Decentralization, Transfer Pricing, and Tacit Collusion

MIKHAEL SHOR and HUI CHEN

Abstract

Research in accounting traditionally regards transfer pricing as an intra-firm transaction problem. Within the context of a simple Cournot model, we demonstrate that firms can use transfer prices strategically as a collusive device. While firms are individually better off from a centralized organizational form with each internal division transferring intermediate goods at marginal cost, all firms benefit from a collusive agreement to organize along profit centers, transferring goods above marginal cost. This collusion yields roughly twice the competitive profits and is sustainable even when collusion on quantities is not. This practice may also escape legal scrutiny, even though the same cost shifting between regulated monopolists and their corporate affiliates is regarded as a major concern for regulators and researchers.

Keywords Collusion; Strategic delegation; Transfer pricing; Vertical integration

JEL Descriptors C700, L410, M410

The full text of this paper begins on p. 581 of this issue.

La décentralisation, l'établissement des prix de cession interne et la collusion tacite

MIKHAEL SHOR et HUI CHEN

Résumé

Les chercheurs en comptabilité envisagent habituellement l'établissement des prix de cession interne comme un problème d'opération intrasociété. Dans le contexte d'un modèle de Cournot simple, les auteurs démontrent que les sociétés peuvent utiliser les prix de cession interne à des fins stratégiques, à titre d'instruments de collusion. Bien que la centralisation, en vertu de laquelle chaque division interne cède des produits intermédiaires au coût marginal, soit plus avantageuse pour les sociétés à l'échelon individuel, toutes les entreprises bénéficient d'un accord de collusion selon lequel elles cèdent leurs produits au-dessus du coût marginal, en qualité de centres de profit. Cette collusion engendre environ le double des profits concurrentiels et peut être maintenue même lorsque la collusion sur les quantités ne le peut pas. Cette pratique peut également échapper à la surveillance des autorités, alors que les mêmes transferts de coûts entre des entreprises monopolistiques réglementées et leurs sociétés apparentées sont une grande source de préoccupation pour les autorités de réglementation et les chercheurs.

Mots clés : collusion, délégation stratégique, établissement des prix de cession interne, intégration verticale

Classification JEL : C700, L410, M410

La version intégrale anglaise de l'article qui précède commence à la page 581 du présent numéro.

Decentralization, Transfer Pricing, and Tacit Collusion

MIKHAEL SHOR, *Vanderbilt University*

HUI CHEN, *University of Colorado at Boulder*

1. Introduction

Although accounting researchers traditionally regard transfer pricing as an intra-firm transaction problem,[1] it has always entailed strategic implications for the competitive environment in which the firm operates.

For example, a regulated firm can purposefully have its unregulated affiliate overcharge the parent firm to inflate the parent firm's cost and final price to consumers. Meanwhile, the unregulated affiliate can also afford to adopt predatory prices to deter new entrants into the market (e.g., Brennan 1990). To avoid this consequence, regulators often provide specific guidelines on the pricing of internal transactions between regulated parents and affiliates enforced through frequent audits.[2]

The practice of cost shifting or cross-subsidization is a prominent phenomenon in industries ranging from health care (Foreman, Keeler, and Banks 1999) and insurance markets (Puelz and Snow 1994) to professional sports (Fort and Quick 1995). Before the dissipation of AT&T, the company was accused of adopting unreasonably high transfer prices from Western Electric, one of its unregulated subsidiaries, to support higher rates on local telephone services. Even after the breakup of AT&T, concerns persisted about the possible collusion among regional Bell operating companies through common agreement to inflate transfer prices (Shughart 1995). If they all agreed not to offer inputs at competitive prices or to report similarly inflated costs, they could sustain the cross-subsidies in which AT&T was previously engaged.

In this study, we investigate how transfer prices can be used as a strategic tool for competing firms to achieve tacit collusion. In our model, firms do not face information asymmetries, agency costs, or tax consequences, removing several traditional motivations for transfer prices. We consider the role of internal transfer prices within the context of a Cournot model of competition.

Each firm consists of an upstream division, the internal supplier, and a downstream division that takes the inputs from the supplier and sells to the market. The price at which internal transfers occur depends on the organizational form adopted by the firm. Firms can adopt one of two organizational forms. A centralized firm determines interdivisional transactions based on overall corporate profit maximization.

* Accepted by Raffi Indjejikian. The authors would like to thank Tim Baldenius, Robert Göx, Luke Froeb, Debra Jeter, and two anonymous referees for helpful comments.

Contemporary Accounting Research Vol. 26 No. 2 (Summer 2009) pp. 581–604 © CAAA
doi:10.1506/car.26.2.10

A decentralized firm treats its divisions as independent profit centers, allowing each to set prices and quantities based on divisional profit-maximization concerns. A centralized firm will set its transfer price at the marginal cost of the upstream division, while the decentralized firm will allow its upstream division to charge a transfer price that maximizes its divisional profit.

We first confirm the fundamental principle that each firm is not only better off if divisions are compelled to transfer at marginal cost, but also that such centralized control is a dominant strategy. It is optimal to adopt a centralized organizational form regardless of the organizational governance adopted by others in the industry. However, we show that all firms are better off if each decentralizes decision making and operates independent profit centers. If divisions are run as profit centers, successive divisions mark up prices, serving to inflate input costs to the downstream division and resulting in artificially higher prices. When this organizational form is adopted by all firms, we show that industry-wide profits are roughly double those obtained at the noncooperative equilibrium. An *n*-person prisoner's dilemma results; while each firm has the incentive to establish a centralized structure, all benefit if each operates independent profit centers. Thus, profit centers may be used to facilitate collusion, and such collusion is shown to be sustainable even when direct collusion on quantity would not be possible. This collusive scheme may even drive total industry output below monopoly levels, significantly affecting consumers.

Our results have an intuitive explanation. The goal of collusion is to raise prices closer to monopoly levels. Allowing upstream divisions to set profit-maximizing prices for their input goods inflates the effective cost for downstream divisions, resulting in just such higher prices. All firms in the industry enjoy the "double-marginalized" profits. While we do not claim that collusion on organizational form is the primary motivation for firms' decentralization decisions, we would like to stress the advantages for firms of this type of collusion compared with traditional models of collusion, such as agreements to restrict firm output. The first advantage concerns the sustainability of collusion on organizational form. In traditional models of collusion among firms, the set of discount factors that support collusion vanishes as the number of firms becomes large. Asymptotically, interest rates arbitrarily close to zero are required for collusion to be sustainable even under the most rash (grim trigger strategy) punishments by other firms. Conversely, collusion on organizational form is sustainable for a wide range of interest rates. Even as the number of firms becomes arbitrarily large, interest rates as high as 50 percent still allow collusion to be sustained.

A second advantage of colluding on organizational form concerns enforcement. Agreeing to set prices or quantities is per se illegal, while the selection of organizational form is not only less regulated but also commonly discussed at industry conferences without raising antitrust concerns. Thus, selection of organizational form facilitates tacit collusion, in which seemingly unilateral, noncoordinated actions serve to enforce artificially high prices. In fact, we may conjecture that colluding on transfer pricing through organizational structure is the most profitable form of collusion within legal limits.

