et al., 2002; Searcy, 2004; Venkatesan and Kumar, 2004; Kuchta and Troska, 2007). While significant efforts have been made to incorporate effects of downstream competition (demand-side effects) in such calculations, the issue of upstream (supply-side) effects, the basis for the present discussion, has only been recently recognized.

To elaborate, consider the following (slight) perturbation of the setting analyzed in Section 2.1. To sidestep the issue of transfer pricing, say the firm only relies on one input which is externally provided. To reflect the presence of multiple segments, say the input is used for the production and sale of two different outputs. The two outputs (segments), A and B, can be viewed broadly as being two distinct products, two markets, or even two different customers. Consumer demand in segment i is again represented by a linear, downward-sloping (inverse) demand function $p_1^i = a^i - q_1^i$, where q_1^i is the firm's output in segment i. As before, the costs of production and conversion are, for simplicity, set equal to zero. (Also, as before, we presume nontrivial participation in each market, or $a^i < 3a^j$, $i, j = A, B$.) The sequence of events in this setting is summarized in Figure 2.4.

The question in this setup is how one measures the incremental benefit of each segment to the firm, and how traditional calculations of segment profit may miss part of this benefit in light of input market considerations.

In particular, with multiple markets, the critical issue is not just an individual market's profitability but also that market's effect on the

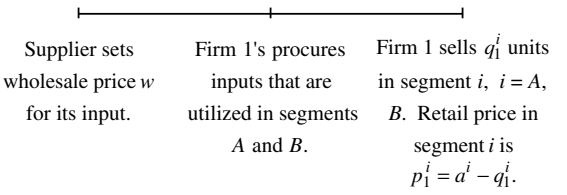


Fig. 2.4 Operations in multiple retail segments.

firm's purchase sensitivity to input pricing, i.e., the consequences for the elasticity of the induced demand function faced by the supplier. If one market exhibits greater price sensitivity, the strategic supplier responds to the more elastic demand by setting a lower wholesale price; if the firm were to drop participation in such a market, the supplier reacts by increasing its input price. Since such wholesale price adjustments are off-equilibrium, they are not reflected in (on-equilibrium) profit calculations and, as such, represent a latent subsidy provided by one segment to another. This force, in turn, means that retaining a seemingly unprofitable market can be the right course of action for a profit-maximizing firm.

To examine this effect more closely, we first derive equilibrium outcomes under participation in both markets and participation in just one market. We then compare the value added by a segment with the accounting profit of the segment.

Participation in Both Output Markets

When the firm participates in both output markets, the equilibrium outcome, derived by working backward in the game, can be derived as follows. Given the firm's market participation and the given wholesale price, the firm chooses retail quantities in its markets by solving:

$$\underset{q_1^A, q_1^B}{Max} [a^A - q_1^A]q_1^A - wq_1^A + [a^B - q_1^B]q_1^B - wq_1^B. \tag{2.9}$$

The first-order conditions of Equation (2.9) yield quantities $q_1^i(w) = [a^i - w]/2$. Given these quantities, the supplier sets the wholesale price, w, to solve:

$$\underset{w}{Max}\, wq_1^A(w) + wq_1^B(w) \Leftrightarrow \underset{w}{Max}\, w[a^A - w]/2 + w[a^B - w]/2. \tag{2.10}$$

The first-order condition of Equation (2.10) then yields the supplier's preferred wholesale price, $w^* = [a^A + a^B]/4$. Using w^* in $q_1^i(w)$ yields the quantities procured in equilibrium. Denoting the equilibrium firm profit under participation in both segments by Π^*, the realized firm profit is:

$$\begin{aligned}\Pi^* &= [a^A - q_1^A(w^*)]q_1^A(w^*) - w^* q_1^A(w^*) \\ &\quad + [a^B - q_1^B(w^*)]q_1^B(w^*) - w^* q_1^B(w^*) \\ &= [a^A]^2/16 + [a^B]^2/16 + 3[a^A - a^B]^2/32. \end{aligned} \tag{2.11}$$

A natural accounting task here is to determine what portion of firm profit in Equation (2.11) can be attributed to each segment. With independent markets, deriving segment profit is straightforward. The profit for segment i, denoted π^i, is $\pi^i = [a^i - q_1^i(w^*)]q_1^i(w^*) - w^* q_1^i(w^*) = [a^i]^2/16 + [a^i - a^j][5a^i - a^j]/64$, $i, j = A, B, i \neq j$.

Participation in Single Output Markets

When firm 1 participates only in output market i, the equilibrium is as follows. Given the wholesale price, the firm chooses its retail quantity by solving:

$$\underset{q_1^i}{Max}[a^i - q_1^i]q_1^i - wq_1^i. \tag{2.12}$$

The first-order condition of Equation (2.12) yields quantity of $q_1^i(w) = [a^i - w]/2$, precisely that in the multiple market case. In this case, however, the supplier sets the wholesale price, w, to solve:

$$\underset{w}{Max}\, wq_1^i(w) \Leftrightarrow \underset{w}{Max}\, w[a^i - w]/2. \tag{2.13}$$

The first-order condition of Equation (2.13) then yields the supplier's preferred wholesale price, $w^{i*} = a^i/2$, where the superscript i indicates participation only in market i. Denoting the equilibrium firm profit under participation in only segment i by Π^{i*}, the realized firm profit is:

$$\Pi^{i*} = [a^i - q_1^i(w^{i*})]q_1^i(w^{i*}) - w^{i*} q_1^i(w^{i*}) = [a^i]^2/16. \tag{2.14}$$

Segment Profit vs. Segment Value Added

As alluded to above, a key feature here is the complementarity that arises from having two segments together in one firm. By holding both segments, the firm essentially prevents the supplier from price discriminating at the market-level (it can only set input prices for the firm, not dictate in which markets the inputs are used). This means any price concessions offered due to a firm's presence in a less-efficient market are shared by both markets. Thus, the multi-segment complementarity that arises here is rooted in the broader phenomenon of efficiency from uniform pricing restrictions.[2] This complementarity is best seen here by comparing firm profit under participation in both segments and the equivalent profit of two separate firms each participating in one market each. Technically speaking, the complementarity can be inferred by comparing Π^* to $\Pi^{A*} + \Pi^{B*}$. This reveals $\Pi^* = \Pi^{A*} + \Pi^{B*} + 3[a^A - a^B]^2/32$. So long as the two markets are not identical (i.e., $a^A \neq a^B$), a supply-side complementarity arises. Without loss of generality, let's presume this complementarity arises due to segment A exhibiting higher retail demand (i.e., $a^A > a^B$).

The nature of this supply-side complementarity can also be seen by examining w^{i*} and w^*, where it is apparent that $w^* = w^{A*}/2 + w^{B*}/2$. With the wholesale price offered by the supplier reflecting the average price the supplier would have charged to two separate firms operating in separate segments, the multi-segment firm has a unique opportunity.

For a given wholesale price, the firm can direct its resources primarily toward the more attractive (i.e., more profitable) segment A. Yet, due to its involvement in multiple segments, the wholesale price is sticky in that it is tied to the average profitability of the segments. This creates a circumstance where the more profitable segment can become even more profitable (at the expense of the less profitable one becoming even less profitable) when both are under the auspices of one firm. This fact is evidenced by the boosted segment profit in the segment A

[2] Efficiencies from uniform pricing have been shown both in the context of final good markets (Robinson, 1933; Schmalensee, 1981; Layson, 1988) and input markets (Katz, 1987; Yoshida, 2000; Valletti, 2003).

relative to what would have been obtained had the segments been part of independent firms: $\pi^A - \Pi^{A*} = [a^A - a^B][5a^A - a^B] > 0$.

What remains to be seen is if and how this complementarity introduces biases in segment profit figures. To see this, we need only compare segment profit with the value added by that segment, i.e., the difference between firm profit with the segment and firm profit without the segment. The value added by segment $A(B)$, denoted $V^A(V^B)$, is $V^A = \Pi^* - \Pi^{B*} = [a^A]^2/16 + 3[a^A - a^B]^2/32$ ($V^B = \Pi^* - \Pi^{A*} = [a^B]^2/16 + 3[a^A - a^B]^2/32$). In each case, value added exceeds the value of the segment as part of an independent firm, $[a^A]^2/16$ ($[a^B]^2/16$), again reflecting the underlying complementarity. Comparing segment value added and the segment profit figure of the multi-segment firm reveals the following proposition.

Proposition 2.3. Segment i's value added can be expressed as $V^i = \pi^i + S^i + D^i$, where

$$\begin{aligned} S^i &= [w^{j*} - w^*]q_1^j(w^*) = [a^j - a^i][3a^j - a^i]/32, \quad \text{and} \\ D^i &= [a^j - q_1^j(w^*)]q_1^j(w^*) - w^{j*}q_1^j(w^*) \\ &\quad - [[a^j - q_1^j(w^{j*})]q_1^j(w^{j*}) - w^{j*}q_1^j(w^{j*})] \\ &= -[a^j - a^i]^2/64. \end{aligned}$$

Proposition 2.3 confirms that accounting segment profit as typically constituted (i.e., π^i) fails to reflect both a supply-side (S^i) and demand-side (D^i) spillover consequence of the firm's participation in multiple segments. The supply-side effect reflects that segment i's presence alters segment j's prevailing wholesale price. Given $3a^j - a^i > 0$, the sign of this effect is tied solely to $a^j - a^i$. If market i has lower retail demand than segment j, its presence helps create a latent supply-side subsidy to segment j. There is also a concomitant demand-side consequence: by affecting segment j's wholesale price, segment i influences the retail quantity selected in segment j. This adjustment in retail quantity reflects a demand-side cost of segment i. The key question is to determine the net consequence of these two effects and, thus, summarize the nature of the difference between segment profit and segment

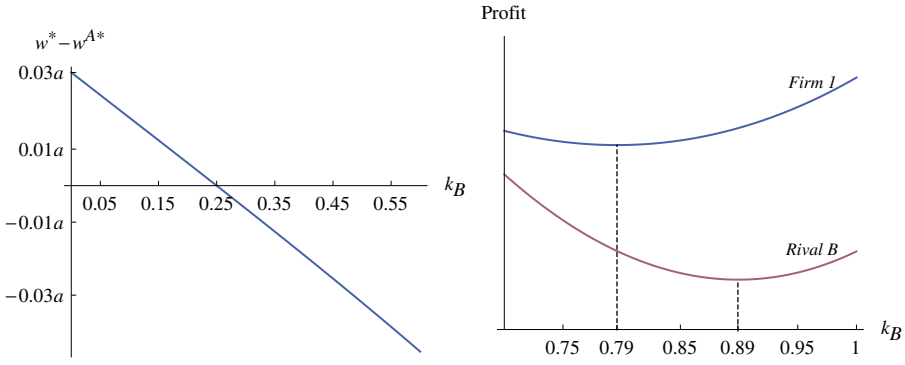
value added. This question is readily addressed by looking at the value of $S^i + D^i$. Simple algebra confirms the following proposition.

Proposition 2.4. Segment i's profit understates the value it provides if $a^i < a^j$ and overstates value if $a^j < a^i$.

A key thing to notice from the proposition is that despite having both demand-side and supply-side effects which are each unrecognized by accounting segment profit, the net direction of the latent effects is in the same direction as the supply-side effect, reflecting the prominent role of supply-side considerations. Further, the nature of this effect is that the underperforming segment is providing a latent cross-segment subsidy to the overperforming segment.

Admittedly, this result is demonstrated in a rather stark setup. This simplified version provides a crisp characterization of the underlying force at work. Similar results persist in a more general model with n separate markets, each of which can have different retail demand and different levels of competition (Arya and Mittendorf, 2010c). In that case, as in Proposition 2.3, the difference between a segment's value added and its profit can be decomposed into a supply-side effect and a demand side effect. And, again, the supply-side effect is prominent in determining the sign of the difference between segment profit and segment value added.

For illustration of these expanded results, consider the effect of different levels of competition in each segment. Denote the retail rival in market i by rival i, and say rival i provides its own inputs at zero cost. In this case, denote demand in market i by $p_1^i = a^i - q_1^i - k^i q_i^i$, where q_i^i is rival i's retail quantity and $k^i \in [0,1]$ is the degree of product substitutability — the greater k^i, the more intense retail competition. Given this, for the case of $a^A = a^B$, profit in segment B understates value added if and only if $k^B > k^A$. Essentially, with $k^B > k^A$, competitive pressures in market B help drive down the common wholesale price that governs activity in both markets. Interestingly, this subsidy can be large enough that the firm may even benefit from increased competition. To see this, say $k^A = 1/4$. In this case, Panel A of Figure 2.5 plots the difference in wholesale price when the firm serves both segments



Panel A

Wholesale price differential as k_B changes

Panel B

Firm and Rival B profit as k_B changes

Fig. 2.5 Pricing and profit effects as a function of competition.

(w^*) and when it serves only segment A (w^{A*}), confirming the notion that greater competition in segment B comes with the upside of a lower wholesale price.

Panel B of Figure 2.5 demonstrates that for $k^B > 0.79$ the beneficial aspect of lower wholesale price (realized in both segments) outweighs the negative consequences of increased competition in segment B. Not only that, but greater competition in segment B coupled with a lower wholesale price for both segments serves to shift the firm's production focus to segment A. As a consequence, when $k^B > 0.89$, even the rival in segment B, who gleans no direct wholesale price effects, benefits from additional competition.

When there are more than two markets, the supply-side and demand-side ramifications are spread among several segments. As for when segment profit understates a segment's value added, again a comparison of the market primitives reflecting whether the market in question has more or less profit potential than the others arises. In the case of several markets, this amounts to a comparison of the segment in question to the average of the other segments. Further, this comparison can be made by examining either the underlying parameters that characterize segment demand and competition, or, more apropos to accountants, by comparing the segment's (unit) contribution margin

to a weighted average of the contribution margins of the remaining segments. This basic notion also persists under price competition and different degrees to which the rivals rely on the supplier.

The supply-side benefit of seemingly underperforming segments has implications for a firm's decision to enter new markets. After all, many firms are harshly criticized for empire building when they expand their realm into other markets, many of which underperform relative to their core business. The expansion of dealerships to small rural markets by major American automakers is one prominent example. While such endeavors may seem, on the surface, to be indulgent and value destroying, the results here point to an upside. Further, the induced effect on input prices for the firm can justify entering markets despite negative segment profit that is gleaned from such entry. This may provide a more benign explanation for empire building tendencies of otherwise successful firms.

More broadly, these results demonstrate that even if product demand and long-term competitive posturing are not pressing considerations, a firm may nonetheless benefit from its less stellar retail performers. In particular, since less profitable markets (be they product lines or customer groups) solidify a firm's reluctance to accept markups in supplier pricing, a firm's active participation in such markets can help support lower input prices. Again, this is a viewpoint which cannot be appreciated without a full understanding of input market conditions and strategic considerations therein.

2.3 Implications for Industrial Organization

Though the focus here has been on complementing traditional views of strategy in downstream markets by considering strategy in upstream markets, this is not to say the two markets are independent. The more general version of the models utilized in Sections 2.1 and 2.2 each include output markets to consider if and how the joint consideration of input markets and output markets affects strategic posturing. In each case, the key effect of considering input markets is found to persist when output market strategy is also at play. It is worth noting that considering both input and output markets has ramifications beyond firm

organization to industrial organization more broadly. As demonstrated in this section, consideration of input markets can change traditional views of licensing to competitors (Section 2.3.1) and strategic make-or-buy decisions when rivals rely on a common supplier (Section 2.3.2).

2.3.1 Licensing to Competitors

When one speaks of strategic posturing in markets, a notably perplexing phenomenon is the prevalence of licensing to competitors. After all, if a firm seeks competitive advantage, why would it voluntarily spawn its own competition by providing access to inputs or technology that would be otherwise unavailable? This is a decision firms make frequently. In fact, licensing revenues are estimated to exceed $100 billion annually in the United States (Kline, 2003).

One reason that has been put forth for this common practice is that a patent holder may not have the wherewithal to produce a final good (or at least is less efficient than its rival in doing so) and decides to rely on licenses for a product to come to fruition. Similarly, for firms competing in differentiated markets, licensing a patent to a competitor may, in essence, be a means of reaching different consumers (e.g., Fauli-Oller and Sadonis, 2003). For firms who patent to direct competitors, licensing may be a means of promoting an "industry standard," discouraging innovation by competitors (Tirole, 2003), or driving out other entrants (Gallini, 1984).

