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Managing Channel Profits When Retailers Have Profitable Outside Options

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Abstract. The channel-coordination literature typically focuses on how a supplier can overcome channel inefficiencies stemming from misaligned pricing incentives. In contrast, we show that when an incumbent supplier faces competition from other suppliers to supply the downstream firms, it may want to create inefficiencies. Our analysis offers useful prescriptions for how incumbent suppliers should react to competitive threats by smaller competitors, how manufacturers should react to powerful retailers who can produce their own private-label brands, and how upstream firms should optimally treat downstream firms who may have different marginal costs of distribution. Our analysis also explains why wholesale prices and thus final-goods prices would be expected to decrease when there is an increase in upstream or downstream competition.

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1. Introduction

Understanding how firms should manage their distribution channels is one of the core topics in modern management and marketing science. Beginning with Jeuland and Shugan's (1983) seminal work, a large channels literature focuses on (i) identifying the kinds of inefficiencies that can arise when downstream firms do not take into account the effects of their actions on their rivals' profits; and (ii) determining how upstream firms can overcome these inefficiencies by designing the contract terms they offer their downstream partners.[1]

The standard framework for analysis involves the principle that contract terms will be chosen whenever possible to maximize channel profits. For example, a monopolist manufacturer setting two-part prices in selling to downstream retailers under certainty will set its wholesale prices to elicit the channel-profit-maximizing retail prices and then redistribute the realized profits among the various parties with lump-sum transfers (e.g., fixed fees paid by the retailers) according to each side's relative power in the channel. Assuming that such lump-sum transfers are possible, the principle of designing the contract terms to maximize channel profits would seem to be obvious.

In this paper, we offer a simple and arguably fundamental reason to explain why the principle of maximum channel profits may fail: the upstream firm may face competition from other potential suppliers to earn the downstream firms' patronage. We show that although the upstream firm could set its wholesale prices to elicit the channel profit-maximizing retail prices, and although it could efficiently allocate realized profits with lump-sum transfers, it will choose not to do so under some conditions—conditions that hold in many settings. Our analysis offers useful prescriptions for how incumbent suppliers should react to competitive threats by smaller competitors, how manufacturers should react to powerful retailers who can produce their own private-label brands, and how upstream firms should optimally treat downstream firms who may have different marginal costs of distribution. Our analysis can also explain why wholesale prices and thus final-goods prices would be expected to decrease when there is an increase in upstream or downstream competition.

We assume that one or more of the downstream firms have the option of purchasing either from the manufacturer or from an alternative supplier (an outside opportunity).[2] Our main insight is that when this opportunity consists of selling a good that competes with the manufacturer's product, and when the downstream firms carrying it would earn positive profit from its sale, then the profit from the outside opportunities is endogenous to the design of the manufacturer's two-part pricing contracts: a lower wholesale price for one downstream firm, in eliciting a lower final-goods price, lowers the outside profit available for all other downstream firms by rendering the manufacturer's product a lower-priced competitor of the alternative product. This raises the fixed fees that the manufacturer can collect from the other downstream firms, and is therefore profitable for the manufacturer. The main idea of the paper can thus also be expressed in terms of the more general principle that in any contracting setting in which the value of the outside option depends on the contract structure, the contract will not maximize the wealth of the contracting agents.

Our findings suggest that understanding the source of the retailers' power in the channel is critical in determining how an upstream firm should best respond to changes in its environment. If, for example, the source of the retailers' power stems from the retailers' threats to replace the manufacturer's product with another, unrelated, product, then the value of the retailers' outside option is exogenous, and the optimal response of the manufacturer is to deal with the threats solely by lowering its fixed fees (e.g., in the case of retailing, this might take the form of an increase in the slotting allowances it offers to obtain shelf space). If, however, the source of the retailers' power stems from the retailers' threats to replace the manufacturer's product with a competing product in the same category (i.e., a substitute product), then the value of the retailers' outside option is endogenous, and the optimal response of the manufacturer is to adjust both the fixed and the marginal parts of its contracts (e.g., offer both a higher slotting allowance and a lower wholesale price).