Industry studies suggest that oligopolists tend to converge in their business models, strategies, and organizational structures. Pepsi and Coca-Cola both steadily integrated with bottling suppliers (Saltzman, Levy, and Hilke 1999). Major car makers spun off component suppliers both in the United States (Lin 2006) and Japan (Ito 1995). Grocers and retailers established their own distribution centers (Martinez 2002). Television networks increasingly produce their own shows (Einstein 2004). Changes to organizational form are usually observable by competitors, facilitating tacit coordination and convergence.

Several previous studies have also examined the strategic use of transfer pricing. For example, Bulow, Geanakoplos, and Klemperer (1985), Alles and Datar (1998), Narayanan and Smith (2000), and Göx (2000) consider how firms in a duopolistic market can set transfer prices in a way that purposefully changes the divisional manager's pricing behavior. In general, transfer prices set below marginal cost would encourage divisional managers to adopt a more aggressive pricing strategy, while prices set above marginal cost would encourage a less aggressive pricing strategy. Gal-Or (1993) and Hughes and Kao (1998) consider strategic implications of cost cross-subsidization in multidivisional firms. They demonstrate that firms can strategically allocate their internal costs so that each firm becomes the dominant producer in one market. Baldenius and Reichelstein (2006) consider a firm whose upstream division has monopoly power in a proprietary component sold both to its own downstream division and to an external market. They find that intracompany discounts improve the firm's profits when the upstream division is capacity-constrained. Although we also focus on the strategic use of organizational form and transfer pricing, we add to the literature an explicit model of collusion and derive the benefits it generates for firms. We investigate the sustainability of such tacit collusion despite private incentives to "cheat" and show it to be sustainable even as the number of firms becomes large. We demonstrate that this collusion can be less socially desirable than a monopoly.

This paper also relates to several recent papers in economics that compare centralized and decentralized corporate structures, including those by Baron and Besanko 1992; Moorthy 1988; Melumad, Mookherjee, and Reichelstein 1992; and Laffont and Martimort 1998. The conception of the firm in this paper is substantially simpler, deliberately ignoring issues like commitment and renegotiation ability. However, the possibility of collusion *among* firms is explicitly modeled. Laffont and Martimort (1998) consider collusion among divisions *within* a firm. Bonanno and Vickers (1988) establish that vertical separation can increase profit within the context of a Bertrand duopoly. None of these studies examines the sustainability of collusion.

Some authors have specifically noted the strategic role of decentralization and delegation (Sklivas 1987; Fershtman and Judd 1987; Alles and Datar 1998). A manager may be compensated partly based on sales (Basu 1995) or market share (Wauthy 1998), which serves as a commitment to higher output, resulting in competing firms decreasing output. In contrast to the present study, these approaches are adopted by all firms in equilibrium and result in lower profits.[3]

2. Model

Each of n firms is composed of two divisions. The upstream division costlessly produces an intermediate good, which the downstream division converts into a final consumer good using a 1:1 Leontief production technology. That is, the input is the only requirement for production, and each unit of the input good is transformed into a single unit of the final good. Note that we are assuming that there is no external market for these goods; the upstream division is the only seller and the downstream division is the only buyer within each firm. We consider the role of an external market in a later section. We distinguish between two types of organizational forms: decentralized, in which each division maximizes its profit, and centralized, in which overall corporate profit is maximized or, equivalently, the central planner requires the transfer of goods from the upstream to the downstream division at cost. Thus, the downstream division's marginal cost is precisely the price charged by the upstream division for the intermediate good. The downstream divisions compete in quantities, à la Cournot. Downstream demand is given by the familiar linear form:

$$p_i = a - bq_i - bQ_{-i} \quad (1),$$

where $Q_{-i} = \Sigma_{j \neq i} q_j$ is the output of all of firm i's competitors. The timing of the game proceeds as follows:

1. Firms simultaneously select an organizational form, $o_i \in \{C, D\}$, either centralized or decentralized.
2. Upstream divisions of decentralized firms set a transfer price, t_i, to maximize division profit. Centralized firms transfer at marginal cost, normalized to 0.[4]
3. Downstream divisions select quantities to maximize profit.

In the following subsection, we derive the noncooperative equilibrium of this game and demonstrate that selection of a centralized organizational structure is a dominant strategy.

Noncooperative equilibrium

We identify the unique subgame perfect equilibrium. As is customary, we analyze the game backwards, first solving the downstream division's optimization problem given any profile of transfer prices elected by the upstream divisions. Given input costs of t_i, the maximization problem faced by the downstream division at firm i is

$$\max_{q_i} (a - bq_i - bQ_{-i} - t_i)q_i \quad (2),$$

which yields, for each firm, the first-order conditions

$$q_i = \frac{a - t_i}{2b} - \frac{1}{2}Q_{-i} \quad (3)$$

and generates the equilibrium quantities

$$q_i^*(t_i, T_{-i}) = \frac{(a - nt_i + T_{-i})}{(n+1)b} \tag{4},$$

where $T_{-i} = \Sigma_{j \neq i} t_j$. Since the transfer prices are set by the upstream divisions of decentralized firms, (4) is an implied demand curve for these divisions. The upstream division in a decentralized firm solves

$$\max_{t_i} t_i q_i^*(t_i, T_{-i}) \tag{5},$$

while a centralized firm transfers at marginal cost, assumed to be 0.

Assume that m firms have decentralized organizational forms and $n - m$ firms transfer at marginal cost. Then, solving (5) results in transfer prices given by

$$t_i = \begin{cases} \dfrac{a}{2n - m + 1} & o_i = D \\ 0 & o_i = C \end{cases} \tag{6},$$

with resulting quantities

$$q_i = \begin{cases} \dfrac{an}{(n+1)(2n - m + 1)b} & o_i = D \\ \dfrac{a(2n+1)}{(n+1)(2n - m + 1)b} & o_i = C \end{cases} \tag{7}.$$

PROPOSITION 1. *$o_i = C$ is a dominant strategy. A centralized firm (transferring at marginal cost) always earns strictly greater profits than a decentralized firm for any election of organizational form by its competitors.*

The proof of this and all other results is in the Appendix. This confirms Hirshleifer's 1956 result that it is preferable to transfer goods at marginal cost, regardless of the behavior of the rest of the industry. The noncooperative equilibrium is

$$o_i = C, \quad t_i = 0, \quad q_i = \frac{a}{(n+1)b} \quad \forall i$$

with resulting industry price and profits of $p^{non} = a/(n+1)$ and $\Pi_i^{non} = a^2/[(n+1)^2 b]$ (superscript *non* representing the noncooperative equilibrium), which are the familiar results of a Cournot model with linear demand and zero marginal costs.

3. Collusion

Next, consider the outcome if firms collude on organizational form. If all firms adopt a decentralized structure despite the strong inclination to centralize, greater profits result.