A complementary explanation for this practice is derived herein by recognizing that patent holders are typically reliant on suppliers for at least a subset of required inputs in order to bring a final product to market. Given the reliance on external input supply, Arya and Mittendorf (2006b) show that a firm wishing to influence supplier pricing may choose to license its core technology to a competitor. Licensing does undermine a firm's monopoly position, but since the firm charges royalties to its new rival, the rival is more sensitive to supplier pricing than the firm. As a result, the supplier is compelled to lower prices for the competitor's sake, the benefit of which is partially extracted by the patent holder.

Of course, a patent holder's decision to weaken its inherent competitive edge also has ramifications for other firms. In particular,

the reduction in double marginalization in the input market brought about by lower supplier prices opens the door for Pareto improvements. Though the supplier is forced to charge lower prices, it also benefits from increased demand on two dimensions. First, its lowered pricing for the rival elicits a larger order from the rival. Second, the increased competition between the firm and the rival in the final product market increases the total demand for the good it supplies. The net effect is that the supplier gains from licensing. Of course, increased competition under licensing also implies that the consumers reap benefits in terms of lowered product prices. Finally, by receiving rights (but no obligation) to use a patent, the rival too benefits.

Such Pareto gains that stem from licensing suggest an additional consideration in the recurring debate over regulation of patents. In some circumstances, the downside of patents is not as severe as often suggested. A patent holder who is granted monopoly power through patent protection may find it useful to voluntarily give up some of this power. Thus, an intermediate point, one between exclusive rights and public domain, may be amenable to all parties and may naturally be a outcome even under the strongest patent protection.

To see the justification for licensing to rivals rooted in input market strategy, consider the following variant of the basic model we have been employing. The patent-holding firm (firm 1) again relies on the supplier for an input, and uses this input in a single output market. The firm also has the option to license its technology to another firm, firm 2, introducing an additional participant in the output market. Consumer demand in the output market is again represented by the (inverse) demand function $p = a - Q$, where p and Q are the price and the (total) quantity of the output, respectively.

If firm 1 opts to license its patented technology to firm 2, the two firms compete as Cournot rivals in the output market. In this case, the licensing arrangement stipulates a royalty fee: for each unit the rival makes, it pays the firm r. Like the firm, the rival too relies on the supplier for the intermediate good. In dealing with firm i, $i = 1, 2$, the supplier sets its per unit price w_i, and firm i responds by purchasing q_i units. Given this basic setting, we next derive the equilibrium outcomes under no licensing and licensing, respectively.

The Outcome Under No Licensing

By not issuing a license, the firm prevents any encroachment of its customer base. In the absence of the rival, the outcome in the firm-supplier game is straightforward to determine using backward induction. Given the supplier price w_1, the firm chooses q_1 to maximize its monopoly profit in the output (product) market. That is, the firm solves:

$$\underset{q_1}{Max}[a - q_1]q_1 - w_1 q_1. \tag{2.15}$$

The first-order condition of Equation (2.15) with respect to q_1 yields $q_1^N(w_1)$, the optimal supply of the product in the no-license case, where $q_1^N(w_1) = [a - w_1]/2$. Given this induced demand, the supplier chooses w_1 to maximize its profit, solving:

$$\underset{w_1}{Max}\, w_1 q_1^N(w_1) \Leftrightarrow \underset{w_1}{Max}\, w_1[a - w_1]/2. \tag{2.16}$$

The first-order condition of Equation (2.16) with respect to w_1 yields w_1^N, the optimal price set by the supplier for the input in the no-license case: $w_1^N = a/2$. Not surprisingly, the supplier sets its price above marginal cost (which, in this case, is zero), and the firm responds by procuring less than it would have had the supplier charged a price equal to its cost. This again is the familiar double marginalization problem — total supply chain profits are lower than if the supplier and the firm were vertically integrated. Substituting w_1^N into $q_1^N(w_1)$, and substituting each into Equations (2.15) and (2.16), yields the firm and supplier profits in the no-license setup, denoted Π_1^N and Π_S^N, respectively: $\Pi_1^N = a^2/16$ and $\Pi_S^N = a^2/8$. The other interested parties in this scenario are the consumers. Consumer surplus in the no-license case, CS^N, equals: $\int_0^{q_1^N(w_1^N)}[q_1^N(w_1^N) - q]dq = a^2/32$.

The Outcome Under Licensing

If the firm issues a license for its technology, it does so fully aware that it creates additional (retail) competition in the process. In fact, in this setting, the competition is severe in that from the consumers' standpoint, the final goods are perfect substitutes. While one may be tempted to conjecture that this move can only hurt the firm, such

a conclusion turns out to be hasty. The reason is that the issuance of a license, in conjunction with a judiciously chosen royalty fee, can influence the supplier's behavior. In effect, by creating a rival who is relatively weak due to the imposition of a nontrivial royalty rate, the firm creates a rival that naturally elicits better terms (pricing closer to marginal cost) from the supplier than its own. The same royalty fee then transfers some of these gains back to the licensing firm.

The above description may create the impression that the firm's benefit from licensing comes at the expense of the supplier. As it turns out, this too is not the case. The reason is that there is an offsetting factor that benefits the supplier: licensing also creates competition between the firm and the rival. Such competition yields total demand for the supplier's product that is higher than in the no-license case.

The two-fold effect of licensing, that it increases total demand in the final product market and reduces the problem of double marginalization in the intermediate good market, allows for an increase in productive efficiency and provides an opportunity for Pareto gains. Conveniently, the firm's optimal royalty rate that creates a weak buyer that commands lower supplier prices achieves gains not just for the firm but also ensures that the rival, the supplier, and the consumers all benefit from the issuance of the license. To confirm this, we examine the three party game — the strategic interactions between the supplier, firm, and rival — under licensing. For completeness, Figure 2.6 presents the sequence of events under licensing.

Again, we work backwards in the game, starting with the duopoly outcome given a royalty rate r and supplier prices w_1 and w_2. With

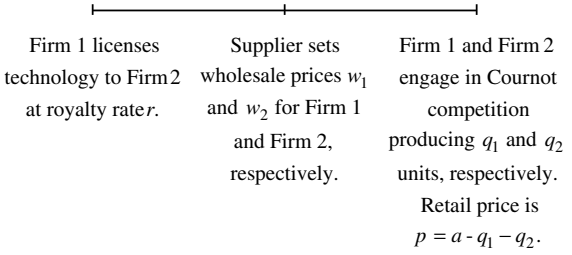


Fig. 2.6 Licensing.

rival production q_2, the firm chooses q_1 to maximize its profit in the output market. That is, the firm's competitive response function solves:

$$\underset{q_1}{Max}[a - q_1 - q_2]q_1 - w_1 q_1 + rq_2. \tag{2.17}$$

The firm's profit in Equation (2.17) mirrors that in Equation (2.15), except that retail competition (reflected in q_2) dampens price in the output market, and royalties (reflected in rq_2) generate profit. The first-order condition of Equation (2.17) with respect to q_1 yields the firm's supply of the product for a given level of rival supply: $q_1 = [a - w_1]/2 - q_2/2$. In a similar fashion, the rival's response function is obtained by solving:

$$\underset{q_2}{Max}[a - q_1 - q_2]q_2 - w_2 q_2 - rq_2. \tag{2.18}$$

The first-order condition of Equation (2.18) with respect to q_2 yields the rival's supply of the product for a given level of firm supply: $q_2 = [a - w_2 - r]/2 - q_1/2$. In effect, the rival internalizes the royalty rate as an added cost of production. Thus, higher royalty rates serve to cut production by the rival. Taking this thinking to the extreme, a high enough royalty rate will itself drive out competition. However, the firm may have reason not to go to such an extreme. Jointly solving the two firms' response function yields equilibrium quantities in the licensing case, $q_1^L(w_1, w_2, r)$ and $q_2^L(w_1, w_2, r)$, where: $q_1^L(w_1, w_2, r) = [a - 2w_1 + w_2 + r]/3$ and $q_2^L(w_1, w_2, r) = [a - 2(w_2 + r) + w_1]/3$. As one should expect, each firm's equilibrium quantity is decreasing in the price it pays to produce its output. For both firms, this cost includes the input price; for the rival, part of this cost also includes the royalty. This effect also reverberates on the outputs of the other, in that a higher price for the rival encourages the firm to increase its production, and vice-versa.

Given this competitive outcome, the supplier sets prices accordingly, solving:

$$\begin{aligned} &\underset{w_1,w_2}{Max}\, w_1 q_1^L(w_1, w_2, r) + w_2 q_2^L(w_1, w_2, r) \\ &\quad \Leftrightarrow \underset{w_1,w_2}{Max}\, w_1[a - 2w_1 + w_2 + r]/3 \\ &\qquad + w_2[a - 2(w_2 + r) + w_1]/3. \end{aligned} \tag{2.19}$$

The first-order conditions of Equation (2.19) with respect to w_1 and w_2 yield the supplier's prices with licensing, $w_1^L(r)$ and $w_2^L(r)$, where $w_1^L(r) = a/2$ and $w_2^L(r) = [a - r]/2$. While the input price offered to the firm is as before, the rival is able to secure a lower price due to the effect of r on its demand. Recognizing that the rival also has to make royalty payments to the firm, the supplier is induced to reduce the price charged to the rival so as to stabilize demand. Since the firm extracts some of the ensuing benefit to the rival (via r), it can indirectly profit from such softer pricing terms.

Given the equilibrium pricing arrangement, $w_1^L(r)$ and $w_2^L(r)$, and quantities $q_1^L(w_1^L(r), w_2^L(r), r)$ and $q_2^L(w_1^L(r), w_2^L(r), r)$, and substituting these into Equation (2.17) reveals the firm's equilibrium profit under licensing for a given royalty rate, $\Pi_1^L(r) = a^2/36 + r[8a - 11r]/36$. The firm's chosen royalty rate maximizes $\Pi_1^L(r)$, or $r^* = 4a/11$. Using r^* in $w_1^L(r)$, $w_2^L(r)$, $q_1^L(w_1^L(r), w_2^L(r), r)$, and $q_2^L(w_1^L(r), w_2^L(r), r)$ and substituting each into Equations (2.17), (2.18), and (2.19) yields firm, rival, and supplier profits in the license setting, denoted Π_1^L, Π_2^L, and Π_S^L, respectively: $\Pi_1^L = 3a^2/44$, $\Pi_2^L = a^2/484$, and $\Pi_S^L = 31a^2/242$. Finally, consumer surplus in the licensing case, CS^L, equals:

$$CS^L = \int_0^{q_1^L(\cdot)+q_2^L(\cdot)} [q_1^L(\cdot) + q_2^L(\cdot) - q]dq = 9a^2/242.$$

The Licensing Decision

In determining the firm's licensing choice and the equilibrium consequences thereof, a comparison of Π_1^N vs. Π_1^L, Π_S^N vs. Π_S^L, and CS^N vs. CS^L is key. The comparison yields the following proposition.

Proposition 2.5.

(i) The firm strictly prefers patent licensing; and
(ii) The firm's decision to license its patent benefits the firm, the (potential) rival, the supplier, and consumers alike.

As alluded to earlier, the key to Proposition 2.5(i) is the firm's ability to indirectly secure better pricing terms from the supplier — it

does so by creating a weak rival for the supplier to deal with, and then siphoning some of the gains via its royalty rate. If the rival is too strong (i.e., r is small), it does not elicit a generous supplier response, and provides steep retail competition. If the rival is too weak (i.e., r is large), it procures very little. The firm chooses r^* to avoid these extremes. In effect, a properly chosen r allows the firm to exert a degree of indirect monopsony power in its relationship with the supplier. Similar benefits also arise if the supplier is forced to charge the same uniform price to both firms. In such a case, the benefit of r is similar but more straightforward — by creating a weak buyer, the firm forces the supplier to offer the same moderated pricing terms to both parties.

The fact that the (potential) rival benefits from procuring the license is as expected since it now accesses a previously unreachable market. It is perhaps more of a surprise that satisfaction with the licensing arrangement also spills over to the supplier. Though licensing is used to solicit better terms from a supplier, this tactic for lower prices comes with the by-product of greater retail competition; the greater retail competition boosts wholesale demand enough that the supplier too is a willing conscript. Finally, the reduced wholesale prices coupled with greater retail competition each serve to grease the wheels of an otherwise inefficient economic chain, the benefits of which are also gleaned by consumers.

In Arya and Mittendorf (2006b), this basic premise is demonstrated to carry forward to cases of different demand elasticities, as well as other contractual arrangements. In particular, varying levels of retail (and, hence, induced wholesale) elasticity can alter the underlying demand but not the key effects nor the optimality of licensing. As for contractual form, the (joint) use of fixed and variable royalty arrangements in licensing contracts is shown to be preferred by the firm. Not only that, but the hybrid fixed and variable licensing arrangement is also the preferred contractual form for the supplier and consumers. In short, the notion that licensing can be justified on the grounds of easing supplier pricing (even if indirectly through the firm's de facto surrogate) is quite robust. As such, input price considerations may point to a key (and complementary) source of benefits from licensing. This may also add a wrinkle to the broader view of the long-term (i.e., innovation) benefits

and short-term (i.e., ex post monopolization) costs of patent protection. After all, if the ex post response to patent protection is to optimally "share the wealth", perhaps patents have a greater societal upside that conventional wisdom would suggest.

2.3.2 The Make-or-Buy Decision

Another topic that inextricably links accounting and industrial organization issues to input markets is the make-or-buy decision that almost all firms face and re-evaluate regularly. What is perhaps less recognized is that the decision about whether or not to outsource also has strategic elements rooted in the interaction between input and output markets. To elaborate, conventional wisdom suggests that the sourcing decision may simply be a matter of comparing internal production costs with the prices charged by external suppliers and picking the cheaper option. However, researchers have been quick to emphasize that the make-or-buy choice is much more delicate and depends on a variety of factors. In particular, the extant literature has examined the effects of long-term dynamics of supplier/buyer interactions (Demski, 1997) and the possibility of learning-by-doing (Anderson and Parker, 2002; Chen, 2005). The literature has also stressed practical considerations that may undercut outsourcing, including the need to maintain adequate input quality and the desire to avoid revealing proprietary information in outsourcing arrangements (Demski and Sappington, 1993; Chen et al., 2006). Furthermore, existing studies have noted that technology spillovers can advantage rivals under outsourcing (Van Long, 2005), cost structures can promote reciprocal outsourcing (Spiegel, 1993), and outsourcing to a common supplier can avoid redundant fixed costs (Shy and Stenbacka, 2003).

Recent work by Arya et al. (2008a) emphasizes that the interaction between output market competition and input market pricing may also complicate sourcing decisions. In particular, if a firm's primary rival relies on a supplier for inputs, that firm too may choose to rely on the same supplier even if doing so is more costly than internal production. This preference for outsourcing to a common supplier arises because it

can reduce the supplier's vested interest in the firm's competitor, and thereby induces the supplier to deliver the input to the rival on less favorable terms than if the rival were the supplier's sole customer.

Earlier work on strategic benefits of outsourcing focuses on settings where the input supply is not perfectly elastic. To illustrate, Salop and Scheffman (1983, 1987) consider a setting where retail producers face an upward-sloping supply curve for the input. This upward-sloping curve may reflect the rising marginal costs of competitive suppliers, for example. In that case, increased demand for the input increases the market price for the input by increasing the marginal cost of producing the input. The higher input price can increase the costs of rival retailers and thereby benefit the retailer that chooses to buy more than the cost-minimizing amount of the input. In a model with Cournot competition in both upstream and downstream markets, Schrader and Martin (1998) demonstrate the value of excessive outsourcing in order to reduce the market supply of a vital input that is available to downstream rivals, and thereby hinder the rival's retail operations. Buehler and Haucap (2006) show that outsourcing that increases production costs can be mutually profitable for downstream firms when the higher costs allow the firms to commit to less intense market competition.

The analysis in Arya et al. (2008a) complements these earlier works by considering strategic outsourcing in a setting where the input supplier produces with constant returns to scale and, crucially, has monopolistic pricing power and so can charge different prices to different input purchasers. In other words, the distinguishing feature of Arya et al. (2008a) is that there are strategic input market effects of the make-or-buy choice.

As with previous settings examined throughout the monograph, supplier power plays a key role. Since the input supplier has market power, a retail firm's decision to produce an input itself can cause the supplier to "play favorites" by reducing the input price it charges to its only customer, the retail rival. To preclude such rational favoritism by the monopoly supplier, a retail firm may be willing to buy the input from the common supplier, even at a price that exceeds the retail firm's unit cost of making the input itself. Thus, excessive outsourcing

that has been identified in settings with upward-sloping competitive input supply extends to settings in which an input supplier exercises market power.