The implications are particularly stark when a powerful retailer suddenly acquires the ability to replace the manufacturer's product with one of its own. In this case, our findings suggest that the manufacturer should not only reduce its fixed fee to this retailer (e.g., increase the slotting allowance it offers to the retailer) to reflect the change in this retailer's bargaining position, but also lower its wholesale prices to the retailer's rivals.[3] The latter, which is done to mitigate the value of the retailer's newfound threat, has not been shown previously and may help to explain the puzzling finding that retailers that seemingly have the most advantageous bargaining positions do not always receive the lowest wholesale prices.[4]

The setting we adopt is that of an upstream firm selling to $N \geq 2$ potentially asymmetric downstream firms where (i) different contract terms and conditions can be offered to each retailer; (ii) contracts are sufficiently flexible in principle to allow full-channel coordination; (iii) downstream competition ranges from independence to perfect substitution; and (iv) the upstream firm itself faces competition from other potential sources of supply. We find that in such settings the upstream firm may want to use its wholesale price as a weapon to reduce the retailers' outside options in negotiations—even though this comes at the expense of maximizing channel profit. Moreover, we show that this effect becomes stronger as competition downstream intensifies or as alternative sources of supply become more attractive, thereby yielding the prediction that both wholesale prices and final-goods prices would be expected to decrease whenever competitive pressures increase. This result once again differs from what one would expect when an upstream firm does not face the threat of potential competition from other supply sources. In that case, wholesale prices would be expected to *increase* as the downstream market becomes more competitive.

We also find that the upstream firm may optimally want to advantage retailers that have higher per-unit operating costs by offering them lower marginal wholesale prices in order to enhance their "bargaining positions" with respect to the more efficient firms.[5] As a consequence, the incumbent willingly accepts that its sales will become more balanced across its different distribution channels. This may help to explain why evidence at the macro level that documents the effects of buyer power can be difficult to obtain (see Messinger and Narasimhan 1995), and it is consistent with the already discussed observation that seemingly less competitive retailers sometimes receive more advantageous terms (UK Competition Commission 2008).[6] It is also consistent with what we learned in the course of (confidential) interviews that were conducted during the Commission's investigation. In these interviews, it was alleged by producers of branded products that they often employed a variety of strategies to strengthen particular distribution channels. To support smaller retailers that purchase through wholesalers, for instance, the producers often sold lots and package sizes at discounts that were effectively made exclusive to the smaller retailers.

The rest of the paper is organized as follows. Section 2 provides an overview of the relevant channels literature and contextual setting. Section 3 introduces the model. Section 4 shows how intrabrand competition persists under the incumbent's optimal contracts. Sections 5 and 6 conduct comparative-statics analyses, with respect to the downstream firms' cost characteristics and with respect to the level of competitive constraints. Section 7 concludes. Appendix A contains omitted proofs and Appendix B contains additional calculations.

2. Literature Review

The starting point of the literature on channel management is a recognition that each channel member's decisions affect other channel members' profits, and thus a lack of coordination among these decisions can lead to lower profits for all. It follows that by ensuring that channel members' incentives are fully aligned through its choice of contractual terms and conditions, a manufacturer can either directly or indirectly (through redistributive means) increase not only its own profit but also the profits of its downstream partners.

This has led researchers to identify the potential sources of inefficiencies and consider how they might be mitigated. Jeuland and Shugan (1983) and Moorthy (1987) were among the first to show in a two-stage monopoly setting that uncoordinated and independent channel members' decisions over margins can lead to a higher retail price than would otherwise occur if these decisions are coordinated.[7] They showed that appropriately chosen quantity-discount schedules and two-part tariffs could solve the problem. Gerstner and Hess (1995) showed that the problem of double marginalization could also be alleviated by having the manufacturer adopt a "pull strategy," whereby it offers discounts directly to price-sensitive consumers as a way of encouraging more sales.[8] Cui et al. (2007) showed that channel coordination could be achieved even without two-part tariff contracts or quantity-discount schedules when channel members are concerned about fairness. And Raju and Zhang (2005) and Kolay and Shaffer (2013) found that channel coordination was optimal in a setting with a dominant retailer and a competitive fringe of price-taking firms that do not make any productive downstream decisions of their own.

Mathewson and Winter (1984) extended the channel-management literature to the case of symmetric, competing downstream firms. They showed that an upstream firm could fully coordinate the channel (induce channel profit-maximizing behavior) provided that it had a sufficient number of instruments at its disposal to control the various targets (e.g., a wholesale price, a fixed fee, and an instrument such as resale price maintenance if there were nonprice targets in the marketing mix that could not be controlled otherwise).[9]

Others have pointed out, however, that channel coordination might not be possible when contracts are privately observable, or when downstream firms are asymmetric.[10] For example, Hart and Tirole (1990), OBrien and Shaffer (1992), and McAfee and Schwartz (1994) have found that channel coordination is likely to fail when the downstream firms cannot observe each other's contract terms because the manufacturer cannot generally commit, in any private contract with each retailer, against setting a low wholesale price that imposes an externality on other retailers.[11] And, Ingene and Parry (1995, 1998, 2000) have argued that channel coordination might not even be possible (or desirable even if it were possible) when the manufacturer must offer each retailer the same two-part tariff or menu of two-part tariffs. They justified this restriction by appealing to the Robinson–Patman Act (i.e., the U.S. law that prohibits price discrimination between competing retailers when its effect is to lessen competition).[12]