PROPOSITION 2. *Colluding on organizational form is profitable. If all firms set* $o_i = D$*, the resulting collusive profit exceeds noncooperative equilibrium profit.*

A natural question is, how sizable is the increase in profit? Does collusion result in only marginal increases, especially as the number of firms gets large, or in marked profit improvements? The next remark addresses this issue. Let Π_i^{col} denote the profit of a representative firm when all firms adopt the decentralized organizational form ($o_i = D \; \forall i$).

REMARK 2.1. *As* $n \to \infty$, $\Pi_i^{col}/\Pi_i^{non} = n(2n + 1)/(n + 1)^2 \to 2$.

The increase in profits appears not to be trivial. Since the area under the demand curve is finite, both noncooperative and collusive profits tend to zero for large n, though overall industry profits are roughly doubled when firms cooperate. The smallest relative profit increase brought about by collusion is when $n = 2$. However, the efficiency impact of collusion with only two firms is stark. As the next result demonstrates, when only two firms exist, total collusive industry output is below monopoly levels.

REMARK 2.2. *For* $n = 2$*, collusion on organizational form is less efficient than a monopoly.*

Hence, two firms colluding on organizational form earn lower profits than two firms colluding purely on total industry quantity or price, and do so at the expense of efficiency. To understand this result, note that organizational form is a crude collusive instrument. The resulting double marginalization results in higher prices than the noncooperative outcome, but does so in a manner that does not allow precise control over the final market price. In the case of two firms, the act of decentralizing overshoots the optimal price. This suggests that a merger among two colluding firms may actually increase efficiency. The benefits accrued from eliminating the intentional double marginalization present in each of the two firms outweighs the loss of competition, even if a monopoly results.

When more than two firms are present, collusion on organizational form serves to inflate prices, but never to monopoly levels. This is due to our decentralized firms having only two divisions. It can be verified that if each of three firms organizes a chain of three divisions, with the first two successively marking up transfer prices to the third downstream division, market prices will again exceed monopoly levels.

4. Sustainability

In the previous section, we found that each firm has a dominant strategy, and that if each elects instead to play its dominated strategy, all firms realize higher profits. Firms find themselves in an n-player prisoner's dilemma. All firms earns greater profits when they agree to decentralize than under the centralized noncooperative equilibrium. However, since centralization is a dominant strategy, the incentive to cheat on the agreement is ever-present.

In this section, we consider the sustainability of cooperation when accompanied by sufficient threats to revert to noncooperative play. Centralizing increases the profit of a firm in the short term, but also decreases rivals' profits. Thus, it is not unreasonable that such a move by one firm could lead to a cascade of similar organizational changes industry-wide. This realization, that centralization by one firm will lead to centralization by its rivals, is effectively the same as supporting collusion through trigger strategies.

Trigger strategies, in general, imply that all firms will play cooperatively until any firm cheats.[5] Specifically, assume that each firm credibly commits to using the grim trigger strategy. Following any firm cheating, all firms will play noncooperatively in the continuation game, and thus the Nash equilibrium with centralized organizational forms will obtain ad infinitum.[6] Even under this most drastic of punishments, collusion on quantities fails to be sustainable as the number of firms increases. Below, we show that collusion on organizational form is quite sustainable under this punishment for any reasonable range of interest rates. This implies that substantially less drastic (and more credible) punishments can also support collusion in this context.

Letting $\delta \equiv 1/(1 + r)$ denote the discount factor, where r is the interest rate, and letting Π^{non}, Π^{col}, and Π^{ch} be the noncooperative, collusive, and cheating profits, respectively, collusion is sustainable if the present value of collusion is greater than the present value of cheating enforced by the grim trigger strategy:

$$\frac{1}{1-\delta}\Pi^{col} > \Pi^{ch} + \frac{\delta}{1-\delta}\Pi^{non}$$

$$\Leftrightarrow \quad \delta > \frac{\Pi^{ch} - \Pi^{col}}{\Pi^{ch} - \Pi^{non}} \qquad (8).$$

Denote the δ that satisfies (8) with equality as δ^*. This represents the minimum sustainable discount factor. Further, we distinguish between two forms of collusion: direct quantity collusion and organizational form collusion, and refer to their minimum sustainable discount factor as $\delta^{*(q)}$ and $\delta^{*(o)}$, respectively.

A traditional result in quantity collusion is that sustainability becomes more difficult with more firms, and no reasonable interest rate may sustain collusion as the number of firms becomes large.[7]

PROPOSITION 3. *As* $n \to \infty$, $\delta^{*(q)} \to 1$.

This proposition implies that as the number of firms becomes large, collusion is sustainable only if future profits are as valuable as present profits — if no discounting occurs. Hence, even under the most drastic of punishments, the grim trigger strategy, neither price nor quantity collusion is sustainable asymptotically. Collusion on organizational form is far easier to support, however.

PROPOSITION 4. *(a)* $\delta^{*(o)} < 1$ *and (b)* $\delta^{*(o)} < 2/3$ *for* $n \geq 4$.

Even as the number of firms becomes large, the critical discount factor is bounded by 2/3. To appreciate the implications of the result, we can translate from the discount factor, δ, to the interest rate, r, using the identity $\delta = 1/(1 + r)$. An upper bound on δ of 2/3 implies a lower bound on the interest rate, r, of 1/2. Firms always find it more profitable to collude when the return on a firm's investments and business operations is less than 1/2.

The intuition for this result lies in the lower profits obtainable by cheating. In the two types of collusion considered (quantity and organizational form), both the noncooperative and collusive profits go to zero as the number of firms becomes large. However, in traditional models of quantity (or price) collusion, total industry quantity does not vary with the number of firms, ensuring that the profits from cheating remain bounded away from zero. In price collusion, for example, a cheating firm captures the entire market by slightly undercutting the agreed-upon price, wholly appropriating the monopoly profit. Conversely, when colluding on organizational form, cheating is still more profitable in the short term than colluding, but since total collusive output grows with the number of firms, the gains from cheating also vanish as the number of firms approaches infinity. Effectively, the imperfect nature of colluding on organizational form, which makes it less profitable than colluding on quantity directly, also diminishes the incentive to cheat, making it easier to sustain.

5. An external market

In the previous sections, we derived results in the absence of an external market for the intermediate goods produced by upstream divisions. In this section, we briefly consider the role such a market would play and confirm that our results still obtain, qualitatively.

Holding everything else the same as in the previous sections, we now introduce an external market for the intermediate good produced by the upstream divisions. The market is composed of firms' upstream divisions from the seller side and firms' downstream divisions from the buyer side. We assume that a centralized firm avoids the external market and transfers from its upstream to its downstream division internally. A decentralized firm has its upstream division competitively selling the intermediate good to an external market, competing against other upstream divisions of decentralized firms. Compared with the previous section, a second level of Cournot competition is created. First, intermediate goods are sold among decentralized firms, and second, final goods are sold to the market by all firms.