Such supplier power may arise, for example, when local retailers enjoy some pricing power but are beholden to a large national supplier of a key product. One might think that the retailers in such a setting would be anxious to reduce their dependence on the dominant supplier by developing an alternate input supply. However, the converse may actually hold since reduced dependence on the dominant supplier can induce the supplier to offer the input to retail rivals on more favorable terms.

To see the basic idea, consider the following scenario. An incumbent firm faces a make-or-buy choice. For simplicity, say the supplier can again produce the input at a cost normalized to zero, whereas the cost of making for the incumbent (firm 1) is c. As before, the supplier sets its prevailing wholesale price to firm 1, w_1, after which the firm can choose whether to buy from the supplier or whether to take the steps necessary to be able to make the product (at cost c). Subsequently, the rival firm (firm 2) enters the market and the supplier quotes it a wholesale price for the input, w_2. (For simplicity, say the entrant does not have the option to make; more on this shortly.) Retail demand is again $p = a - Q$. The sequence of events is summarized in Figure 2.7.

Given this setting, we next address the equilibrium consequences of the make-or-buy decision. To do so, we first consider the equilibrium outcome in the event the firm chooses to make. We then detail the

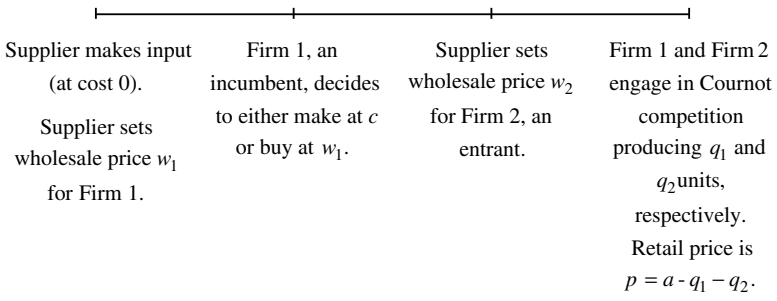


Fig. 2.7 Make vs. buy decision.

outcome under the buy regime. Finally, we address supplier pricing and the ultimate make-or-buy decision.

The Make Regime

Working backwards in the game, the quantity competition that arises between the firm and its rival in the make scenario involves firm 1 choosing q_1 to maximize its profit given its unit production cost, c, and the rival firm's production level, q_2, solving:

$$\underset{q_1}{Max}[a - q_1 - q_2]q_1 - cq_1. \tag{2.20}$$

Similarly, the rival, firm 2, chooses its quantity, taking its wholesale price, w_2 and firm 1's production level, q_1, as given. In particular, firm 2 solves:

$$\underset{q_2}{Max}[a - q_1 - q_2]q_2 - w_2q_2. \tag{2.21}$$

Jointly solving Equations (2.20) and (2.21) yields equilibrium quantities as a function of firm 2's wholesale price: $q_1(w_2) = [a - 2c + w_2]/3$ and $q_2(w_2) = [a - 2w_2 + c]/3$. With these outputs in mind, the supplier thus sets firm 2's wholesale price to maximize its profit:

$$\underset{w_2}{Max}\ w_2q_2(w_2) \Leftrightarrow \underset{w_2}{Max}\ w_2[a - 2w_2 + c]/3. \tag{2.22}$$

Solving Equation (2.22) yields the equilibrium wholesale price for firm 2 in the make regime (as indicated by the "M" superscript): $w_2^M = [a + c]/4$. As one would expect, the greater the retail demand for the entrant (the higher a), the more the supplier can and does charge for its input. Also, the greater the incumbent's production cost, the more the supplier charges the entrant. This effect is due to the supplier's natural desire to keep its customer (here, only the entrant) in a favorable competitive position relative to the incumbent. If the incumbent is very efficient (low c), it will extract much of the retail profit, leaving the entrant (the supplier's de facto partner) with little gains. In this case, if the supplier responds to incumbent efficiencies with wholesale price cuts for the entrant, the entrant purchases more from the supplier. It is this de facto partnership which plays a critical role in the incumbent's make-or-buy choice.

Substituting the equilibrium wholesale price into $q_1(w_2)$ and $q_2(w_2)$ yields equilibrium retail quantities in the make regime, denoted q_1^M and q_2^M, where $q_1^M = q_1(w_2^M) = [5a - 7c]/12$ and $q_2^M = q_2(w_2^M) = [a + c]/6$. Substituting these values into Equations (2.20), (2.21), and (2.22) yields equilibrium profits in the make regime for the incumbent, entrant, and supplier, respectively: $\Pi_1^M = [5a - 7c]^2/144$, $\Pi_2^M = [a + c]^2/36$, and $\Pi_S^M = [a + c]^2/24$. Given this, we now derive the outcome when the incumbent opts to outsource.

The Buy Regime

Presuming the incumbent agrees to buy at unit price w_1 (in lieu of making), it chooses q_1 to solve:

$$\underset{q_1}{Max}[a - q_1 - q_2]q_1 - w_1 q_1. \tag{2.23}$$

Again, the entrant chooses its quantity as in Equation (2.21). Jointly solving Equations (2.21) and (2.23) yields equilibrium quantities as a function of the prevailing wholesale prices: $q_1(w_1, w_2) = [a - 2w_1 + w_2]/3$ and $q_2(w_1, w_2) = [a - 2w_2 + w_1]/3$. With the incumbent's buy decision secured (and its wholesale price finalized in the process), the supplier sets the entrant's wholesale price to maximize its profit:

$$\begin{aligned} &\underset{w_2}{Max}\, w_1 q_1(w_1, w_2) + w_2 q_2(w_1, w_2) \\ &\quad \Leftrightarrow \underset{w_2}{Max}\, w_1[a - 2w_1 + w_2]/3 \\ &\qquad + w_2[a - 2w_2 + w_1]/3. \end{aligned} \tag{2.24}$$

Solving Equation (2.24) yields the equilibrium wholesale price for the entrant in the buy regime (as indicated by the "B" superscript): $w_2^B = [a + 2w_1]/4$. As in the make regime, greater retail demand again translates into a greater wholesale price. Also, the greater the incumbent's input cost (now w_1), the more the supplier charges the entrant. In this case, the effect of the incumbent's cost is greater $\left(\frac{dw_2^B}{dw_1} = 1/2\right.$ vs. $\left.\frac{dw_2^M}{dc} = 1/4\right)$, because the cost itself is extracted by the supplier. Thus, if firm 1's cost (w_1) is unusually high, not only can the supplier increase w_2 without losing out on firm 2 purchases excessively, but it

can increase w_2 further so as to shift purchases to its high-margin customer, firm 1. This desire to balance its wholesale profits among its two customers translates into a different pricing incentive for the supplier relative to the make case, wherein the supplier is concerned only with firm 2's success.

Substituting the wholesale price w_2^B into $q_1(w_1, w_2)$ and $q_2(w_1, w_2)$ yields equilibrium retail quantities in the buy regime, denoted $q_1^B(w_1)$ and $q_2^B(w_1)$. Substituting these values into profits in Equations (2.23), (2.21), and (2.24) yields equilibrium profits in the buy regime for the incumbent, entrant, and supplier, respectively: $\Pi_1^B(w_1) = [5a - 6w_1]^2/144$, $\Pi_2^B(w_1) = a^2/36$, and $\Pi_S^B(w_1) = a^2/24 + w_1[a - w_1]/2$. Given the outcomes in each regime, we now consider when the incumbent opts to buy, and what price the supplier opts to charge.

The Make-or-Buy Choice

The conventional view of the firm's make-or-buy choice is that it would never pay more to buy the input than the cost of making it internally. However, if one compares $\Pi_1^B(w_1)$ and Π_1^M, a slightly different picture emerges. In particular, comparing firm 1 profit in each case confirms that the firm will opt to buy from the supplier if and only if $w_1 \leq 7c/6$. Presuming the supplier is the least-cost producer of the input (i.e., $c > 0$), firm 1 is willing to pay more than its internal cost of production to buy the input from the supplier. The premium firm 1 is willing to pay in order to buy is due to the advantage it secures from subsequent competition with firm 2. This advantage arises because firm 1's decision to buy the input creates an opportunity cost for the supplier in providing inputs to firm 2: now, the supplier foregoes profit when retail successes by firm 2 reduce firm 1's retail output. It is this opportunity cost of selling inputs to firm 2 which entices the supplier to increase firm 2's wholesale price. Formally, the difference between firm 2's input price in the buy regime and the make regime is $w_2^B - w_2^M = [2w_1 - c]/4$. Thus, if the supplier sells its input to firm 1 at the firm's cost ($w_1 = c$), firm 2's input price in the buy regime will be greater than that in the make regime by $c/4$. Because firm 1's equilibrium

profit increases as firm 2's cost increases, then, firm 1 is willing to pay beyond its own production cost in order to buy the input from the (more efficient) supplier.

Note, however, if the supplier is the less efficient producer, the result is the reverse in that firm 1's willingness to pay is below its cost. Intuitively, in this case, if the supplier sells its input to firm 1 at the firm's cost, the supplier incurs a loss for each unit procured by firm 1. In that event, the supplier has even more incentives for firm 2 to succeed and, thus, becomes an even stronger partner for firm 2 when firm 1 opts to buy.

Though firm 1 is willing to pay up to $7c/6$ for the input, that does not mean the supplier is guaranteed to charge that amount. In fact, a particularly efficient supplier may seek to set a price below this to best balance purchase quantities among firms 1 and 2. In particular, if firm 1 were guaranteed to buy, maximizing $\Pi_S^B(w_1)$ reveals that the profit-maximizing input price for the supplier is $w_1 = a/2$. Thus, if this price is itself lower than the maximum willingness to pay, $7c/6$, i.e., if $c \geq 3a/7$, it will be the supplier's equilibrium price. Otherwise, the supplier is restricted to charge $7c/6$ if it wants to attract firm 1. Comparing $\Pi_S^B(7c/6)$ and Π_S^M then reveals when the supplier actually seeks to attract firm 1. This exercise yields the following proposition.

Proposition 2.6.

(i) With $c > 0$, firm 1 buys the input.
(ii) If $0 < c < 3a/7$, firm 1 pays unit price $w_1 = 7c/6$.
(iii) If $c \geq 3a/7$, firm 1 pays unit price $w_1 = a/2$.

In Proposition 2.6(i), despite strategic elements in play, the more efficient (lower cost) producer makes the input in equilibrium. As confirmed in Arya et al. (2008a), this feature persists more generally, when both firm 1 and the supplier have nonzero costs of production, if firm and firm 2 produce differentiated retail products, and/or if the retail

market is characterized by price competition. That is, in each case, the incumbent firm may be willing to pay more than its in-house production cost to buy the input, but only if the supplier is actually the more efficient producer of the input in the first place. This result suggests that despite the myriad strategic forces that can influence sourcing decisions, firms may arrive at socially efficient sourcing choices even in the absence of regulatory guidance.

Another issue worth noting in this vein is that it was presumed that the incumbent firm's sourcing decision is made prior to the entrant's wholesale price being established. This played a critical role, since the sourcing decision itself was made in large part to influence the subsequent price charged to the entrant. Also as confirmed in Arya et al. (2008a), the presumed sequence was not made haphazardly. Instead, it is in the supplier's interest to refrain from setting (or at least finalizing) firm 2's price, w_2, until after firm 1's sourcing decision has been confirmed. The reason for this is that the supplier can use the threat of price cuts to firm 2 to get the most from firm 1. That is, not only are strategic considerations critical to the sourcing decision, but they also play a key role in the sequencing of behavior in industries (more on this theme in Section 3.3).

While we present the basic force here that a firm's sourcing decision may deviate from the usual cost comparisons due to a desire to influence prices charged to others in the simplest possible form, the theme is further extended in Arya et al. (2008a). In particular, when a firm can opt to outsource a fraction of its inputs (i.e., both make and buy), a similar strategic premium in sourcing arises. The key forces also arise when both the incumbent and entrant firms have symmetric make-or-buy choices. In that case, firm 2's ability to make the input itself puts natural downward pressure on the wholesale price charged to firm 2. Nonetheless, firm 1's sourcing decision continues to influence the prevailing price for firm 2 and, thus, a strategic element to the make-or-buy choice remains. This also creates a demand for the firms to buy from a common supplier in that both firms seek not only a source of inputs but also seek to influence the treatment provided to their rivals. Buying from the same supplier as their rivals presents a natural opportunity to do so.

Finally, we note that the strategic aspect of the make-or-buy decision can also extend to influence the number and characteristics of the firms that make up an industry. In particular, a firm's decision to buy from a particular supplier can influence the prevailing wholesale prices charged to subsequent entrants to such a degree that firms are wary to enter an industry. As such, while one may be tempted to think a vertically integrated firm that relies entirely on in-house technologies to produce is best suited to maintain control over an industry, it turns out a firm seeking to solidify its power in an industry may actually seek out external inputs. Doing this creates captive suppliers who will not actively seek to prop up potential entrants, since the entrants cannot offer them much more than the incumbent. If, on the other hand, suppliers are kept at bay by the incumbent firm, the same suppliers may seek out potential entrants so as to get a toe-hold in the market, and do so at the expense of the incumbent.

Taken together, the results in this setting and throughout Section 2 present the common theme that a firm who is a seller in an output market not only has substantial strategic considerations in that market, but such considerations may be complicated when it also relies on inputs from an external (and self-interested) party. Such reliance on strategic suppliers for inputs can influence the way we view organizational form, transfer pricing, segment and market profit analysis, and the way in which industries form and evolve. As we next demonstrate in Section 3, many of these same types of considerations arise (though in quite different ways) when an output market participant also serves as a supplier in input markets.

3

Organizational Design When a Firm is a Seller in Input Markets

This section presents a synthesis of research that examines consequences of an output market participant also being a seller in input markets. This consideration is much more than a theoretical construct — it is a practical reality. Soft-drink producers, cereal manufacturers, and gasoline refiners have long supplied key inputs both to their downstream affiliates and to retail competitors. Additionally, manufacturers routinely sell items through traditional retailers, their own outlets, and catalog sales. In retailing arrangements, company-owned stores are often located proximate to independent franchises. In the telecommunications industry, cable, Internet, and phone providers are actively engaged in buying and selling capacity both to their own affiliates and to unaffiliated rivals. And so on. Despite their ubiquity for many years, such supply arrangements have become even more prominent in recent years due to the presence of online sales arms affiliated with manufacturers who also sell through independent retail outlets (e.g., Tedeschi, 2005).

Given the prominence of circumstances where output sellers are also input sellers, it is comforting to note that research on organizational

structure in light of this industrial structure has taken root. Here, we bring together some of the implications for this research in the realm of organizational structure. In particular, we first revisit transfer pricing considerations. Then, we discuss issues of segment profitability measurement. Finally, we conclude the section by examining implications of input market participation for traditional views of industrial organization.

3.1 Decentralization and Transfer Pricing

As first discussed in detail in Section 2.1, decentralized firms routinely exhibit friction brought to the forefront by transfer pricing. In particular, a parent's upstream division (affiliate) excessively charges the parent's downstream division who, in response, underprocures inputs. These inefficiencies wrought by transfer pricing form the basis for calls for centralized planning or the use of marginal-cost transfer prices. Yet, delegated forms of transfer pricing and above-marginal cost prices persist, and even flourish. As in Section 2.1, we next show how input market participation by a retail firm can provide one justification for such practices.

The modeling change is on the practical aspect missing in typical analyses of efficient transfer prices: the fact that upstream affiliates often are also suppliers to rivals of downstream affiliates. While this issue would seemingly only exacerbate coordination issues, Arya et al. (2008c) demonstrate that frictions in decentralized entities can actually prove helpful. To elaborate, we label a firm that makes inputs, and provides them to its own downstream affiliate as well as the affiliate's output market rivals as a "vertically integrated producer" (VIP). VIPs often find themselves unable to resist the ex post temptation to encroach excessively on their wholesale (input market) customers' retail (output market) business. With such behavior imminent, the wholesale customer requires substantial concessions ex ante to purchase inputs.