In contrast to this literature, we show that the manufacturer will typically not want to coordinate the channel whether or not it can offer discriminatory terms to each retailer, whether or not contracts are observable, and whether or not channel coordination is feasible (i.e., the manufacturer has enough instruments to coordinate the channel). In addition, we derive testable hypotheses that differ sharply from those that arise when the manufacturer need not worry about the retailers' outside options. Specifically, our model suggests that wholesale and final-goods prices would be expected to decrease as competitive pressures increase.

3. Model

There are $N \geq 2$ downstream firms. Each firm $n \in \{1, \ldots, N\}$ operates at a constant marginal cost of c_n and requires a certain input to make a final good. The input can either be purchased from the incumbent supplier, who has market power, or from competitive sources, who are willing to supply the input at cost. We assume the incumbent has a cost advantage over the competitive sources. Specifically, we assume the incumbent's marginal cost of supplying each downstream firm is m, which we normalize to zero, whereas the marginal cost of each of the competitive sources is $\hat{m} > m = 0$. Let $\Delta_m \equiv \hat{m} - m$ denote the difference in costs and assume that one unit of input is needed to make each unit of output. For example, the downstream firms may be retailers who resell the input to final consumers.

This setting captures in a parsimonious way the idea that even well-known suppliers of important inputs and products may face competition. Although we assume here that the incumbent is more efficient than its upstream rivals at supplying the input, it is straightforward to show that our results would hold equally well if we assumed instead that the incumbent's input was simply more desirable or of a higher quality (in the sense that consumers would be willing to pay more for a final good that uses the incumbent's inputs).[13] One can thus think of Δ_m as representing the incumbent's intrinsic advantage over the competitive sources due to its lower supply costs or more desirable input. What matters for our analysis is the size of Δ_m. The larger it is, the greater the incumbent's advantage over the competitive sources. While our main model thus focuses on the case where the suppliers' inputs are not differentiated, we will show that our results extend also to the case of differentiated inputs.

To show that the incumbent will typically not want to coordinate the channel even when its contract terms are observable and channel coordination is feasible, we assume that (a) the incumbent's contract terms are observable, and (b) the incumbent's contract offer to downstream firm n consists of two parts, a fixed transfer t_n and a constant marginal wholesale price w_n, for all $n \in \{1, \ldots, N\}$. In contrast, we assume for simplicity that the competitive sources always supply their inputs at cost (one can think of the competitive firms as being engaged in simultaneous Bertrand competition to supply an undifferentiated input over which they have little or no market power).[14] It follows that a respective downstream firm n's marginal cost of producing the final good if it accepts the incumbent's offer is $k_n = c_n + w_n$, whereas its marginal cost of producing the final good if it rejects the incumbent's offer and instead buys from one of the competitive sources is $\hat{k}_n = c_n + \hat{m}$.

After the offers are made, and after they are accepted or rejected, downstream firms compete by choosing their final prices p_n according to the final demand each faces for its respective good. Sales to consumers are then made and payoffs are realized for all firms.

To summarize, the timing of moves is as follows. First, the incumbent supplier makes its offers (t_n, w_n). Second, offers are accepted or rejected. If a downstream firm rejects its offer, it turns to one of the competitive sources and procures the input at constant marginal cost $\hat{m} > 0$. If it accepts its offer, it procures the input according to the terms of its accepted contract. Third, the downstream firms compete by setting final prices p_n.

4. Persistence of Downstream Competition

It is useful to begin by letting $\mathbf{k}$ denote the vector of downstream marginal costs when all offers are accepted, where the nth component of $\mathbf{k}$ is given by $k_n = c_n + w_n$. Assume that for all active firms, there is a unique price equilibrium in pure strategies, and denote the respective equilibrium final prices by $p_n(\mathbf{k})$. Denote also the vector of final prices by $\mathbf{p}(\mathbf{k})$, and the respective demands that follow from these final prices by $q_n(\mathbf{p})$. Then, it follows that the respective downstream profits *gross of the fixed transfers* $(t_1, \ldots, t_n)$ are given by

$$\pi_n(\mathbf{k}) = q_n(\mathbf{p})[p_n(\mathbf{k}) - k_n],$$

and the sum of the upstream and downstream profits when all offers are accepted is[15]

$$\Omega(\mathbf{k}) = \sum_{n=1}^{N}[\pi_n(\mathbf{k}) + q_n(\mathbf{p})w_n] = \sum_{n=1}^{N} q_n(\mathbf{p})[p_n(\mathbf{k}) - c_n].$$

We will henceforth refer to $\Omega(\mathbf{k})$ as the overall channel profit. We assume that $\Omega(\mathbf{k})$ has a unique maximum, and that at this maximum, all firms are active.