Consider the case where all firms are decentralized. Since competition among the upstream divisions implies a single, market-clearing price in the intermediate goods market, we have $t_i \equiv t$ for all i. From (4), downstream quantities are given by:

$$q_i^*(t) = \frac{a - t}{(n+1)b} \tag{9}$$

for any intermediate goods price, t. Solving for t and substituting total market quantity, we obtain the demand in the intermediate goods market:

$$t = a - \left(\frac{n+1}{n}\right)bQ \tag{10}.$$

Effectively, the market-clearing price in the intermediate goods market becomes the input cost to downstream divisions. Thus, the demand faced by upstream divisions is the residual demand of the downstream divisions. In particular, solving for the equilibrium involves three steps. First, downstream divisions face the demand curve $p = a - bQ$ given in (1). Second, upstream divisions, in a subgame perfect equilibrium, can calculate the resulting downstream demand for any outcome in the intermediate goods market, and this is given by (9). Lastly, this implies a residual demand curve for upstream firms, (10), over which they compete in quantities. The following result demonstrates that the resulting equilibrium is identical to the one obtained without an external market.

PROPOSITION 5. *Noncooperative equilibrium profits and collusive profits in the presence of an external market are equivalent to those in the absence of an external market.*

In the noncooperative equilibrium, all firms are centralized. Since no firm avails itself of the external market, this is identical to our earlier results. In the case of a collusive market, all firms have their upstream divisions selling to the intermediate goods market. Unlike the previous section, in which each upstream division is effectively a sole seller to one of the n market participants, each becomes one of n sellers to the whole market in the presence of an external market. This result demonstrates that resulting firm profits are identical.

While Proposition 5 suggests that the gains from colluding on organizational form are invariant to the existence of an external market, the gains from cheating on this collusive scheme are not the same as when no external market exists.

Imagine that when a firm cheats, it stops selling to the external market and production decisions are made centrally (which is equivalent to assuming that the downstream division is supplied at marginal cost). Competitors continue to function in the external market for the remainder of that period (all later periods revert to equilibrium as per the grim trigger strategy) with full knowledge that the cheater will have a cost advantage. We define "cheating" in this setting as a firm centralizing its transfer-pricing decisions and letting its upstream division sell the intermediate

product to its own downstream division at desired quantity and marginal cost. This implies that the firm completely withdraws its production from the market. Having observed the "cheating" firm's action, other firms in the industry continue to function in the external market for the remainder of that period. We maintain the harshest (grim trigger strategy) punishment; other firms revert to equilibrium by centralizing in all later periods.[8] The next result suggests that the existence of an external market makes collusion on organizational form easier.

REMARK 5.1. *Collusion is easier to sustain in the presence of an intermediate goods market than in its absence.*

Although both the noncooperative and collusive outcomes yield identical profits with and without an intermediate market, the presence of an intermediate market does change the incentive to cheat. In particular, cheating when an external market exists involves withdrawing one's upstream goods from this market and transferring them internally instead. The intermediate goods market must arrive at new equilibrium quantities and transfer price to make up for this change in supply and demand. Since one firm is now centralized, it will expand production, lowering the residual demand for the remaining colluding firms. This drives the equilibrium transfer price in the intermediate goods market down, inflating the output of the remaining decentralized firms and moderating the profitability from cheating.[9] These lower profits from cheating in the presence of an intermediate goods market diminish the incentive to cheat, making collusion more sustainable. Effectively, upon observing a firm withdraw from the intermediate goods market, the remaining firms will initiate punishment by reverting to the noncooperative equilibrium in the following period. In the mean time, the presence of an intermediate goods market allows them a half-measure of punishment in the current period. In short, an external market for intermediate goods allows colluding firms to make significant adjustments to their own transfer costs when a rival cheats, diminishing the benefit from cheating.

Overall, the external market does not qualitatively change the incentive to collude. Again, we denote by $\delta^{*(o)}$ the minimum discount factor that sustains collusion.

PROPOSITION 6. $\delta^{*(o)} < 1$ *for all* $n \geq 2$.

The proposition implies that collusion on organizational form is sustainable with or without an external market. Admittedly, our model does not consider the possibility of preferential transfers in which, for example, an upstream division will transfer to its own downstream division at a price slightly more favorable than those prevailing at the market (Baldenius and Reichelstein 2006). However, we find that the industry-wide double marginalization that results with an intermediate market serves a similar collusive purpose to intra-firm firm double marginalization in the absence of an external market.

6. Conclusion

Double marginalization occurs when upstream divisions raise transfer prices without accounting for the resulting loss of profits in downstream divisions. In a competitive industry, the resulting final price leads to suboptimal overall profit of an individual firm as each markup is successively promulgated down the supply chain. However, all firms in an industry would benefit if they collude on inflating final prices to near-monopoly levels by artificially raising transfer prices.

We demonstrate that the seemingly unprofitable strategy of decentralizing price-setting decisions actually makes sense when considered in a strategic context, incorporating its impact on industry profitability. In particular, adopting inefficient organizational forms can serve as facilitating devices that make collusion sustainable when direct collusion on quantities would not be possible. We contribute to the literature by demonstrating how transfer prices can be used as a collusive mechanism to affect competition and thus welfare beyond one single firm. The results of the paper may also provide some explanation of why decentralization as an organizational form is becoming increasingly popular in many industries.

In models of tacit collusion, departures from linear demand forms generally result in a loss of tractable analytical solutions. Nevertheless, we can conjecture what is likely to occur under more general demand forms. In our two-stage market, the impact of internal transfer prices on equilibrium prices depends crucially on the passthrough rate. These rates reflect the proportion of cost increases reflected in final prices, and depend not only on the demand curve's elasticity, but also on the change of that elasticity with price (Bulow and Pfleiderer 1983; Froeb, Tschantz, and Werden 2005). While the passthrough rate is generally higher for convex demand forms than for linear demand, and lower for concave demand (Ten Kate and Niels 2005), this need not alter the incentive to collude, since commonly used demand curves often cause these effects to go in the same direction for both the profits from colluding and from cheating.

Collie (2004) demonstrates numerically that quantity collusion with constant-elasticity-of-substitution demand is easier to sustain the higher is the elasticity of demand. Tyagi (1999) finds that the impact of product substitutability on tacit collusion is qualitatively the same under linear demand as under all concave demand functions within a certain class, and these results are only reversed when firms are significantly differentiated and face sufficiently convex demand functions. Lambertini (1994) analyzes Cournot collusion for a class of demand functions that includes the linear, and likewise finds that collusion is more sustainable under more concave demand functions. Thus, it appears that our results would apply to common formulations of concave demand functions and, since our critical discount factor is always strictly bounded away from 1, to demand functions that are not too convex. Of course, overly convex demand functions call into question the existence of Cournot equilibria and may significantly alter qualitative findings of the Cournot model when they do exist (Svizzero 1997).