A decentralized structure where transfer pricing is a prominent consideration alters the landscape. When related party transfer prices reside above the producer's marginal cost, the parent firm is able to convey less aggressive retail encroachment which, in turn, engenders higher

wholesale prices. Decentralization comes with a downside, no doubt. It imposes costs consistent with the traditional view that are manifest in the retail realm: the retail affiliate's market share is reduced by excessive prices, while the unaffiliated rival's market share is expanded. Despite this downside, the boost in wholesale profitability brought by decentralization can outweigh these costs for the VIP.

While we first demonstrate these effects of decentralization for transfer prices set by an omniscient planner, we then extend the setting to address the case in which the upstream and downstream entities themselves determine the appropriate pricing via negotiation. The results indicate that as long as neither of the affiliated parties is too influential in setting prices, a decentralized structure is preferred. Further, when negotiations are set so that the parties each have proper negotiating power, ceding control of all decisions to the separate affiliates can replicate the parent's preferred arrangement.

These results build upon the literatures on dual distribution and strategic decentralization. Extant work has emphasized that dual distribution (i.e., VIP) arrangements, wherein a manufacturer provides inputs to a downstream competitor, stand to offer benefits of better reaching heterogeneous consumers, effectively monitoring independent distributors, and signaling product profitability (Gallini and Lutz, 1992; Dutta et al., 1995; Vinhas and Anderson, 2005). However, the downside of dual distribution arrangements lies in concerns of excessive supplier encroachment and the related inability to "direct traffic" in the channel (Kalnins, 2004; Vinhas and Anderson, 2005). The setting presented here demonstrates that the concerns of dual distribution can be minimized by a degree of related party conflict associated with decentralization and transfer pricing.

To this end, the premise behind the benefits of decentralization identified here relates to those in the literature on strategic delegation (e.g., Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987) and, in particular, strategic transfer pricing (e.g., Alles and Datar, 1998; Goex and Schiller, 2006). As discussed previously, that literature has examined benefits of a central planner ceding control to its affiliates and the role of transfer prices that deviate from marginal cost on downstream competitive interactions. In the context of the Cournot model studied herein,

such analyses would advocate transfer prices below marginal cost so as to convey a strong competitive posture in retail markets. In contrast, we demonstrate that when the rival is also a wholesale customer, the parent opts to erode retail profits via transfer prices above marginal cost in order to boost wholesale profits. This dichotomy speaks volumes about the importance of input market participation on the role of transfer pricing in decentralized organizations.

Finally, we note that the result presented here also connects to the literature on transfer pricing for inputs which are also sold in imperfect external markets. Most notably, Baldenius and Reichelstein (2006) demonstrate that eliminating distortions in intra-company trade entails offering related-party discounts. In the present analysis, we consider the case in which the input sold externally ends up in competition with the input transferred internally. In such a circumstance, it is demonstrated that while eliminating distortions is not preferred, related-party discounts can still arise.

To put some structure on the discussion, consider the following simplified model. A vertically integrated producer (VIP), again denoted firm 1, consists of two entities, an upstream subsidiary and a downstream subsidiary. The upstream subsidiary is the sole supplier of a key input to the downstream subsidiary as well as an independent downstream rival (firm 2). The two downstream parties engage in (Cournot) competition in the final good market. The inverse demand function for the final good produced by firm i is $p_i = a - q_i - kq_j, i, j = 1, 2, i \neq j$, where p_i denotes the retail price for firm i's good, and q_i and q_j denote the product quantities of firms i and j, respectively. The parameter $k \in (0, 1)$ represents the degree of substitution among the competing products, where the limiting values of $k = 0$ and $k = 1$ correspond to the cases of independent products and perfect substitutes, respectively. Each unit of the final product for each firm requires one unit of the upstream subsidiary's input. For simplicity, the input production cost and each firm's selling cost are zero. With this basic setting, we will compare the outcomes under centralization and decentralization, as well as investigate the preferred transfer pricing arrangement. The ensuing analysis employs backward induction to identify the (subgame perfect) equilibria.

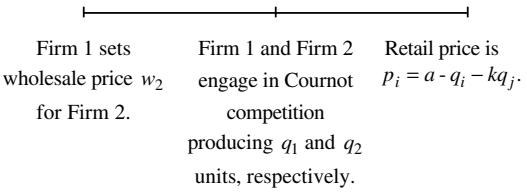


Fig. 3.1 Timeline under centralized production.

Centralization

With centralized planning by the VIP, the sequence of events is as follows. First, the VIP establishes its per-unit (wholesale) price for firm 2, denoted w_2. Second, the VIP and firm 2 simultaneously choose retail quantities for their products, after which demand and profits are realized. This sequence of events is summarized in Figure 3.1.

In the centralized regime, the VIP chooses its retail quantity, q_1, to maximize firm-wide profit, denoted $\Pi(q_1, q_2, w_2)$, given firm 2's chosen retail quantity, q_2, and the stated wholesale price, w_2. Formally, the VIP's problem is:

$$\underset{q_1}{Max}\ \Pi(q_1, q_2, w_2) \Leftrightarrow \underset{q_1}{Max}\ w_2 q_2 + [a - q_1 - kq_2]q_1. \tag{3.1}$$

In $\Pi(q_1, q_2, w_2)$ from Equation (3.1), the first term, $w_2 q_2$, reflects the VIP's wholesale profit, while the second term, $[a - q_1 - kq_2]q_1$, reflects its retail profit. Notice that the VIP's choice of q_1 in Equation (3.1) is made with an eye only on retail profit. That is, the VIP takes wholesale profit as given (i.e., w_2 and q_2 as given) when choosing its retail output. As we will see shortly, this feature of ex post behavior under centralization can make it unappealing ex ante.

In a similar way, given input price, w_2, and the VIP's chosen quantity, q_1, firm 2 chooses retail quantity q_2 to maximize its profit, or:

$$\underset{q_2}{Max}[a - q_2 - kq_1]q_2 - w_2 q_2. \tag{3.2}$$

Solving the first-order conditions associated with Equations (3.1) and (3.2) jointly yields equilibrium quantities as a function of the wholesale price in the centralized regime (indicated by the superscript C): $q_1^C(w_2) = \frac{a[2-k]+kw_2}{4-k^2}$ and $q_2^C(w_2) = \frac{a[2-k]-2w_2}{4-k^2}$. Note, each firm's retail

quantity is increasing in product demand. Further, the VIP's (firm 2's) quantity is increasing (decreasing) in the wholesale price charged to firm 2. Intuitively, the VIP's (firm 2's) retail competitive position is strengthened (weakened) by an increase in firm 2's input cost. However, due to product differentiation, firm 2 can still sell to customers outside the VIP's reach. This means the VIP may opt not to foreclose its rival but instead seek profits both in the retail and wholesale arenas. More precisely, the VIP's wholesale pricing problem, which seeks to maximize the sum of wholesale and retail profits, is as follows:

$$\underset{w_2}{Max}\, \Pi(q_1^C(w_2), q_2^C(w_2), w_2). \tag{3.3}$$

Solving the first-order condition of Equation (3.3) and then substituting the ensuing wholesale price into quantities $q_1^C(w_2)$ and $q_2^C(w_2)$ and profit in Equation (3.3) yields the equilibrium outcome under centralization: $w_2^C = \frac{a[8-4k^2+k^3]}{2[8-3k^2]}$; $q_1^C = \frac{a[2-k][4+k]}{2[8-3k^2]}$; $q_2^C = \frac{2a[1-k]}{[8-3k^2]}$; and $\Pi^C = \frac{a^2[6-k][2-k]}{4[8-3k^2]}$.

The equilibrium outcomes make clear the need to model imperfect retail substitutability ($k < 1$), as this creates a scenario where the VIP opts not to foreclose the rival and thus captures nontrivial participation in both wholesale and retail markets. In other words, with imperfect substitutes, firm 1's joint participation as an input provider and output provider is endogenous. As we next consider, the extent of the firm's profitability in each of its markets is altered under decentralization.

Decentralization

With decentralized production, the VIP relies on its downstream subsidiary to determine production, thereby creating a scenario where the transfer price which governs intra-company trade plays a critical role. In this case, the sequence of events is as follows. First, the VIP establishes the wholesale price for firm 2, w_2, and the intra-company transfer price, denoted w_1. Second, the downstream subsidiary (division) and firm 2 simultaneously choose retail quantities for their products to maximize their respective entities' profits. Finally, consumer demand and entity profits are realized. This sequence of events is summarized in Figure 3.2.

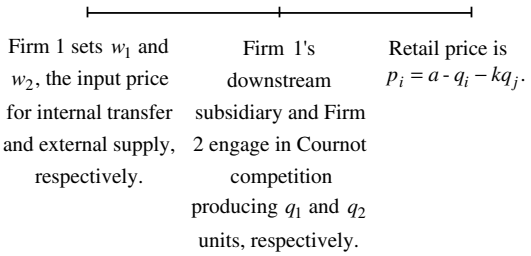


Fig. 3.2 Timeline under decentralized production.

Under the decentralized regime, firm 2's retail decision is again as in Equation (3.2). The downstream subsidiary chooses its quantity, q_1, to maximize its profit, denoted $\tilde{\Pi}(q_1, q_2, w_1, w_2)$, given firm 2's chosen quantity, q_2, and input prices, w_1 and w_2 (the "$\sim$" indicates that it is the downstream division's, not the VIP's, profit).

$$\underset{q_1}{Max}\, \tilde{\Pi}(q_1, q_2, w_1, w_2) \Leftrightarrow \underset{q_1}{Max}[a - q_1 - kq_2]q_1 - w_1 q_1. \tag{3.4}$$

Solving the first-order conditions associated with Equations (3.2) and (3.4) jointly yields equilibrium quantities as a function of the wholesale price and transfer price in the decentralized regime (indicated by the superscript D): $q_1^D(w_1, w_2) = \frac{a[2-k]-2w_1+kw_2}{4-k^2}$ and $q_2^D(w_1, w_2) = \frac{a[2-k]-2w_2+kw_1}{4-k^2}$. Comparing $q_1^C(w_2)$ and $q_1^D(w_1, w_2)$, one can readily confirm that marginal cost transfer pricing ($w_1 = 0$) permits decentralization to replicate centralization, consistent with the typical view. And, as w_1 increases, the VIP's production is reduced while firm 2's production is increased, reflecting that the VIP's downstream division internalizes higher transfer costs which, in turn, emboldens the rival firm 2. Given this induced demand, the VIP's input pricing problem is:

$$\underset{w_1, w_2}{Max}\, \Pi(q_1^D(w_1, w_2), q_2^D(w_1, w_2), w_2). \tag{3.5}$$

Solving the first-order conditions of Equation (3.5) and then substituting the ensuing input prices into quantities and profit in Equation (3.5) provides the equilibrium outcome under decentralization: $w_1^D = \frac{a[1-k]k}{2[2-k^2]}$; $w_2^D = \frac{a}{2}$; $q_1^D = \frac{a[2-k]}{2[2-k^2]}$; $q_2^D = \frac{a[1-k]}{2[2-k^2]}$; and $\Pi^D = \frac{a^2[3-2k]}{4[2-k^2]}$.

Given the equilibrium outcomes in each regime, we next compare centralization to decentralization.

Centralization vs. Decentralization

The standard view is that a ceiling on decentralized profit is the profit which can be achieved by centralized decision making. This view is manifest in, for example, textbook prescriptions of marginal-cost transfer pricing to alleviate attendant production distortions. In the case of a VIP selling products to a retail rival, however, a new consideration arises. With centralized decision making, the VIP rationally ignores wholesale profit when choosing retail output. Knowing this will be the case down the line, the rival expects intense competition from its supplier and thus procures fewer inputs for a given wholesale price. The VIP's only remedy to this ex post retail aggression is to offer wholesale price concessions to its input market customer ex ante.

Decentralization presents an avenue through which the firm can convey a less-aggressive posture ex post and, thereby, rely less on drastic wholesale price cuts. In particular, with a transfer price above marginal cost, the VIP conveys to its wholesale customer that its downstream affiliate will be less aggressive in retail competition, thereby boosting its wholesale customer's demand.

Despite the boost in wholesale profit, this feature still comes with the traditional downside of high transfer prices in the retail realm. In particular, the VIP's equilibrium *retail* profit in regime i, $i = C, D$, is: $\Pi^{Ri} = [a - q_1^i - kq_2^i]q_1^i$. And, comparing retail profit across regimes yields: $\Pi^{RD} - \Pi^{RC} = -\frac{a^2k^2[2-k][1-k][4+2k-k^2]}{4[2-k^2][8-3k^2]^2} < 0$. Clearly, then, decentralization with transfer prices above marginal cost imposes a strict loss in retail profit. However, the offsetting tension, which is missing in typical discussion of transfer pricing, resides in the wholesale realm. The lower retail output by the firm and the concomitant surge in retail output by the rival stand to increase the VIP's wholesale profit. Further, by convincing the rival that the VIP will take a less aggressive competitive posture, decentralization permits a higher wholesale price. Thus, in the wholesale market, decentralization affords two benefits: both higher prices and more purchases. The result is a strong boost in wholesale profit. More precisely, the VIP's equilibrium *wholesale* profit in regime i is: $\Pi^{Wi} = w_2^i q_2^i$. And, comparing wholesale profit across regimes yields: $\Pi^{WD} - \Pi^{WC} = \frac{a^2k^2[1-k][16-8k-7k^2+4k^3]}{4[2-k^2][8-3k^2]^2} > 0$. Given the

multiple ramifications of decentralization, its net effect remains to be seen. Mathematically, this is determined by comparing VIP profits in each regime. This exercise, coupled with a comparison of other relevant equilibrium outcomes is presented in the next proposition.

Proposition 3.1.

(i) The transfer price under decentralization is set above marginal cost, i.e., $w_1^D > 0$.
(ii) The firm's retail output is lower under decentralization, i.e., $q_1^D < q_1^C$.
(iii) The rival's retail output is higher under decentralization, i.e., $q_2^D > q_2^C$.
(iv) The wholesale price is higher under decentralization, i.e., $w_2^D > w_2^C$.
(v) VIP profit is higher under decentralization than under centralization.

Intuitively, the preference for decentralization in Proposition 3.1(v) can be inferred from the fact that the VIP intentionally deviates from marginal-cost transfer pricing as in Proposition 3.1(i). That is, since marginal-cost transfer pricing can replicate centralization, the fact that the VIP prefers a higher transfer price indicates that the potential gains (at the margin) in the wholesale market exceed the potential losses in the retail market. In fact, $0 < w_1^D < w_2^D$, indicating that the optimal balancing of the two markets entails transfer pricing above marginal cost, but there still is preferential pricing provided to the affiliated party.

Recall, at the extreme case of $k = 1$, the VIP opts to foreclose its rival and serves only the retail market under both centralization and decentralization. Further, at the other extreme of $k = 0$, the VIP and firm 2 are not retail competitors and thus the two markets separate, again leading to identical outcomes under centralization and decentralization. However, for $0 < k < 1$, decentralization results in the higher wholesale profit, lower retail profit, and higher overall profit as detailed

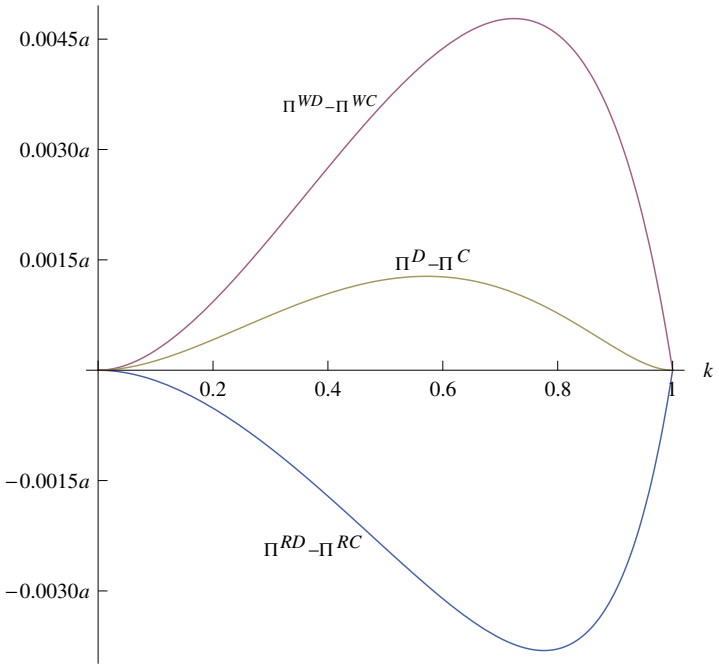


Fig. 3.3 Wholesale, retail, and total profit as a function of k.

in Proposition 3.1. These features of the setting are presented pictorially in Figure 3.3.

Broadly speaking, the reason decentralization proves helpful mirrors that in other settings of strategic delegation: decentralization engenders a decision maker whose priorities differ from those of the firm which, in turn, convinces a strategic party that the firm will take a certain course of action. In other manifestations of strategic delegation (e.g., Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987) and strategic transfer pricing (e.g., Alles and Datar, 1998; Goex and Schiller, 2006), the firm seeks to convey a certain posture in retail markets so as to increase profits in such markets. In this instance, however, the posture conveyed in the retail market is to the detriment in that market and only useful for its ramifications in the wholesale market.

More specifically, in the standard strategic delegation literature, a firm seeks an aggressive retail arm when facing Cournot competition.

Thus, a commonly noted friction under decentralization — internal pricing above marginal cost — makes the outcome particularly undesirable for the firm. In contrast, when the firm seeks to balance its interests in multiple markets (here, wholesale and retail), pricing above marginal cost is precisely the kind of friction that aids the firm in softening its retail market stance. Decentralization permits the VIP to convince its wholesale customer that it will not wile away its customer's retail profitability by encroaching excessively. This, in turn, boosts the customer's wholesale demand and its willingness to pay.

In the above analysis, the optimality of decentralization is derived in an environment in which the VIP is able to determine transfer prices that govern related party trade and is privy to relevant information in doing so. Given that decentralized organizations are often characterized by central offices which lack key information or the logistical ability to establish prevailing prices, we next revisit the outcomes when decentralization entails handing control over input pricing to the subsidiaries. To reflect pricing decisions made by the two subsidiaries, we employ the standard (constrained) Nash bargaining solution, generalized to (possibly) asymmetric bargaining power (e.g., Myerson, 1991). The negotiation is constrained in that the parties bargain only over the prevailing transfer price, not subsequent strategic decisions. Besides allowing an axiomatic representation of outcomes when parties bargain over a decision, this approach is commonly employed because it also allows for a tractable characterization of equilibria without requiring an explicit representation of the specific bargaining process. In particular, denoting the upstream division's profit by $\hat{\Pi}(q_1, q_2, w_1, w_2) \equiv w_1 q_1 + w_2 q_2$, the chosen input prices are the outcome of a bargaining process that solves the generalized Nash product of the two subsidiaries' profits, taking into account the ensuing effects in the retail market:

$$\underset{w_1,w_2}{Max}[\tilde{\Pi}(q_1^D(w_1,w_2), q_2^D(w_1,w_2), w_1, w_2)]^{\beta} \times [\hat{\Pi}(q_1^D(w_1,w_2), q_2^D(w_1,w_2), w_1, w_2)]^{1-\beta}. \tag{3.6}$$

In Equation (3.6), $\beta \in (0,1)$ reflects the relative influence (bargaining power) of the downstream affiliate in setting input prices. The first-order conditions of Equation (3.6) reveal the chosen input prices in

the case of negotiated pricing, denoted $w_1^N(\beta)$ and $w_2^N(\beta)$ (the superscript reflects the *negotiated* outcome). As one can expect, $w_1^N(\beta)$ is decreasing in β, reflecting the fact that the downstream division prefers a relatively low transfer price to boost its retail profitability, whereas the upstream division prefers a relatively high transfer price to boost its profitability from related-party sales. Recall, decentralization is useful when a modest transfer price (i.e., one above but not too far above marginal cost) is in place so as to balance the VIP's priorities in the wholesale and retail markets. Thus, as long as neither subsidiary holds too much influence in the determination of input prices, VIP profit under negotiated pricing, $\Pi^N(\beta)$, is preferred to centralization, despite the fact that input pricing is left to the devices of self-interested subsidiaries.

In establishing organizational structure, the VIP may have influence on the relative power of the two subsidiaries in setting prices, via provision of either formal or real authority.[1] In this case, if the VIP could establish the relative influence and decision-making power of the divisions as part of its decentralized structure, what would be its preferred arrangement? To answer this question, one first needs to determine VIP profit as a function of bargaining power, as presented in Equation (3.7):

$$\begin{aligned}\Pi^N(\beta) = \tilde{\Pi}(q_1^D(w_1^N(\beta), w_2^N(\beta)), q_2^D(w_1^N(\beta), w_2^N(\beta)), w_1^N(\beta), w_2^N(\beta)) \\ + \hat{\Pi}(q_1^D(w_1^N(\beta), w_2^N(\beta)), q_2^D(w_1^N(\beta), w_2^N(\beta)), w_1^N(\beta), w_2^N(\beta)).\end{aligned} \tag{3.7}$$

Taking the first-order condition of Equation (3.7) reveals the optimal means of doling out bargaining power, β^*. Using this value in Equation (3.7) and comparing it with Π^D reveals that this arrangement replicates that under centralized transfer pricing. These results are summarized in Proposition 3.2.

[1] In terms of formal authority, the VIP could, for example, set the particular form of bargaining (which itself determines who exerts the most influence), or set ground rules for the outcome if the two parties cannot come to agreement (similar in spirit to the status quo arrangement considered in Edlin and Reichelstein, 1996). In terms of real authority, the VIP can "play favorites", demonstrate a willingness to rubber stamp appeals made by one party, etc.

Proposition 3.2.

(i) The VIP's preferred assignment of bargaining rights is $\beta = \beta^* = [2-k]^2/[6-4k-3k^2+2k^3]$.

(ii) Negotiated pricing with judicious assignment of bargaining rights replicates the VIP's preferred decentralized outcome, i.e., $w_1^N(\beta^*) = w_1^D, w_2^N(\beta^*) = w_2^D$, and $\Pi^N(\beta^*) = \Pi^D$.

The fact that negotiated transfer pricing can replicate the VIP's preferred arrangement is perhaps surprising because preferred pricing on two dimensions (w_1 and w_2) is achieved by the negotiation process despite the process being identified by only one parameter (β). This feat is achieved due to the fact that $w_2^N(\beta)$ is free of β. To elaborate, w_2^D is the upstream affiliate's preferred wholesale price for firm 2 were it given complete control over pricing. And, as its bargaining power is decreased, concessions to the downstream affiliate are most aptly provided through lower w_1, not changes in w_2. In other words, the two affiliated parties are in broad agreement over not giving a break to the outside party, instead exploiting their bargaining strengths to push w_1 in the direction of their liking. Given this feature, a careful choice of β can ensure $w_1^N(\beta) = w_1^D$ and, thereby, replicate the desired outcome.

A notable feature of β^* is that it is free of a. That is, the VIP can implement its preferred assignment of decision rights without knowing the precise conditions "on the ground". Thus, if the VIP's detached status makes it unaware of retail market conditions, it can nonetheless effectively utilize decentralization to achieve its desired purpose.

Besides demonstrating the benefits of decentralization and negotiated transfer pricing summarized above, Arya et al. (2008c) also show that these essential forces are invariant to the particulars of the affiliates' compensation structures or incentives as long as each affiliate cares more about its own profit than it does the other's profit. In addition, they generalize the above results to include differential efficiencies of the competing retail providers and to consider the effects of parity restrictions on input prices (that require the related-party price to be the same as the arm's length price). Finally, they demonstrate that not

only can decentralization and a negotiated transfer price serve as a natural break on temptations for encroachment by the VIP, but they can replicate the outcome that would be achieved if the VIP could credibly precommit to its precise retail quantity.

In short, while decentralization and negotiated transfer pricing are often vilified for the inefficiencies they introduce, it turns out that such "inefficiencies" can be efficient when the supplier in question is a VIP. Given the prevalence of such structures, a positivist will find comfort in the concomitant prevalence of negotiated transfer pricing and decentralized firm structures.

We next expand upon this theme by revisiting segment profit calculations (in this case upstream and downstream segments) in light of the subtle interconnectedness inherent in a VIP structure.

3.2 Measuring Segment Profitability

The issue of transfer pricing, as analyzed in Section 3.1, invariably leads one to consider profit measurement more broadly. That is, the establishment of transfer prices for internal transfers is ostensibly aimed at generating meaningful measures of upstream (wholesale) and downstream (retail) profitability for a vertically integrated entity. As with most segment profit measurement exercises, this attempt at developing useful measures is not innocuous, as it frames compensation, performance evaluation, and resource allocation decisions. That said, transfer pricing is not the only issue facing firms seeking to measure segment profits. As discussed in Section 2.2, complementarities due to demand effects are rampant. In a similar vein, when one thinks of measuring wholesale and retail profitability, a key interaction is that incurring costs to instill input quality improvements inevitably also improves the end-product sold in the retail realm. In such cases, it is a delicate exercise to determine the relative contribution of each segment.

Both transfer pricing and traditional views of cross-segment complementarities (naturally) follow the physical flow of goods. That is, transfer pricing seeks to measure how behavior by the upstream (wholesale) arm impacts the downstream (retail) arm. Similarly, quality or technological improvements to inputs too have the "trickle-down"

feel in that costs incurred by the wholesale arm have nontrivial repercussions on the retail arm. Less commonly considered, however, are how retail operations and efficiency therein can influence wholesale operations. The reason for this is that in the traditional view of a vertically integrated firm, whose only wholesale customer is the retail arm itself, there is no meaningful interaction that flows upstream.

More precisely, say the retail arm incurs a "selling" cost per unit of $s \geq 0$ to reach its consumers. This cost could entail shipping, advertising, commissions, etc. When the vertically integrated firm is not an external input supplier (and, thus, the retail firm faces no competition), measuring firm-wide effects of selling costs is tantamount to measuring retail effects, i.e., determining the effect of s on wholesale profit is inconsequential. To see this most clearly, consider centralized decision making so as to isolate measurement issues. In particular, the firm chooses retail quantity to maximize profit:

$$\underset{q_1}{Max}[a - q_1]q_1 - sq_1. \tag{3.8}$$

The firm-profit maximizing quantity is $q_1 = [a - s]/2$. In terms of wholesale and retail profit, given a transfer price of w_1, wholesale profit is $w_1 q_1 = w_1[a - s]/2$, and retail profit is $[a - q_1]q_1 - sq_1 - w_1 q_1 = [a - s][a - s - 2w_1]/4$. As expected, given centralized decision making the transfer price has no effect on profit itself, only how it is split among the divisions. This helps provide a strong dichotomy from the focus in Section 3.1. Of course, we presume the transfer price is not so extreme that either division incurs losses, i.e., $0 \leq w_1 \leq [a - s]/2$. The question of interest is how changes in downstream costs affect the firm and segment profits. Since greater costs depress retail quantities, they also will depress wholesale quantities. This turns out to be the only connection between the two segment profit measures.

In particular, the change in wholesale profit given an increase in sales costs is $\frac{dw_1[a-s]/2}{ds} = -w_1/2 \leq 0$, and the associated change in retail profit is $\frac{d[a-s][a-s-2w_1]/4}{ds} = -[a - s - w_1]/2 < 0$. The change in firm-wide profit is simply the sum of the two, or $-[a - s]/2 < 0$. Two observations follow from this: (i) an increase (decrease) in sales costs induces a decrease (increase) in profit at the retail, wholesale, and firm-wide levels; and (ii) for the retail profit measure to fully reflect the

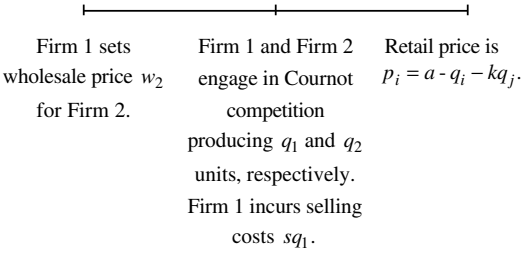


Fig. 3.4 Measuring segment profitability.

effects of retail costs on firm-wide profit, one simply needs a marginal cost transfer price (here, $w_1 = 0$). Both features jibe with conventional wisdom.

What we consider next is how the VIP structure can alter this viewpoint. To do so crisply, we will follow the preceding logic and examine the case of $w_1 = 0$. That is, the transfer price is set so wholesale profit corresponds to profit earned in the external sale of inputs. Again, to ensure nontrivial participation of both firms, we presume the retail products are not perfect substitutes, i.e., $k < 1$. Also to ensure nonnegative quantities by both retail operators, say firm 1's selling cost $s < a[4 + k][2 - k]/[8 - k^2] \equiv \bar{s}$, and firm 2's selling cost is zero. The sequence of events is presented in Figure 3.4.

In this case, the VIP chooses its retail quantity, q_1, to maximize firm-wide profit, $\Pi(q_1, q_2, w_2)$, given 2's chosen retail quantity, q_2, and the stated wholesale price, w_2. Formally, the VIP's problem is:

$$\underset{q_1}{Max}\ \Pi(q_1, q_2, w_2) \Leftrightarrow \underset{q_1}{Max}\ w_2 q_2 + [a - q_1 - kq_2]q_1 - sq_1. \qquad (3.9)$$

In a similar way, given its input price, w_2, and the VIP's chosen quantity, q_1, firm 2 chooses retail quantity q_2 to maximize its profit, precisely as in Equation (3.2). Solving the first-order conditions associated with Equations (3.2) and (3.9) jointly yields equilibrium quantities as a function of the wholesale price and selling cost: $q_1(w_2; s) = \frac{a[2-k]+kw_2-2s}{4-k^2}$ and $q_2(w_2; s) = \frac{a[2-k]+ks-2w_2}{4-k^2}$. In this case, note that the VIP's (firm 2's) quantity is decreasing (increasing) in the VIP's selling cost. Intuitively, the VIP's (firm 2's) competitive position is undercut (fortified) by an increase in the VIP's selling cost. Given this, the

VIP's wholesale pricing problem, which seeks to maximize the sum of wholesale and retail profits, is as follows:

$$\underset{w_2}{Max}\,\Pi(q_1(w_2;s),q_2(w_2;s),w_2). \tag{3.10}$$

Solving the first-order condition of Equation (3.10) yields $w_2(s) = \frac{a[8-4k^2+k^3]-sk^3}{2[8-3k^2]}$. Thus, wholesale profit is $W(s) = w_2(s)q_2(w_2(s);s) = \frac{2w_2(s)[a(1-k)+sk]}{8-3k^2}$, while retail profit is $R(s) = [a - q_1(w_2(s);s) - kq_2(w_2(s);s)]q_1(w_2(s);s) - sq_1(w_2(s);s) = \left[\frac{[\bar{s}-s][8-k^2]}{2[8-3k^2]}\right]^2$. Recall, the question of interest is how changes in downstream costs affect the profit recorded for each segment. The next proposition presents the relevant comparative statics.

Proposition 3.3.

(i) With a centralized VIP, retail profit is decreasing in retail sales costs. That is, $R'(s) = -\frac{[\bar{s}-s][8-k^2]^2}{2[8-3k^2]^2} < 0$.

(ii) With a centralized VIP, wholesale profit is increasing in retail sales costs. That is, $W'(s) = \frac{ak[8-5k^2]+2k^4[a-s]}{[8-3k^2]^2} > 0$.

As demonstrated in Proposition 3.3(i), changes in retail efficiency induce the expected effects on retail profit. That is, as a firm's retail arm becomes less efficient, its retail profit suffers. In the case of a firm that does not participate in the (external) input market, as in the benchmark previously discussed, the same effects are echoed in wholesale profitability. In contrast, the VIP structure introduces a reversal in the upstream reverberations. While downstream inefficiency harms retail profit, it stands to boost wholesale profit. In effect, as retail efficiency suffers, the firm pivots its focus away from retail operations to wholesale operations. In fact, since $w_2'(s) < 0$, as s increases, not only is the retail arm directly harmed, but the firm's desire to shift the flow of inputs to the more efficient (rival) channel translates into the firm magnifying the costs in retail competition by also boosting the efficiency of the rival. In a sense, the VIP is constantly engaged in a balancing act that requires the firm to shift its wholesale prices so as to best direct inputs to the most profitable channel. As the VIP's own retail

costs increase, it then shifts resources away from that channel to its other channel. For the VIP, the other channel's profits are manifest in the wholesale realm and, thus, wholesale profits are boosted by higher retail costs.