In our model, we consider only two polar firm structures. Our management is empowered only with the ability either to set up to maximize firm-level profits or

to set up independent profit centers, with the upstream and downstream divisions each maximizing their own profits. A more general approach could allow the firm's management to directly control the transfer price, in a way that purposefully changes the divisional manager's pricing behavior (Bulow, Geanakoplos, and Klemperer 1985; Alles and Datar 1998; Narayanan and Smith 2000; Göx 2000). Several authors have found, for example, that intra-firm discounts or transfer prices set below marginal cost can encourage divisional managers to take more aggressive pricing strategy (Gal-Or 1993; Hughes and Kao 1998; Baldenius and Reichelstein 2006). It is informative to consider how such broader managerial latitude would influence our results.

First, if our conception of a centralized firm is replaced with central management directly setting transfer prices, the resulting equilibrium would be sensitive to our modeling assumptions. In particular, most previous papers do not consider whether strategic transfer prices are sustainable if adopted industry-wide. In our model, a symmetric outcome in which all firms transfer above marginal cost would not be sustainable in a one-shot equilibrium, while symmetric transfers *below* marginal cost would serve to reduce each firm's equilibrium profit. Thus, the collusive outcome would be even easier to sustain since the punishment — reversion to centralized structures — would be more severe. On the other hand, if we replace our notion of decentralized firms with ones that can coordinate not only on the existence of profit centers, but on the exact transfer price, collusive profits would certainly be higher than those we obtain in our model. Effectively, firms would coordinate on precisely those transfer prices that result in a monopolistic industry price downstream. It is notable that the collusive outcome in our paper could also be improved upon by adding additional levels of divisions when there are many firms. The resulting triple marginalization with three divisions, for example, would further inflate price. However, these more direct collusive mechanisms require substantial interfirm coordination, and suffer from a lack of sustainability as the number of firms becomes large. Most important, collusion on transfer prices directly raises obvious antitrust ire.

An intriguing question is how double marginalization in the context of this paper could escape scrutiny while the same type of cost shifting between regulated monopolists and their corporate affiliates is regarded as a major concern for regulators and researchers. Price- and quantity-setting cartels have historically been considered antitrust violations per se — that is, without recourse to pro-competitive arguments. However, collusion on organizational structure is much easier to sustain because it has not generally triggered legal investigation. In fact, it is often encouraged by tax authorities around the world through "arm's-length" standards that mirror the decentralized firms of our model. Encouraging firms to set transfer prices at market price levels may help facilitate tacit collusion.

Appendix

Proof of Proposition 1

Substituting the quantities in (7) into the demand equation (1), one obtains the industry price, given by

$$p = \frac{a(2n+1)}{(n+1)(2n-m+1)}$$

and profit is given by

$$\Pi_i = \begin{cases} \dfrac{a^2 n(2n+1)}{[(n+1)(2n-m+1)]^2 b} & o_i = D \\ \dfrac{a^2(2n+1)^2}{[(n+1)(2n-m+1)]^2 b} & o_i = C \end{cases} \tag{11}.$$

Consider the optimal response of firm i given that k firms have adopted decentralized organizational forms. If firm i adopts a decentralized form, then its profit (letting $m = k + 1$) is

$$\frac{a^2 n(2n+1)}{[(n+1)(2n-k)]^2 b}.$$

If firm i elects to transfer at marginal cost, it earns

$$\frac{a^2(2n+1)^2}{[(n+1)(2n-k+1)]^2 b}.$$

To complete the proof, it is adequate to show that, for all $k \in \{1, \ldots, n-1\}$,

$$\frac{a^2(2n+1)^2}{[(n+1)(2n-k+1)]^2 b} > \frac{a^2 n(2n+1)}{[(n+1)(2n-k)]^2 b}$$

$$\Leftrightarrow \quad (2n+1)(2n-k)^2 - n(2n-k+1)^2 > 0$$

Since the left-hand side of the last expression is decreasing in k, one need only confirm it for $k = n - 1$:

$$\Leftrightarrow \quad (2n+1)(n+1)^2 - n(n+2)^2 > 0$$

$$\Leftrightarrow \quad n^3 + n^2 + 1 > 0. \qquad \blacksquare$$

Proof of Proposition 2

If $o_i = D\ \forall i$, the profit-maximizing t_i derived by substituting $m = n$ into (6) is $a/(n+1)$. Substituting into (4),

$$q_i = \frac{a}{(n+1)b}\left(\frac{n}{n+1}\right)$$

and

$$p = a - nbq_i = \frac{(2n+1)a}{(n+1)^2}.$$

The resulting firm profit is

$$\begin{aligned}\Pi_i^{col} &= \left(\frac{a}{n+1}\right)^2 \frac{1}{b}\left[\frac{n(2n+1)}{(n+1)^2}\right] \\ &= \Pi_i^{non}\left[\frac{n(2n+1)}{(n+1)^2}\right] \qquad (12).\end{aligned}$$

We need to show that these profits are larger than the noncooperative profits, or $\Pi_i^{col} > \Pi_i^{non}$:

$$\begin{aligned}&\left[\frac{n(2n+1)}{(n+1)^2}\right]\Pi_i^{non} > \Pi_i^{non} \\ \Leftrightarrow\quad &n(2n+1) > (n+1)^2 \\ \Leftrightarrow\quad &n^2 - n - 1 > 0\end{aligned}$$

Since the left-hand side of the last equation is increasing in $n > 1/2$, we need only confirm the equation for $n = 2$ $(1 > 0)$. ■

Proof of Remark 2.1

By (12) above,

$$\frac{\Pi_i^{col}}{\Pi_i^{non}} = \frac{n(2n+1)}{(n+1)^2},$$

which converges to 2, by repeated application of L'Hôpital's rule. ■

Proof of Remark 2.2

Monopoly quantity in a Cournot model with linear demand is given by $Q^{mon} = a/2nb$. For decentralization-colluding firms, $q_i = na/(n+1)^2 b$. Thus, decentralization collusion is less efficient if

$$\begin{aligned} & \frac{na}{(n+1)^2 b} && < && \frac{a}{2nb} \\ \Leftrightarrow \quad & 2n^2 && < && (n+1)^2 \\ \Leftrightarrow \quad & n^2 - 2n - 1 && < && 0 \\ \Leftrightarrow \quad & n && < && 1 + \sqrt{2}\,. \end{aligned}$$ ■

Proof of Proposition 3

First consider quantity collusion. Monopoly quantity is given by $a/2b$. Thus, a symmetric collusive scheme would assign output of $a/2nb$ to each participant, resulting in an industry price of $a/2$. Hence,

$$\Pi^{col} = \frac{a^2}{4nb},$$

$$\Pi^{non} = \left(\frac{a}{n+1}\right)^2 \frac{1}{b}.$$

If one were to cheat, the optimal response derived from (3) would be to select the quantity

$$\begin{aligned} q_i &= \frac{a}{2b} - \frac{1}{2} Q_{-i} \\ &= \frac{a}{2b} - \frac{1}{2}\left[\frac{(n-1)a}{2nb}\right] \\ &= \frac{a}{2nb}\left(\frac{n+1}{2}\right), \end{aligned}$$

with resulting price and profit of

$$p = \frac{(n+1)a}{4n}$$

and

$$\Pi^{ch} = \frac{a^2}{4nb}\left[\frac{(n+1)^2}{4n}\right].$$

With Π^{col}, Π^{ch}, and Π^{non} given by the above, we can obtain $\delta^{*(q)}$ by (8):

$$\delta^{*(q)} = \frac{\frac{a^2}{4nb}\left[\frac{(n+1)^2}{2n}\right] - \frac{a^2}{4nb}}{\frac{a^2}{4nb}\left[\frac{(n+1)^2}{4n}\right] - \left(\frac{a}{n+1}\right)^2\frac{1}{b}}$$

$$= \frac{(n+1)^2 - 4n}{(n+1)^2 - \left(\frac{4n}{n+1}\right)^2}$$

$$= \frac{(n+1)^2}{(n+1)^2 - 4n}.$$

For price competition, collusion profits are as above, $\Pi^{col} = a^2/4nb$, cheating entails undercutting the monopoly price by a tiny amount $\varepsilon > 0$, resulting in the capture of nearly the entire monopoly profit of $\Pi^{ch} = a^2/4b$, and the equilibrium of Bertrand competition in this context requires that each participant price at marginal cost, thus $\Pi^{non} = 0$ and

$$\delta^{*(q)} = \left(\frac{a^2}{4b} - \frac{a^2}{4nb}\right)/\left(\frac{a^2}{4b} - 0\right)$$

$$= \frac{n-1}{n}.$$

From the expressions above, we can confirm that

$$\lim_{n\to\infty} \delta^{*(q)} = 1 \text{ and } \lim_{n\to\infty} \delta^{*(p)} = 1.$$ ■

Proof of Proposition 4

With Π^{non} given by $[a/(n+1)]^2/b$ and Π^{col} given by (12), we need to determine Π^{ch}, the profit from cheating. If a single firm, i, centralizes ($o_i = C$) while the remaining firms $j \neq i$ remain decentralized ($o_i = D$), then profits for the centralized firm are given by (11), letting $m = n - 1$, which yields

$$\Pi^{ch} = \left[\frac{a^2}{(n+1)^2 b}\right]\left(\frac{2n+1}{n+2}\right)^2$$

$$= \Pi^{non}\left(\frac{2n+1}{n+2}\right)^2 \qquad (13).$$

By (8):

$$\delta^{*(o)} = \frac{\Pi^{ch} - \Pi^{col}}{\Pi^{ch} - \Pi^{non}}$$

$$= \frac{\Pi^{non}\left(\frac{2n+1}{n+2}\right)^2 - \Pi^{non}\left[\frac{n(2n+1)}{(n+1)}\right]}{\Pi^{non}\left(\frac{2n+1}{n+2}\right)^2 - \Pi^{non}}$$

$$= \frac{(2n+1)^2(n+1)^2 - n(2n+1)(n+2)^2}{(2n+1)^2(n+1)^2 - (n+2)^2(n+1)^2}$$

$$= \frac{(2n+1)[n^2(n+1)+1]}{3(n+1)^3(n-1)}.$$

First, we can confirm that the values of $\delta^{*(o)}$ for $n = 2, 3, 4$, are 65/81, 259/384, and 81/125, respectively, the last of which is less than 2/3. Next, brute force differentiation reveals that $\delta^{*(o)}$ is decreasing for $n < 3 + \sqrt{10}$ and strictly increasing for $n > 3 + \sqrt{10}$. Thus, we need only confirm that

$$\lim_{n \to \infty} \delta^{*(o)} = 2/3,$$

by repeated application of L'Hôpital's rule. ■

We will use the following lemma in the proofs of Propositions 5 and 6.

LEMMA 1. *In the presence of an external market, if exactly* $m \in \{1, \ldots, n\}$ *firms have adopted a decentralized form* ($o_i = D$)*, the market price in the intermediate goods market is given by*

$$t = \frac{a}{(n-m+1)(m+1)} \tag{14}.$$

Proof

From (4), the downstream division of a decentralized firm would produce:

$$q_i = \frac{a - (n-m+1)t}{(n+1)b} \tag{15}.$$

Define the total output of the decentralized firms by

$$Q^{DEC} \equiv \sum_{i|o_i = D} q_i^d.$$

Solving for t, the residual demand for upstream divisions is given by:

$$t = \frac{a - \frac{(n+1)}{m} bQ^{DEC}}{(n - m + 1)} \quad (16).$$

An upstream division of a decentralized firm maximizes

$$\pi_i = tq_i = \frac{a - \frac{(n+1)}{m} bQ^{DEC}}{(n - m + 1)} q_i,$$

yielding the first-order condition:

$$q_i = \frac{ma}{2(n+1)b} - \frac{1}{2} Q^{DEC}_{-i}.$$

The above implies that the total quantity traded in the external market is:

$$Q^{DEC} = \frac{m^2 a}{(n+1)(m+1)b}.$$

Substituting into (16) yields the desired result. ■

From the lemma, we can derive the impact on transfer prices of a firm centralizing and withdrawing from the intermediate goods market. Compare the equilibrium transfer price when m firms are decentralized firms, t_m, with the price t_{m-1} when an additional firm centralizes:

$$t_{m-1} - t_m > 0 \Leftrightarrow m < \frac{n+1}{2}.$$

A firm centralizing raises prices only if more than a majority of other firms are already centralized. A single firm withdrawing from the market always reduces the transfer price ($t_{n-1} - t_n < 0$).

Proof of Proposition 5

When all firms are centralized, the external market is unused, so this is equivalent to the case without an external market. When all firms are decentralized, the transfer price is obtained from Lemma 1 by letting $m = n$:

$$t = \frac{a}{n+1},$$

which is equivalent to the transfer prices in the absence of an external market, leading to equivalent prices and profits. ■

Proof of Proposition 6

To determine the profits from cheating, assume that Firm 1 is centralized while all other firms are decentralized. From (4), downstream divisions produce

$$q_1 = \frac{a + (n-1)t}{(n+1)b} \qquad q_i = \frac{a - 2t}{(n+1)b}, i > 1.$$

From Lemma 1, the transfer price is $t = a/2n$, implying

$$q_1 = \frac{a}{(n+1)b}\left(\frac{n-1}{n} + \frac{n+1}{2n}\right)$$

$$q_i = \frac{a}{(n+1)b}\left(\frac{n-1}{n}\right), i > 1$$

$$Q = \frac{a}{(n+1)b}\left(n - 1 + \frac{n+1}{2n}\right)$$

$$p = \frac{a}{(n+1)}\left(\frac{3n-1}{2n}\right)$$

While the noncooperative and collusive profits, Π^{non} and Π^{col}, are the same as in the absence of an external market, the profit of a cheating firm (Firm 1) is given by:

$$\begin{aligned}\Pi^{ch} &= pq_1 \\ &= \left[\frac{a^2}{(n+1)^2 b}\right]\left(\frac{3n-1}{2n}\right)^2 \\ &= \Pi^{non}\left(\frac{3n-1}{2n}\right)^2 \qquad (17).\end{aligned}$$