In other words, while it is well known that upstream behavior and efficiency have repercussions on subsequent downstream actions and profits, the preceding analysis confirms that ensuing downstream behavior and efficiency have substantial repercussions on upstream actions and profits. The effects are even more subtle than the previous discussion suggests, however. After all, as discussed in Section 3.1, a centralized VIP has the added problem of being unable to resist the temptation to excessively encroach on its wholesale customer's retail territory. While increasing the pseudo-costs (transfer prices) downstream and decentralizing can be one means of overcoming the excessive ex post focus on retail profits, even increased actual costs can have a similar effect. In particular, the shift in focus toward the wholesale realm engendered by higher retail costs can actually benefit the firm as a whole. This conclusion is confirmed by viewing how firm-wide profit changes with retail selling costs, i.e., examining $R'(s) + W'(s)$. The next proposition presents this exercise.

Proposition 3.4.

(i) With a centralized VIP, firm profit is decreasing in retail sales costs for all $s < s^* \equiv \frac{a[8-4k+k^2]}{8+k^2}$.

(ii) With a centralized VIP, firm profit is increasing in retail sales costs for all $s > s^*$.

From the proposition, higher sales costs do not necessarily even reduce firm profit. In particular, since $s^* < \bar{s}$, there is a nontrivial region of s-values for which cost-cutting at the margin is actually harmful for the firm. The reason this happens is that the direct benefit of cost cutting (realized in the retail realm) is more than offset by the indirect detrimental effects of more aggressive retail encroachment on wholesale profit. Figure 3.5 presents a graphical depiction of the results in Propositions 3.3 and 3.4, for $a = 1$ and $k = 1/2$, plotting

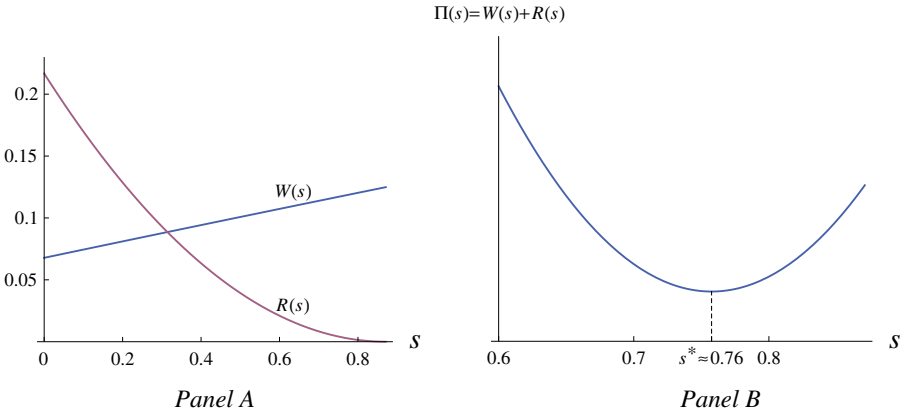


Fig. 3.5 Wholesale, retail, and total profit as a function of s.

$R(s)$ and $W(s)$ as a function of s in Panel A, and $R(s) + W(s)$ as a function of s in Panel B.

This is not to say that the indirect effects of selling costs are always paramount, but more broadly that they are not trivial. The bigger picture that can be gleaned from the propositions in this section is that retail profit figures fail to reflect the entirety of the ramifications of retail actions on firm-wide profit, even when transfer prices are moot. In fact, the benefits to the firm of retail cost cutting (or, equivalently, demand boosting) are less than those observed at the retail level (as evidenced by $W'(s) > 0$). Thus, while it may seem natural for retail arms to insist on aggressive investment in better logistics, advertising, or product promotion, it is also natural that decision makers with a less myopic view of firm-wide profit would view such efforts with skepticism.

3.3 Implications for Industrial Organization

While this section's focus so far has been on how concurrent selling in input and output markets can alter traditional views of accounting and performance measurement, concurrent participation in input and output markets of course also has implications beyond the accounting realm. Further, the very forces that shape accounting and the firm's

organizational structure may also reach beyond the firm to issues shaping the structure of industries. While industrial organization is clearly a broad field with many considerations, we will focus here on two prominent industrial organization questions that permeate strategy, regulation, and marketing; the discussion of these topics in introductory microeconomics courses speaks to their widespread acceptance. In particular, given our focus on the role of the VIP structure, we (re)examine the standard issues of Stackelberg leadership (Section 3.3.1) and compare the competitiveness of price and quantity competition (Section 3.3.2).

3.3.1 Retail Encroachment and Time-to-Market

The notion that a firm can gain competitive advantage from faster time-to-market is solidified in the economic psyche, both theoretically and in practice. In theoretical terms, a standard result in industrial organization is that, provided the "normal" conditions of retail products being substitutes from the consumer perspective and each firm having a downward-sloping reaction function are satisfied, "we can typically expect that each Stackelberg firm would prefer to be the leader" (Varian, 1992, p. 298). In practical terms, such a desire to be the leader to the market is manifest in firms' aggressive rollout dates for new products, updated models, and seasonal merchandise. One only needs to look at retail stores stocking Christmas decorations in early fall to know the temptation to be first to the market is real.

Despite the theoretical consensus that firms want to be first in the market, some exceptions exist in practice. For example, manufacturer outlet stores typically stock new items only after traditional retail outlets have had a chance to reach consumers. Such exceptions are expanding, as firms sometimes hold back online sales of items until after traditional retail launch. This "delay" is even inevitable when retail and online launch officially occur at the same time, since shipping times ensure that realistically speaking retail stores are faster to the market. Note that these exceptions share a common feature — they reflect not traditional distribution channels, but instead the VIP structure. In this section, we demonstrate that this late-to-market feature is perhaps

not a fluke. Instead, the VIP structure naturally lends itself to the firm sometimes seeking to be slow to market via one of its distribution channels. As the VIP structure becomes more prevalent in practice, so too may the desire to be more judicious in market timing.

To demonstrate the unique effects of being both an input supplier and output seller on time-to-market incentives, we will first demonstrate the benchmark case in which firm 1 competes with firm 2, but neither is an input supplier. That is, say each makes its own inputs and neither provides inputs to an external market. This represents the traditional Stackelberg game. To demonstrate this benchmark, say firm i is the leader while firm j is the follower. In this case, the follower, taking q_i as given, chooses its retail quantity to solve:

$$\underset{q_j}{Max}[a - q_j - kq_i]q_j. \tag{3.11}$$

The first-order condition of Equation (3.11) reveals firm j's retail response to firm i's market leadership: $q_j(q_i) = [a - kq_i]/2$. Accounting for this ensuing response, firm i thus chooses its retail quantity to solve:

$$\underset{q_i}{Max}[a - q_i - kq_j(q_i)]q_i. \tag{3.12}$$

The first-order condition of Equation (3.12) reveals firm i's retail quantity: $q_i = \frac{a[2-k]}{2[2-k^2]}$. Given this, firm j's equilibrium quantity is $q_j = \frac{a[2-k]}{2[2-k^2]} - \frac{ak^2}{4[2-k^2]}$. Using these quantities in Equations (3.12) and (3.11) reveals equilibrium profit of $\frac{a^2[2-k]^2}{8[2-k^2]}$ for firm i and $\frac{a^2[2-k]^2}{8[2-k^2]} - \frac{a^2[4-3k]k^3}{16[2-k^2]^2}$ for firm j. The benchmark confirms the standard thinking: the leader (firm i) earns greater profit than the follower (firm j), and does so by securing greater market share. In fact, it is readily confirmed that being the leader is also preferred to participating in a simultaneous move game. This feature also carries forward to the case of two firms relying on (unaffiliated) external supply. The reason is that the first mover has the ability to use its quantity levels as a means of scaring away the competition (as evidenced by the fact that $q_j(q_i)$ is decreasing in q_i). So, being first mover means the firm has a strong advantage in competitive deterrence.

The point we seek to make here is that when a firm not only competes in the retail realm but supplies in the wholesale realm, these

forces change. While Section 3.1 presents the equilibrium outcome for a simultaneous move game in the VIP setup, we have not yet identified the equilibrium with sequential moves when firm 1 is a VIP. We will examine the cases when the VIP is a leader and when the VIP is a follower, each in turn.

VIP Leader

Say firm 1 (the VIP) is a Stackelberg leader. In this case, firm 2, the follower, chooses retail quantity to maximize:

$$\underset{q_2}{Max}[a - q_2 - kq_1]q_2 - w_2q_2. \tag{3.13}$$

The first-order condition of Equation (3.13) reveals firm 2's retail response to firm 1's market leadership: $q_2^L(q_1, w_2) = [a - kq_1 - w_2]/2$ (the superscript indicates the VIP is a Leader). Given this ensuing response, firm 1 thus chooses its retail quantity and the prevailing wholesale price to solve[2]:

$$\underset{q_1,w_2}{Max}[a - q_1 - kq_2^L(q_1, w_2)]q_1 + w_2q_2^L(q_1, w_2). \tag{3.14}$$

Note that in Equation (3.14), the VIP considers both its retail profit (the first term) and its wholesale profit (the second term). The first-order conditions of Equation (3.14) reveal firm 1's equilibrium retail quantity and wholesale price: $q_1^L = \frac{a[2-k]}{2[2-k^2]}$ and $w_2^L = a/2$. Using these values in $q_2^L(q_1, w_2)$ and the profit expression in Equation (3.14) reveals the VIP's equilibrium profit when it serves as a Stackelberg leader, $\Pi^L = \frac{a^2[3-2k]}{4[2-k^2]}$.

VIP Follower

If, on the other hand, the VIP is a Stackelberg follower, the equilibrium is determined as follows. Firm 1's choice of retail quantity, having

[2] Practically speaking, the wholesale price may be established prior to the leader establishing its retail quantity. But, in this case where the leader is also the party establishing the wholesale price, it is without loss of generality to presume the decisions are made concurrently.

observed firm 2's quantity, maximizes:

$$\underset{q_1}{Max}[a - q_1 - kq_2]q_1 + w_2 q_2. \tag{3.15}$$

The first-order condition of Equation (3.15) reveals that firm 1's retail response to firm 2's market leadership is $q_1^F(q_2) = [a - kq_2]/2$ (here, the superscript indicates the VIP is a Follower). Given this ensuing response and the prevailing wholesale price, firm 2 chooses its retail quantity to solve:

$$\underset{q_2}{Max}[a - q_2 - kq_1^F(q_2)]q_2 - w_2 q_2. \tag{3.16}$$

The first-order condition of Equation (3.16) reveals firm 2's equilibrium retail quantity as a function of the wholesale price: and wholesale price: $q_2^F(w_2) = \frac{a[2-k]-2w_2}{2[2-k^2]}$. Given the ensuing Stackelberg equilibrium, firm 1 thus chooses the prevailing wholesale price to solve:

$$\underset{w_2}{Max}[a - q_1^F(q_2^F(w_2)) - kq_2^F(w_2)]q_1^F(q_2^F(w_2)) + w_2 q_2^F(w_2). \tag{3.17}$$

Taking the first-order condition of Equation (3.17) yields $w_2^F = \frac{a[8-6k^2+k^3]}{2[8-5k^2]}$. Using this in $q_2^F(w_2)$, and using that in $q_1^F(q_2)$ provides equilibrium quantities when the VIP is the Stackelberg follower. Using the equilibrium outcomes in the VIP profit expression in Equation (3.15) then reveals the VIP's equilibrium profit when it serves as a Stackelberg follower, $\Pi^F = \frac{a^2[12-8k-k^2]}{4[8-5k^2]}$.

Leader vs. Follower

Comparing equilibrium wholesale prices, retail quantities, and overall profits for the cases of VIP leader and VIP follower yields the following proposition.

Proposition 3.5.

(i) The prevailing wholesale price is higher if the VIP is a Stackelberg leader, i.e., $w_2^L > w_2^F$.

(ii) Firm 2's retail quantity is higher if the VIP is a Stackelberg follower, i.e., $q_2^F(w_2^F) = \frac{2a[1-k]}{[8-5k^2]} > q_2^L(q_1^L, w_2^L) = \frac{a[1-k]}{2[2-k^2]}$.

(iii) The VIP's retail quantity is higher if it is a Stackelberg follower, i.e., $q_1^F(q_2^F(w_2^F)) = \frac{a[8-2k-3k^2]}{2[8-5k^2]} > q_1^L = \frac{a[2-k]}{2[2-k^2]}$.
(iv) VIP profit is higher if the VIP is a Stackelberg follower, i.e., $\Pi^F > \Pi^L$.

From Proposition 3.5(i) and (ii), Stackelberg leadership continues to look attractive. After all, being a leader continues to drive away the retail competition, and also affords a higher wholesale price. Recall, however, that in the VIP's case, its joint focus on wholesale and retail profits makes it acutely aware that its aggressive retail posture can harm its wholesale profit. For this reason, it seeks a means through which it can convince its wholesale customer it will be less of a threat. As a leader, however, its only means of doing this is to depress its retail production substantially. Thus, a VIP who is a Stackelberg leader has no choice but to lead with low production levels so as to convince its wholesale customer to purchase more.

This leads to a stark contrast from the typical view of quantity leadership — from Proposition 3.5(iii), the VIP actually supplies a higher retail quantity if it is the follower. As a follower, the VIP does not need to convince its wholesale customer that it will not be a threat. Instead, the wholesale customer, being the leader, itself ensures the VIP is not an excessive threat by flooding the market with products prior to the VIP's quantity choice. After this happens, then, the VIP can choose its own quantity worried only about its own retail profit and, thus, opts to offer more retail goods than if it had to worry about its wholesale profit too (as is the case when it is a Stackelberg leader). Proposition 3.5(iv) then confirms that, despite emboldening the retail rival, the VIP's being late to the retail market is actually in its own best interest. In a sense, being late to the market is a substitute for the VIP to commit to less aggressive encroachment. What makes it such an effective substitute in the VIP's eyes is that it forces firm 2 to take action to cement the commitment. And, this action entails buying more inputs from the VIP, boosting its wholesale profit substantially. It is this boost in wholesale profit that makes the VIP a willing conscript in being slow to the market.

In fact, a quick comparison of VIP profit as a Stackelberg follower to the case of simultaneous retail action (i.e., Π^C in Section 3.1) also confirms that the VIP prefers being a follower to any other time-to-market. Taken together, the results in this section present a stark contrast to the typical view that speed to market is paramount. In the case of a firm jointly participating in input and output markets, the converse is true in that delay turns out to be optimal. This result may provide one explanation for the case of vertically integrated firms seeming to be excessively slow to market with their new products in their own channel while traditional retail firms are quicker to provide such goods to end users.

3.3.2 Quantity vs. Price Competition

Another fundamental result in microeconomics is the comparison between price (Bertrand) and quantity (Cournot) competition. The classic analysis of duopoly competition concludes that because price competition engenders more intense competition, it generates a higher level of consumer surplus and lower firm profits than quantity competition (e.g., Singh and Vives, 1984; Vives, 1985; Okuguchi, 1987).

As it turns out, even this rather robust classic result is naturally altered when a firm serves as a seller in both input and output markets, as demonstrated in Arya et al. (2008b). In particular, when one competing retail firm is also the supplier of a key input to its rival, the competitive environment in the retail realm is altered. Under quantity competition, the VIP rationally ignores wholesale profit when choosing its retail quantity (since it takes its rival's quantity as given when forming Cournot conjectures). In contrast, under price competition, the VIP realizes adjusting its retail price can shift consumer purchases toward its retail rival (who also serves as its wholesale customer). Due to this effect, the VIP may set a higher input price under price competition than would result under quantity competition. The higher input price not only limits the rival's retail aggression, it also increases the VIP's own opportunity cost of engaging in aggressive retail competition. By increasing the wholesale profit the VIP foregoes when its retail rival's output declines, the high wholesale price serves as a credible commit-

ment for the VIP to refrain from aggressive retail competition. The resulting higher retail prices actually generate lower consumer surplus under price competition.

To demonstrate the unique effects of being both an input supplier and output seller on the price vs. quantity competition comparison, we first demonstrate the benchmark case in which firm 1 competes with firm 2, but neither is an input supplier. The quantity competition case for this benchmark proceeds as follows. Taking q_j as given, firm i chooses its retail quantity to solve:

$$\underset{q_i}{Max}[a - q_i - kq_j]q_i. \tag{3.18}$$

Taking the first-order conditions for Equation (3.18) for $i, j = 1, 2, i \neq j$ reveals the competitive equilibrium under quantity competition: $q_i = a/[2 + k]$. In this case, industry profits are $\Pi_1 + \Pi_2 = [a - q_1 - kq_2]q_1 + [a - q_2 - kq_1]q_2 = \frac{2a^2}{[2+k]^2}$, and consumer surplus is $CS = [(q_1)^2 + 2kq_1q_2 + (q_2)^2]/2 = \frac{a^2[1+k]}{[2+k]^2}$.

In contrast, under price competition, retail quantities depend on the chosen retail prices. In particular, inverting the demand functions, quantities as a function of prices (p_1 and p_2) are: $q_1(p_1, p_2) = \frac{a[1-k]-p_1+kp_2}{1-k^2}$ and $q_2(p_1, p_2) = \frac{a[1-k]-p_2+kp_1}{1-k^2}$. In this case, taking p_j as given, firm i chooses its retail price to solve:

$$\underset{p_i}{Max}\ p_iq_i(p_1, p_2). \tag{3.19}$$

Taking the first-order conditions of Equation (3.19) for $i, j = 1, 2, i \neq j$ reveals the competitive equilibrium under price competition: $p_i = \frac{a[1-k]}{[2-k]}$. Thus, under price competition, industry profits are $\Pi_1 + \Pi_2 = p_1q_1(\cdot) + p_1q_2(\cdot) = \frac{2a^2[1-k]}{[2-k]^2[1+k]}$, and consumer surplus is $CS = [(q_1(\cdot))^2 + 2kq_1(\cdot)q_2(\cdot) + (q_2(\cdot))^2]/2 = \frac{a^2}{[2-k]^2[1+k]}$.

In this benchmark, comparing terms reveals that industry profits are higher under quantity competition, consumer surplus is higher under price competition, and total surplus (industry profits plus consumer surplus) is higher under price competition. The intuition for this is gleaned best from the limiting case of $k = 1$. After all, in

this case, duopoly quantity competition yields total retail quantities of $2a/3$. This is above the monopoly level of $a/2$ but below the perfect competition level of a. The limited (duopoly) competition ensures that some quantity rationing occurs in equilibrium, ensuring retail prices above marginal cost, and boosting industry profits at the expense of consumers and economic efficiency. In contrast, with price competition (and perfect substitutes) consumers will buy exclusively from the low-price provider. This leads to a "race to the bottom" in pricing, ensuring that an equilibrium occurs only when the firms employ marginal cost pricing. Such pricing eliminates retail rationing and replicates perfect competition.

This same intuition carries forward to the case of $k < 1$, wherein retail competition is more aggressive when it occurs in the pricing realm, and consumers and total surplus benefit from such intense competition. In fact, the benchmark result that price competition is more competitive and assures greater efficiency persists in more general contexts, with differential demand (e.g., differential elasticity and/or demand intercepts among the products), differential costs, and independent input supply. The critical deviation from the benchmark we consider here is when a retail firm (firm 2) relies on input supply provided by a rival (firm 1), a prominent and growing industrial structure. We next consider the equilibria in this case under both quantity and price competition.

Quantity Competition

Consider the duopoly equilibrium under quantity competition with a VIP. Recall, this corresponds to the centralization case in Section 3.1. As derived therein, the equilibrium wholesale price and quantities, denoted by superscript Q for quantity competition, are $w_2^Q = \frac{a[8-4k^2+k^3]}{2[8-3k^2]}$, $q_1^Q = \frac{a[2-k][4+k]}{2[8-3k^2]}$, and $q_2^Q = \frac{2a[1-k]}{[8-3k^2]}$.

Using this equilibrium solution in firm profits and consumer surplus expressions reveals VIP profit of $\Pi^Q = \frac{a^2[6-k][2-k]}{4[8-3k^2]}$, firm 2 profit of $\Pi_2^Q = \frac{4a^2[1-k]^2}{[8-3k^2]^2}$, and consumer surplus of $CS^Q = \frac{a^2[80-76k^2+12k^3+9k^4]}{8[8-3k^2]^2}$. Next we derive the equilibrium under price competition.

Price Competition

With retail price competition, taking p_2 as given, firm 1 chooses its retail quantity to solve:

$$\underset{p_1}{Max}\ p_1 q_1(p_1,p_2) + w_2 q_2(p_1,p_2). \tag{3.20}$$

Note that in Equation (3.20), the VIP's strategic choice (here, p_1) does influence its wholesale profit in contrast to the Cournot case. Thus, the VIP's decision in the retail market will reflect a balancing of profits in its two markets. Firm 2, taking p_1 as given, chooses its retail price to solve:

$$\underset{p_2}{Max}\ p_2 q_2(p_1,p_2) - w_2 q_2(p_1,p_2). \tag{3.21}$$

Taking the first-order conditions of Equations (3.20) and (3.21) reveals the competitive equilibrium as a function of the prevailing wholesale price (the superscript indicates price competition): $p_1^P(w_2) = \frac{a[2-k-k^2]+3kw_2}{4-k^2}$ and $p_2^P(w_2) = \frac{a[2-k-k^2]+[2+k^2]w_2}{4-k^2}$. Given the ensuing competitive equilibrium, firm 1 thus chooses the prevailing wholesale price to solve:

$$\underset{w_2}{Max}\ p_1^P(w_2) q_1(p_1^P(w_2),p_2^P(w_2)) + w_2 q_2(p_1^P(w_2),p_2^P(w_2)). \tag{3.22}$$

Taking the first-order condition of Equation (3.22) reveals the wholesale price under price competition: $w_2^P = \frac{a[8+k^3]}{2[8+k^2]}$. Using this equilibrium wholesale price in firm profit and consumer surplus expressions reveals VIP profit of $\Pi^P = \frac{a^2[12+4k+k^2+k^3]}{4[8+8k+k^2+k^3]}$, firm 2 profit of $\Pi_2^P = \frac{a^2[1-k][2+k^2]^2}{[1+k][8-k^2]^2}$, and consumer surplus of $CS^P = \frac{a^2[80+16k+36k^2+24k^3+k^4+5k^5]}{8[1+k][8+k^2]^2}$. We next contrast the outcomes under price and quantity competition in light of the VIP structure.

Quantity vs. Price Competition

Comparing the equilibrium expressions under quantity and price competition, respectively, yields the following proposition.

Proposition 3.6.

(i) The prevailing wholesale price is lower under quantity competition, i.e., $w_2^Q < w_2^P$.
(ii) The VIP's profit is lower under quantity competition, i.e., $\Pi^Q < \Pi^P$.
(iii) Firm 2's profit is lower under quantity competition, i.e., $\Pi_2^Q < \Pi_2^P$.
(iv) Consumer surplus is higher under quantity competition, i.e., $CS^Q > CS^P$.
(v) Total surplus is higher under quantity competition, i.e., $\Pi^Q + \Pi_2^Q + CS^Q > \Pi^P + \Pi_2^P + CS^P$.

An immediate implication from Proposition 3.6 is that the presence of a VIP completely reverses the classic results comparing price and quantity competition. In particular, while price competition is typically viewed as both more competitive and more efficient, Proposition 3.6(ii)–(v) reveal that neither is true when a VIP is present. Proposition 3.6(i) provides intuition as to why this is the case.

To elaborate, recall that under quantity competition, the VIP engages in retail competition while ignoring wholesale profit. In contrast, under price competition, the VIP plays close attention to such profit when choosing its retail price. Thus, in a world where the VIP is concerned about excessive retail encroachment, retail price competition provides an avenue through which this encroachment can be reduced. If the VIP wants to commit to less encroachment, it only needs to raise the wholesale price, since doing so creates a substantial opportunity cost of encroachment — the more retail territory is seized by the VIP the more it foregoes in wholesale profit.

The desire to follow this means of commitment to being less aggressive in retail encroachment in borne out in the higher wholesale price under retail price competition (Proposition 3.6(i)). In fact, this effort to reduce retail encroachment is of first-order importance, relegating the usual heightened competitive pressures due to retail price competition to the status of second-order importance. This is borne out

by the fact that consumer surplus is lower under price competition (Proposition 3.6(iv)). Relatedly, the more cooperative posture under price competition means industry (and even individual firm) profits are greater under price competition (Proposition 3.6(ii) and (iii)). Finally, by putting the brakes on retail competition, the Bertrand game also undercuts efficiency (Proposition 3.6(v)). Each of these features runs counter to the typical view.

Arya et al. (2008b) demonstrate the reversal of the classic results comparing quantity and price competition in a more general setup. In particular, given regularity conditions that ensure non-foreclosure of firm 2, Arya et al. (2008b) demonstrate the results in Proposition 3.6 in a circumstance where varied demand and/or retail costs create additional differentiation among the duopolists. They also derive the basic results when the wholesale price is negotiated between the firms and when wholesale pricing takes the form of two-part tariffs. Their results also endogenize the industrial structure in that they begin with separate firms and demonstrate that the more efficient retail producer will opt to merge with the supplier, thereby creating the presumed VIP structure.

In light of both the theoretical and practical justifications for the presence of VIPs in a variety of markets, the results summarized in Section 3 force one to revisit not only classical views of firm organization but also fundamental results that underlie our basic intuition about markets and how they operate. By so easily reversing our typical intuition, the results suggest many additional avenues for research which may paint a more complete picture not only of how firms operate, but also how firm operations change as industrial structures evolve. We next take a broader view to provide a discussion of this and related issues that naturally arise in the line of research summarized herein.

4

Discussion

This monograph seeks to synthesize recent work at the intersection of the accounting, economics, marketing, operations, and strategy literatures which revisit traditional views of organizational (and industrial) structure in light of firms' concurrent participation in input and output markets. Economics and strategy have long analyzed organizational structure as a strategic tool to combat competitive forces. At the same time, research in accounting, marketing, and operations has sought to investigate means of achieving supply chain coordination, both within and across organizations. While the lists of such efforts is lengthy, to a large extent these literatures have evolved without fully incorporating the insights derived from one another (at least in our view). Perhaps importantly, the design of organizational structure, the focus in one stream, interacts noticeably with upstream outsourcing concerns tied to the work on supply chains. It is these interactions that the present synthesis seeks to outline. In particular, we re-examine some key results in accounting (on transfer pricing and segment profit determination), as well as those in other related fields (on industrial structure, supply chain efficiency, and marketing channel structure) noting that firms routinely participate in both input and output markets.

To categorize these results, we first consider how a firm's presence as a buyer in input markets alters how we view it as a participant in output markets. In short, we demonstrate that circumstances entailing outsourcing can justify both decentralization of decision making and transfer prices above marginal cost. Each of these findings can provide some comfort to accountants, both because they are features we observe and because they often form the basis for criticism of accounting practices. Further, being a buyer in input markets adds caveats to the ways in which we interpret segment profits in that underperforming segments can provide benefits to their better performing counterparts by helping support lower wholesale prices. This suggests that overreliance on accounting profit figures too can be counterproductive and, thus, recommends a more holistic view of segment evaluation and firm organization.

Expanding these results beyond fundamental questions of accounting to the broader realm of strategy and industrial organization, we find that a firm may seek additional competition by licensing its technology or intellectual property, not to reach out to different customers but instead to influence input pricing. Licensing fees ensure the new rival is weak, which, in turn engenders reduced input prices to the rival. Licensing fees also serve as a means for the licensor to extract the benefits from such lower input prices. Also along this theme, the presence of a firm's rival in output markets too may change a firm's decision to make or buy from the rival's supplier. The decision to buy from a rival's supplier ensures the supplier is less tied to the fortunes of the rival and thereby breaks a de facto vertical alliance between the supplier and the rival. Taken together, the results suggest that a firm's role as a buyer in input markets requires a subtle view of the firm's organization, its accounting, and its competitive environs.

A second category of results herein involves a firm's role as a seller in input markets when it is also a seller in output markets. Besides being an increasingly common industry structure, this structure has, until recently, been underappreciated by academic research. Take for instance the question of transfer pricing. Much effort has been devoted to investigating the ideal transfer price to coordinate investment and order flow among related parties in a vertical chain. These efforts have

naturally expanded to the case where inputs transferred internally are also sold externally (thereby creating the potential for market-based transfer prices). The next question which naturally arises is what happens when outputs created from those inputs sold externally find their way to competition with the firm's own outputs. It is this circumstance we investigate herein. The short answer to this is that traditional views are again changed, even reversed. A firm seeking to balance wholesale (input market) and retail (output market) profits does so best not by limiting transfer prices but employing transfer prices above cost. Relatedly, this issue also expands to the questions of measuring the profits of retail and wholesale segments of a firm's business. While enhancing retail efficiency via cost-cutting or more targeted advertising is sure to bring retail success, this success may come at a cost in the wholesale market. As a result, the benefits of efficiency are often overstated and can even be negative.

We also expand the view of a firm as a seller in both input and output markets beyond the realm of accounting. In doing so, we revisit some fundamental results in industrial organization. In particular, we demonstrate that a firm who sells in both input and output markets may seek to be late to the market in order to give its wholesale customer an edge. Competitive leadership thus can take the form of being a follower. Further, the traditional view of price competition being more competitive and more efficient is turned on its head when one views the common industrial structure of a firm that sells inputs to its retail rival. Price competition entails the firm bearing an opportunity cost from retail aggression (lost wholesale profits), one boosted by higher wholesale prices. To best balance retail and wholesale profits, then, the firm facing price competition actually hikes wholesale prices and thereby undercuts both competition and efficiency.

While we recognize these results are not comprehensive in terms of all that can potentially be done to jointly examine input and output markets and the interactions therein, we hope they are at least provocative. In our minds at least, they beg new questions, some of which we have tried to make progress on, and others which we hope will be tackled in the future. We next describe a few of these possible avenues.

Contractual Form in Input Markets

The analysis conducted throughout this work was performed under the presumption of linear wholesale pricing, wherein a supplier sets a (per unit) input price and the wholesale buyer procures units as needed. While descriptive of practice and the most commonly studied contractual form, this is by no means the only contractual possibility. Traditional studies of input markets (absent output market considerations) note that two-part tariffs and/or other nonlinear pricing arrangements can better achieve input market efficiency. The intuition for this is that a two-part tariff arrangement can separate profit extraction and procurement choices — with the wholesale price set equal to marginal cost, the input buyer internalizes the supplier's marginal cost, and the fixed fee can be set so as to extract the ensuing surplus.

That said, the typical thinking that two-part tariffs (or other, more complicated, contractual arrangements) can achieve efficiency and thereby render input market considerations moot is sensitive to the presumption of no output market competition. With an independent supplier providing goods to a buyer who is in competition with another firm, the supplier can employ marginal prices in excess of cost to soften retail competition or below marginal cost to intensify competition. Depending on industrial structure, then, the notion that marginal prices will not deviate from marginal costs is incorrect. Thus, even with complex contracts, when firms are active in both input and output markets, subtle considerations like the ones studied here can continue to arise.

For example, consider the case of an input buyer employing decentralization and transfer pricing to reduce prevailing supplier prices (as in Section 2.1). In this case, under two-part tariffs, similar forces arise but are manifest in a different way (Arya and Mittendorf, 2007). In that case, the input supplier would seek to charge a marginal price equal to marginal cost and extract the surplus through a fixed "access" fee. But, if a decentralized firm permits its upstream division also to charge a two-part tariff, it too can use its fixed charge to extract some of the surplus and bring it back to the firm. If one eliminates weakly dominated strategies in such a case, decentralization again helps and

again does so by reducing supplier prices. In this case, the improved supplier terms are manifest not in terms of a decrease in the linear unit price but instead in terms of reduced access fee.

Consider also the case of an input buyer licensing its intellectual property to a rival as a means of influencing supplier behavior (as in Section 2.3.1). While this preference was demonstrated using linear royalty rates, similar results can be derived in an environment of both fixed and variable royalties. In fact, the use of a two-part tariff licensing fee is preferred by the firm, supplier, and consumers. After all, with linear fees, the variable royalty rate served two purposes, introducing weakness to elicit favorable supplier pricing and to extract the benefits of this weakness. With a two-part fee, the royalty rate can serve the former purpose while the fixed fee can serve the latter. In this case, the variable rate is lower (but still not zero), reducing the inherent inefficiencies.

Similarly, the result that a VIP structure changes traditional views of price vs. quantity competition carries forward to the case of two-part tariff pricing. In that case, as long as the retail competitors' products are sufficiently differentiated, the supplier will set the variable charge above marginal cost in order to soften retail competition among its wholesale customers. With variable charges above marginal cost, then, the qualitative conclusions derived with no fixed fees persist. In particular, the above-cost variable charge will be higher under price competition than quantity competition when prices are set by a VIP. And, the higher variable wholesale charge under price competition will translate into higher firm profits, lower consumer surplus and lower total surplus under price competition than under quantity competition.