Again denoting by $\delta^{*(o)}$ the minimum discount factor that sustains collusion,

$$\begin{aligned}\delta^{*(o)} &= \frac{\Pi^{ch} - \Pi^{col}}{\Pi^{ch} - \Pi^{non}} \\ &= \left[\frac{n(2n+1)}{(n+1)^2}\right]\Pi^{non}\left(\frac{3n-1}{2n}\right)^2 - \Pi^{non} \\ &= \frac{(n+1)^2(3n-1)^2 - 4(n)^3(2n+1)}{(n+1)^2[(3n-1)^2 - 4(n)^2]} \\ &= \frac{n^4 + 8n^3 - 2n^2 - 4n + 1}{(n+1)^2(5n^2 - 6n + 1)}\end{aligned}$$

Differentiation of $\delta^{*(o)}$ reveals that it is decreasing in n for $n > 1$. When $n = 2$, $\delta^{*(o)} \simeq 0.802 < 1$. ■

Proof of Remark 5.1

We wish to show that

$\delta^{*(o)}$ without intermediate market $\geq \delta^{*(o)}$ with an intermediate market.

By Proposition 5, the profits from collusion and cooperation are the same whether or not an intermediate goods market exists. Therefore, sustainability of collusion depends only on the relative profits from cheating, so the above is equivalent to

$\Leftrightarrow \Pi^{ch}$ without intermediate market $\geq \Pi^{ch}$ with an intermediate market.

Substituting the profits from cheating from (13) and (17),

$$\Leftrightarrow \quad \Pi^{non}\left(\frac{2n+1}{n+2}\right)^2 \geq \Pi^{non}\left(\frac{3n-1}{2n}\right)^2$$

$$\Leftrightarrow \quad n^2 - 3n + 2 \geq 0$$

$$\Leftrightarrow \quad n \geq 2.$$

The inequality is strict when $n > 2$. ■

Endnotes

1. For example, Edlin and Reichelstein (1995), Vaysman (1996), Baldenius (2000), Baldenius and Reichelstein (2006), and Baldenius, Reichelstein, and Sahay (1999) consider how transfer prices overcome informational asymmetry, and Jacob (1996), Klassen, Lang, and Wolfson (1993), Harris (1993), and Smith (2002) examine tax-minimization strategies for multinational firms.
2. For example, the Public Utility Commission of Texas has noted: "[T]here is a strong likelihood that a utility will favor its affiliates where these affiliates are providing services in competition with other, non-affiliated entities … there is a strong incentive for regulated utilities or their holding companies to subsidize their competitive activity with revenues or intangible benefits derived from their regulated monopoly businesses" (Public Utility Commission of Texas 1998).
3. Fershtman, Judd, and Kalai (1991) demonstrate that the collusive outcome is obtainable in equilibrium when a manager is offered an incentive contract that pays a positive amount only if the profit obtained is near the collusive profit and if a manager can base his quantity on the contract offered.
4. Our notion of a centralized firm is akin to that of Hughes and Kao 1998, where "central management chooses outputs to maximize total firm power" (269), though we consider an isomorphism, delegating this decision to the downstream division. There are circumstances in which centralized firms can do better when management is empowered to set transfer prices different from marginal cost. For example, firms can avoid taxes by shifting profit to the division with lowest tax bracket (Horst 1971), overcome information asymmetry between division managers and the central corporate authority (Amershi and Cheng 1990; Vaysman 1996; Baldenius, Reichelstein, and

Sahay 1999), or cross-subsidize divisions facing different competitive environments (Gal-Or 1993; Hughes and Kao 1998). While none of these findings is directly applicable to our setting, we later discuss how strategic setting of transfer prices by central management may alter our results.

5. We do not explicitly consider the observability of transfer prices by other firms (Göx 2000). Observability is not an issue in the noncooperative equilibrium and in the collusive outcome since firms' expectations are realized, but is relevant for determining the gains to cheating. We assume that intra-firm transfer prices are not observed by rival firms, but cheating is detected as soon as downstream divisions compete. Having detection occur earlier (at the transfer stage) or later (with a lag of several periods) will change the gains to cheating, but does not change our results qualitatively.
6. The grim trigger strategy is used to obtain the minimum sustainable discount factor and thus requires a maximal credible punishment (Friedman 1971). Determining whether the threat of permanent reversion to the noncooperative equilibrium is credible is beyond the scope of this paper. Alternatives to trigger strategies in environments with uncertainty are provided by Green and Porter 1984 and Abreu 1986.
7. See, for example, Shapiro 1989 and Motta 2004 (167–8). This result also holds for collusion on price, though this is not directly comparable to our model in which downstream divisions compete in quantities. For completeness, we also include an analogous result to Proposition 3 for collusion on price (for $\delta^{*(p)}$) in the Appendix.
8. Implicitly, we are assuming that a firm's exit from the external market is observed and allows the external market to reflect the equilibrium price among the remaining $n - 1$ firms. Several other derivations under different informational assumptions yield similar qualitative results.
9. The impact of a firm's exit from the intermediate goods market reflects both the decrease in total supply and demand, and the strategic reaction of the remaining firms accounting for the centralized firm increasing its output. The exact expression for this transfer price is provided in Lemma 1 in the appendix. A firm's departure from the intermediate goods market raises the equilibrium transfer price only if a majority of other firms are already centralized. When considering the effect of a single firm "cheating", the impact on transfer prices is unambiguously negative.

References

Abreu, D. 1986. Extremal equilibria of oligopolistic supergames. *Journal of Economic Theory* 39 (1): 191–225.

Alles, M., and Datar, S. 1998. Strategic transfer pricing. *Management Science* 44 (4): 451–61.

Amershi, A., and P. Cheng. 1990. Intrafirm resource allocation: The economics of transfer pricing and cost allocations in accounting. *Contemporary Accounting Research* 7 (5): 61–99.

Baldenius, T. 2000. Intrafirm trade, bargaining power, and specific investments. *Review of Accounting Studies* 5 (1): 27–56.

Baldenius, T., and S. Reichelstein. 2006. External and internal pricing in multidivisional firms. *Journal of Accounting Research* 44 (1): 1–28.

Baldenius, T., S. Reichelstein, and S. Sahay. 1999. Negotiated versus cost-based transfer pricing. *Review of Accounting Studies* 4 (1): 67–91.

Baron, D. P., and D. Besanko, D. 1992. Information, control, and organizational structure. *Journal of Economics and Management Strategy* 1 (2): 237–75.

Basu, K. 1995. Stackelberg equilibrium in oligopoly: An explanation based on managerial incentives. *Economics Letters* 49 (4): 459–64.

Bonanno, G., and J. Vickers. 1988. Vertical separation. *Journal of Industrial Economics* 36 (3): 257–65.