All this is not to say that expanding contractual horizons has no effect on the underlying conclusions derived under linear pricing, only that they are perhaps less sensitive to this presumption than one might initially conjecture. However, additional research to this end may enhance our understanding of the contracts we see (and don't see) in practice. One may also expand beyond standard contracts to incentive contracts offered along the supply chain. There is a substantial literature on the role of incentives offered in supply chain contracts. However, despite the depth of this literature, it is bereft of

circumstances where input buyers also compete in the output realm with their input suppliers. Expanding this literature to reflect such realities of market structure may be a fruitful exercise.

The Nature of Competition

While the nature of competition (price vs. quantity) formed the crux of part of our analysis (Section 3.3.2), the remainder of the analysis was conducted under the presumption that output markets entailed quantity competition. Given the inherent sensitivity of many results to the presumed form of competition (e.g., Bulow et al., 1985; Gal-Or, 1985; Darrough, 1993; Goex, 2000), a natural question is how the results herein change under retail price competition. Perhaps counter to typical views, the short answer here is that many of the results are qualitatively unchanged.

Take first the case of decentralization to influence supplier pricing (Section 2.1). In that case, decentralization and transfer prices above marginal cost served to convey weakness to the supplier who, in response, set a lower input price. While this result arises even without output market competition, it persists in the presence of such competition. With price or quantity competition in the output market, the same essential tension is in place, but the detrimental effects of transfer prices above cost are less pronounced under price competition. In that case, high transfer prices lead to higher retail prices which, in turn, elicit softened competitive response by the retail rival(s). The result is that not only are the same basic forces in play under either quantity or price competition but, in fact, the benefits of decentralization and above-cost transfer prices are even more pronounced with price competition.

The result that underperforming segments can boost the fortunes of overperforming segments by putting downward pressure on input prices (Section 2.2) too can be demonstrated in the context of output market competition. Again, while the precise expressions are, of course, influenced by the nature of competition, the basic conclusions are not. Similar statements also apply to the strategic reasons for outsourcing to a common supplier (Section 2.3.2).

As far as the consequences of a firm being an input supplier while also being an output supplier, again price competition does not substantially alter the basic conclusions. The benefit of decentralization and above-cost transfer prices when a firm is a VIP (Section 3.1) continue under price competition. In that case, however, a centralized VIP excessively fixates on wholesale profit to the detriment of its retail business when engaging in retail competition. As a result, decentralization proves helpful as a means of committing to being tougher in competition, thereby again better balancing retail and wholesale profits. Despite the fact that price competition entails a shift away from (rather than toward) a focus on wholesale profit, the benefit again arises when transfer prices are set above marginal cost. In this light, the strategic benefit of transfer prices identified herein is less sensitive to the nature of competition than is the case when transfer prices serve a strategic role in output markets (see, e.g., Goex, 2000).

Of course, the price vs. quantity competition distinction is one, albeit a prominent, manner in which the nature of competition can vary. As discussed in Section 3.3.1, joint participation in output and input markets can also alter conclusions about the timing of competitive behavior. While only output market thinking does not provide much credence to a leading firm intentionally being late to market, this can arise naturally when input and output markets are jointly considered. This suggests that other features of competitive forms too may be changed by such joint considerations. The desire to innovate, patterns of entry, the introduction of generic brands that compete with one's own products, and forward and/or backward integration all beg for additional study in the joint presence of output and input market participation.

Commitment and Observability

As is well recognized (e.g., Goex and Schiller, 2006), when one speaks of strategic firm organization, questions naturally arise about a firm's ability to commit to organizational structure, compensation, transfer pricing, and the like. Take, for instance, the case of strategic transfer pricing, where one firm sets a transfer price above (or below) marginal

cost to influence the behavior of a competitor. For such efforts to be effective, of course, the rival must be aware of this decision, i.e., it must be observable. In the same light, it must also be the case that the firm cannot renege on its observed decision once the rival has reacted accordingly. This issue represents a notable caveat to any study presenting strategic effects of organizational design. As such, it also represents a consideration in much of the results presented here.

However, it turns out that input markets represent a different circumstance than output markets due to the sequential nature of behavior. Take the case of decentralization to convey weakness and thereby induce lower input prices (Section 2.1). In that case, recall that the firm's transfer price was chosen simultaneously with the supplier's input price, i.e., both were mutual best responses. As a result, the firm did not need to make any credible commitment to the transfer price; instead, the transfer price was self-enforcing. Instead, the only observable commitment that had to be made by the firm was of its decentralized structure. While one may argue that firm structure too can be altered, it is certainly a more sticky decision. That is, since firm structure is not something that can be altered on a whim, and changing structure realistically entails substantial logistical and administrative effort, it may be, by its very nature, a more enduring choice. Though this enduring nature of structure decisions is typically viewed as a sign of bureaucratic red tape, these results suggest that such red tape may be the glue that holds together important implicit strategic commitments.

As far as the use of transfer pricing as a commitment to soften subsequent retail competition so as to boost wholesale sales (Section 3.1), the presumed commitment to a particular transfer price proves more critical since it is established prior to the behavior it seeks to influence. In this sense, the strategic nature of the transfer price more closely mirrors that in traditional strategic transfer pricing studies (e.g., Alles and Datar, 1998). In this case, there may be a natural means of achieving such a commitment. As detailed in Arya et al. (2008c), the imposition of arm's length pricing restrictions which prevent firms from providing favorable related-party pricing may naturally serve as a commitment to a particular price. That is, arm's length restrictions (which are also manifest as parity pricing restrictions and uniform pricing regulations)

require the firm's internal (transfer) price to mirror that set for external (wholesale) customers. In the case where transfer prices are set above marginal cost so as to credibly convey less aggressive retail encroachment, these restrictions fit the bill. Once the firm sets its wholesale price, it has effectively also conveyed a commitment to its transfer price. Since both of the desired prices are above cost, arm's length pricing restrictions can ensure the optimality of decentralization even absent (direct) observability or commitment to such prices.

More broadly, the issue of observability goes beyond internal transfer pricing to permeate external wholesale prices. After all, it is typically presumed that a wholesale price set by a supplier is observed by not just the recipient but also its rivals. As research in the output market realm has shown, the issue of observable retail prices is a critical one. Attempts to compel firms to post retail pricing have arisen in a variety of industries, from alcoholic beverages to eye exams. These disclosures have mostly served to hinder price discrimination and favoritism, thereby promoting greater competition; however, they have also created potential for greater collusion in some markets (Austin and Gravelle, 2008). These dual consequences of retail price disclosure have largely echoed the theoretical research noting both societal upsides and downsides of enhanced disclosures (e.g., Stigler, 1964; Varian, 1980; Schultz, 2005).

A key theme permeating the present work is that input markets, by their nature, introduce subtle new considerations. In this vein, in a recent working paper (Arya and Mittendorf, 2010a), we have sought to consider the consequences for disclosure standards in input markets. This work seeks to focus on the unique aspects of input markets in divining the efficacy of disclosure standards for input market pricing. Supply markets are often characterized by limited competition (or even monopoly), and buyers in the supply market are not ultimate consumers but instead face competition of their own. Each of these features is unique to input markets and plays a critical role in the analysis.

When the unique features of input markets are considered, we find a picture that is distinct from typical views about disclosure in retail markets. In particular, when supplier power is concentrated, disclosure

provides an avenue through which a powerful supplier can use its (observed) wholesale prices to coordinate retail behavior of its wholesale customers. From an efficiency perspective, such coordination is unwanted, thereby pointing to benefits of contract opacity. In contrast, when supplier power is dispersed, disclosure of contracts becomes a means through which suppliers compete indirectly via their retail surrogates. In this case, efficiency is promoted by the increased competition that accompanies such disclosures. In short, the efficacy of disclosure requirements for wholesale contracts depends critically on supplier concentration in input markets.

To get a feel for the intuition that underlies this conclusion, consider two retailers. Say the retailers are each served by a separate supplier as when a Burger King franchise competes with a nearby McDonalds franchise. In this case, when contracts are disclosed, each supplier recognizes that any price cuts it offers to its wholesale customer will give the customer a multi-faceted benefit in retail competition: the customer reaps not only direct savings but also conveys a more aggressive retail posture to its rival. Absent disclosure of contracts, however, the supplier cannot use its wholesale price to influence the retail competitor, only its own customer. As a result, without contract disclosure, wholesale prices are higher. Such higher wholesale prices under confidentiality stand to hurt consumers (due to the ensuing increase in retail prices), and even hinder industry profit (due to the detrimental effect of double marginalization).

If, on the other hand, both retailers rely on a single (common) supplier, the supplier's incentives are radically different. This corresponds with two competing electronics retailers who each sell the same brand of televisions. With both of its customers competing directly in the retail realm, the supplier now seeks a way to soften this competition and foster a more cooperative retail environment. When contracts are disclosed, the supplier can use a high wholesale price for one customer to signal a softened retail stance to another. The end result is inflated wholesale prices. Confidentiality of terms prevents the supplier from using its wholesale prices to undercut retail competition. In this case, then, confidentiality points to lower wholesale prices and greater efficiency.

As Arya and Mittendorf (2010a) demonstrate, this basic tension from the two retailer case persists more generally in that the greater intra-brand competition the more efficient confidential supply chain contracts become. Besides providing a view of price disclosure in input markets which is distinct from that in output markets, it also provides a different view of disclosure of (stochastic) costs in output markets. After all, the role of cost disclosure on output market competition is well-studied (for reviews, see Dye, 2001; Verrecchia, 2001). One key result in that case is that under quantity competition, the disclosure of its costs benefits the retail firm. Since input prices are simply costs, one may think that the same result persists in the case of disclosure of input prices. However, since input prices are endogenous and strategically determined, disclosure thereof represents a drastically different decision. In fact, when retail firms rely on a common supplier, the retailers (and society as a whole) prefer to maintain confidentiality of cost terms.

In our view, further investigation of the role of disclosure when firms participate in both input and output markets is justified. It is worth noting that the preferences for disclosure of proprietary information to output markets and the preferences for disclosure to (or) from suppliers of inputs are both well documented. But, the considerations of the interaction of the two are notably missing. For example, the question of disclosure to (or from) a VIP is an open one.

Multiperiod Interactions

As a final caveat and plea for additional work, we note that the settings reviewed herein all represent one-shot interactions. Though these represent a natural starting point, they of course do not provide the full picture of firm behavior. The importance of considering multiple periods is not lost on accountants. After all, the notions of periodicity, matching, and the conservation of income all firmly undergird the most fundamental of accounting ideas. These notions require a long-term view, and for this reason we feel an understanding of enduring relationships across time is essential if this line of work is to greatly expand our knowledge. In this regard, we will discuss a few efforts with

the recognition that the discussion is neither representative of all that has been done nor of what can be done.

The matching principle, a key precept of financial accounting, has been viewed extensively through the lenses of valuation, incentives, and the like. The present analysis suggests additional investigation into matching and its effect on input market relationships. Arya and Mittendorf (2009) represents one foray in this direction, by revisiting standard analyses of supply chain (channel) efficiency in light of the ubiquity of earnings-based metrics. At the risk of oversimplifying the results, the basic premise therein is that self-interest undermines efficiency in vertical relationships. That is, the supplier's inherent desire for pricing above its cost invariably leads to underprocurement by buyers which, in turn, leads to rationing at the consumer level. Though many contractual, structural, and regulatory solutions have been put forth for this dilemma, Arya and Mittendorf (2009) posits that a much-maligned feature of accounting may act as a natural salve. In particular, matching stipulates that the cost of goods (inputs) purchased need not be reflected as expenses until the associated outputs are sold. Further, this expense is reflected in nominal (not real) terms. This feature is emphasized as a downside of accounting and stressed as creating an incentive to overproduce, even leading to accusations that accounting promotes "channel stuffing".

In a sense, accounting metrics promote the classic problem of "money illusion" (e.g., Fisher, 1928), in that the input buyer does not fully realize the real cost relative to the real benefits of purchases but instead focuses on nominal costs and benefits. However, when viewed through the lens of self-interested channels, the incentive to overproduce can help overcome the rationing that arises due to self interest. The end result is that the matching principle and reliance on accounting metrics based upon it can help promote efficiency in a supply chain. And, if long-term investments too play a critical role in channel behavior, the use of earnings metrics can benefit all parties along the supply chain.

A related issue is of inventory holding and inventory management. Multiperiod input market relationships and accounting practice each focus intently on the role of inventory. A key question in the realm of

inventories is who has control over (and ownership of) inventories, and who has access to the information regarding inventory levels. Traditional inventory management models balance between having sufficient stocks to meet unforeseen spikes in demand with the desire to minimize holding costs, thereby leading to firms relying on Just-In-Time inventory (JIT), Vendor Managed Inventory (VMI), or other such trends. Yet, accounting invariably forces one to think of information and its role in economic relationships. In this vein, Arya and Mittendorf (2010b) seek to examine the strategic input market effects of sharing inventory information. This investigation is done in a world of certainty so as to isolate strategic input market considerations from traditional views of inventory rooted in meeting uncertain demands. Their study builds upon Anand et al. (2008) who demonstrate that inventory can serve a strategic role — if an input buyer opts to hold inputs in inventory, it lowers its willingness to pay for inputs in subsequent years (since left-over inventory stock can be used to meet the most pressing demands). With this role of inventory in mind, the supplier sets higher input prices to discourage inventory hoarding. The net result is that (the potential for) inventory hoarding can harm suppliers and buyers alike. By sharing inventory information, a firm permits its supplier to employ usage contingent pricing — the supplier offers a discount/rebate for timely sales thereby shifting input purchases away from inventory hoarding toward sales to ultimate consumers. The net result is that all supply chain parties (including consumers) can be made better off by the installation of an inventory information sharing system. These results provide an explanation for the cooperative sharing of information in otherwise contentious vertical relationships.

As a final example of multiple period considerations in input markets, we feel obligated to mention the sale of goods which last for multiple periods. Such durable goods represent the bane of a monopolist's existence. As first suggested by Coase (1972), durable goods create a time-inconsistency problem wherein a firm has incentives to lower prices and sell more goods after an initial round of sales of durable goods is completed. The ensuing price drops invariably reduce the holding value of the goods purchased by early adopters, and, foreseeing such price drops, early adopters mark down what they are willing to pay for the

product in the first place. In short, profits are hurt by a firm's inability to convince consumers that it will keep prices consistently high. In a sense, a firm at one point in time is competing with itself at another point in time. In fact, Coase (1972) conjectured that if a monopolist can adjust prices frequently he may, in fact, lose his entire monopoly power in the "twinkling of an eye."

The bulk of research on the time-inconsistency problem with respect to durable goods is conducted in the absence of input markets. Arya and Mittendorf (2006a) layer input market considerations on the traditional durable goods (monopoly) model and demonstrate that much of the channel strife which stems from self-interest that research has sought to remedy may actually prove helpful in the presence of durable goods. If a consumer is aware it is buying a durable good from a disintegrated supply chain subject to modest distortions induced by self-interest, it can also rest assured that future supply of the good will be rationed due to channel discord. While this discord, in isolation, can be harmful to the channel, it can also boost early adopters' willingness to pay since it serves as a credible commitment not to subsequently flood the market with products. When viewed this way, perhaps the very things that are typically seen as limitations inherent in input markets may actually promote long-term efficiency therein.

Again, the papers on multiple period interactions and their effects on (and influence by) input markets is not intended to be comprehensive. There are no doubt more facets of the long-term view that have been studied and, perhaps more importantly, should be studied. The role of reputation, long-term contracts, career concerns of employees within firms, product spoilage, and obsolescence represent just a sampling of such topics.

A Brief Conclusion

In this review, we have culled recent research that examines how participation in input markets can alter firm strategy and organization. This stream of literature encompasses a variety of implications, from accounting practices and standards to the structure and organization of industries. In each case, it is shown how critical input markets can

be to how firms and markets behave. Taken holistically, the results suggest that any policy-maker, business professional, standard setter, or student should take a close look at a firm's role in input markets before drawing any conclusions about how that firm does or should behave. More close to home, the results suggest that accounting practices, when viewed absent input market considerations, are inherently myopic.

While this broad theme is clearly borne out in the specific studies addressed, it goes without saying that the specific works considered do not fully represent all that has been done or all that can be done in studying firm behavior and accounting practice. Clearly, in our view, this represents a stream of literature ripe for more investigation. For our part, we intend to pursue this line of inquiry further to gain a better understanding of how changing, perhaps even evolutionary, industrial structures influence and are influenced by strategic firm behavior both within and outside the realm of accounting practices. We hope that others in the many disciplines of management and economics choose to do the same.

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