Brennan, T. J. 1990. Cross-subsidization and cost misallocation by regulated monopolists. *Journal of Regulatory Economics* 2 (1): 37–51.

Bulow, J. I., J. D. Geanakoplos, and P. D. Klemperer. 1985. Multimarket oligopoly: Strategic substitutes and complement. *Journal of Political Economy* 93 (3): 488–511.

Bulow, J. I., and P. Pfleiderer. 1983. A note on the effect of cost changes on prices. *Journal of Political Economy* 91 (1): 182–85.

Cheng, J. M. 2002. A breakthrough in transfer pricing: The renegotiate-any-time system. *Management Accounting Quarterly* (2). http://www.mamag.com.

Collie, D. 2004. Collusion and the elasticity of demand. *Economics Bulletin* 12 (3): 1–6.

Eccles, R. G., and H. C. White. 1988. Price and authority in inter-profit center transactions, *American Journal of Sociology* 94 (Supplement): 17–51.

Edlin, A. S., and S. Reichelstein. 1995. Specific investment under negotiated transfer pricing: An efficiency result. *The Accounting Review* 70 (2): 275–91.

Einstein, M. 2004. *Media diversity: Economics, ownership, and the FCC*. Mahwah, NJ: Lawrence Erlbaum Associates.

Fershtman, C., and K. L. Judd. 1987. Equilibrium incentives in oligopoly. *American Economic Review* 77 (5): 927–40.

Fershtman, C., K. L. Judd, and E. Kalai. 1991. Observable contracts: Strategic delegation and cooperation. *International Economic Review* 32 (3): 551–9.

Foreman, S. E., T. E. Keeler, and D. A. Banks. 1999. Cross-subsidization in hospital care: Some lessons from the law and economics of regulation. *Health Matrix: Journal of Law–Medicine* 9 (1): 1–35.

Fort, R., and J. Quirk. 1995. Cross-subsidization, incentives, and outcomes in professional team sports leagues. *Journal of Economic Literature* 33 (3): 1265–99.

Friedman, J. W. 1971. A non-cooperative equilibrium for supergames. *Review of Economic Studies* 38 (1): 1–12.

Froeb, L., S. Tschantz, and G. J. Werden. 2005. Pass-through rates and the price effects of mergers. *International Journal of Industrial Organizations* 23 (9–10): 703–15.

Gal-Or, E. 1993. Strategic cost allocation. *Journal of Industrial Economics* 41 (4): 387–402.

Göx, R. F. 2000. Strategic transfer pricing, absorption costing, and observability. *Management Accounting Research* 11 (3): 327–48.

Green, E. J., and R. H. Porter. 1984. Noncooperative collusion under imperfect price information. *Econometrica* 52 (1): 87–100.

Harris, D. 1993. The impact of U.S. tax law revision on multinational corporations' capital location and income-shifting decisions. *The Accounting Review* 31 (Supplement): 111–40.

Hirshleifer, J. 1956. On the economics of transfer pricing. *Journal of Business* 29 (3): 172–84.

Horst, T. 1971. The theory of the multinational firm: Optimal behavior under different tariff and tax rates. *Journal of Political Economy* 79 (5): 1059–72.

Hughes, J. S., and J. L. Kao. 1998. Cross-subsidization, cost allocation, and tacit coordination. *Review of Accounting Studies* 2 (3): 265–93.

Ito, K. 1995. Japanese spin-offs: Unexplored survival strategies. *Strategic Management Journal* 16 (6): 431–46.

Jacob, J. 1996. Taxes and transfer pricing: Income shifting and the volume of intrafirm transfers. *Journal of Accounting Research* 34 (2): 301–12.

Klassen, K., M. Lang, and M. Wolfson. 1993. Geographic income shifting by multinational corporations in response to tax rate changes. *Journal of Accounting Research* 31 (Supplement): 141–73.

Laffont, J.-J., and D. Martimort. 1998. Collusion and delegation. *RAND Journal of Economics* 29 (2): 280–305.

Lambertini, L. 1994. Cartel stability and the curvature of market demand. *Bulletin of Economic Research* 48 (4): 329–34.

Lin, P. 2006. Strategic spin-offs of input divisions. *European Economic Review* 50 (4): 977–93.

Martinez, S. W. 2002. Food wholesaling. In *The U.S. Food Marketing System*, Agricultural Economic Report No. 811, eds. J. M. Harris, P. Kaufman, S. Martinez, and C. Price. Washington, DC: United States Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/aer811/aer811d.pdf.

Melumad, N. D., D. Mookherjee, and S. Reichelstein. 1992. A theory of responsibility centers. *Journal of Accounting and Economics* 15 (4): 445–84.

Moorthy, K. S. 1988. Strategic decentralization in channels. *Marketing Science* 7 (4): 335–55.

Motta, M. 2004. *Competition policy: Theory and practice*. Cambridge, U.K.: Cambridge University Press.

Narayanan, V. G., and M. Smith. 2000. Impact of competition and taxes on responsibility center organization and transfer prices. *Contemporary Accounting Research* 17 (3): 497–529.

Public Utility Commission of Texas. 1998. 23 Tex. Reg. 5294. *Technical report*, May 22.

Puelz, R., and A. Snow. 1994. Evidence on adverse selection: Equilibrium signaling and cross-subsidization in the insurance market. *Journal of Political Economy* 102 (2): 236–57.

Saltzman, H., R. Levy, and J. Hilke. 1999. *Transformation and continuity: The U.S. carbonated soft drink bottling industry and antitrust policy since 1980*. Washington, DC: Bureau of Economics, Federal Trade Commission. http://www.ftc.gov/reports/softdrink/softdrink.pdf.

Shapiro, C. 1989. Theories of oligopoly behavior. In *Handbook of Industrial Organization*, eds. R. Schmalensee and R. Willig, 329–414. Amsterdam: Elsevier.

Shughart, W. 1995. Sibling rivalry: The emergence of competition among the baby Bells. *Managerial and Decision Economics* 16 (4): 479–92.

Sklivas, S. D. 1987. The strategic choice of managerial incentives. *RAND Journal of Economics* 18 (3): 452–58.

Smith, M. J. 2002. Ex ante and ex post discretion over arm's length transfer prices. *The Accounting Review* 77 (1): 161–84.

Svizzero, S. 1997. Cournot equilibrium with convex demand. *Economics Letters* 54 (2): 155–8.

Ten Kate, A., and G. Niels. 2005. To what extent are cost savings passed on to consumers? An oligopoly approach. *European Journal of Law and Economics* 20 (3): 323–37.

Tyagi, R. K. 1999. On the relationship between product substitutability and tacit collusion. *Managerial and Decision Economics* 20 (6): 293–8.

Vaysman, I. 1996. A model of cost-based transfer pricing. *Review of Accounting Studies* 1 (1): 73–108.

Wauthy, X. 1998. Strategic delegation, market shares and entry deterrence. Working paper, Facultés universitaires Saint-Louis, Brussels.