Benchmark Case. We first consider a benchmark case in which the incumbent's advantage, Δ_m, is sufficiently large that it can act as an unconstrained monopolist. In this case, the downstream firms have no credible outside option and will earn zero if they reject the incumbent's offer. The incumbent's maximization problem in stage one thus becomes

$$\max_{w_1,\ldots,w_N,t_1,\ldots,t_N} \sum_{n=1}^{N}[t_n + q_n(\mathbf{p})w_n] \tag{1}$$

such that

$$\pi_n(\mathbf{k}) - t_n \geq 0 \quad \text{for all } n. \tag{2}$$

We can see from this that $t_1, \ldots, t_N$ will be chosen to satisfy (2) with equality, and therefore the optimal wholesale prices, $w_1, \ldots, w_N$, will be chosen to maximize overall channel profit:

$$\max_{w_1,\ldots,w_N} \Omega(\mathbf{k}). \tag{3}$$

It follows that when the downstream firms do not have credible outside options, the incumbent will choose its terms to perfectly coordinate the channel and extract all surplus. Intuitively, the incumbent earns the same profit that a fully integrated firm would earn in this case because it does not need to leave surplus on the table, and the N independently chosen wholesale prices are sufficient to induce the N retail prices that maximize $\Omega(\mathbf{k})$.

Credible Outside Options. Now suppose that the incumbent cannot act as an unconstrained monopolist. More precisely, suppose now that at the vector of wholesale prices that would maximize overall channel profits (i.e., solve (3)), at least one downstream firm, say firm i, can earn positive profit by rejecting the incumbent's offer and buying its inputs instead from one of the competitive sources.[16] Then the incumbent will not be able to extract all the surplus, and in order to continue as firm i's supplier, it will have to allow it to earn at least as much surplus as it could earn by buying from its outside option. Among other things, this will mean lowering t_i below what it would have been.

It should therefore be clear that the incumbent's ability to extract surplus will be limited when the downstream firms have credible outside options. The more firms there are with such options, the more limited the incumbent's ability will be. What is less clear, however, is whether there will be other consequences. In particular, will the incumbent still want to serve every downstream firm, or can it do better by dropping some? And if it does serve every firm, will it still want to set its wholesale prices to maximize channel profits?

Consider first whether the incumbent will still want to serve every downstream firm. Take firm i. Given that this firm has a credible outside option, the incumbent might consider dropping it. However, the following lemma suggests that this will not be optimal.

Lemma 1. *In any equilibrium, the incumbent serves all downstream firms.*

Lemma 1 follows from our assumption that the incumbent has a cost advantage. To see this, suppose to the contrary that an equilibrium exists in which an active firm i rejects the incumbent's offer and buys from one of the competitive sources at constant marginal cost $\hat{m}$. Let $(\tilde{w}_i, \tilde{t}_i)$ denote the offer to firm i

in this equilibrium. Consider now a deviation in which the incumbent replaces $(\tilde{w}_i, \tilde{t}_i)$ with the offer $(\hat{m}, -\epsilon)$ while keeping all other offers the same. Note that firm i will accept this offer because regardless of the other firms' acceptance decisions, it will earn ϵ more by accepting its offer than it could earn by buying from one of the competitive sources. Moreover, since firm i's marginal cost under the deviation is unchanged (relative to its marginal cost in the supposed equilibrium), there will be no induced change in the acceptance decisions of the other downstream firms, and therefore no induced change in any of the equilibrium prices in stage three. It follows that for $\epsilon > 0$ sufficiently small, the incumbent's profit will strictly increase ($\hat{m} q_i(\mathbf{p}) - \epsilon > 0$), which contradicts our supposition of an equilibrium in which downstream firm i rejects its offer.

Having established that the incumbent will indeed want to serve all downstream firms, we now consider how the incumbent's contract terms will be affected. Note that if some firm n were to reject the incumbent's offer and purchase from one of the competitive sources, the downstream equilibrium prices and profits for all firms would no longer be determined using $k_n = c_n + w_n$ for firm n, but would instead be determined using $\hat{k}_n = c_n + \hat{m}$. In a slight abuse of notation, we let $\pi_n(\hat{\mathbf{k}}_n)$ denote the (off-equilibrium) profit of firm n when firm n is the only downstream firm that rejects the incumbent's offer. In this case, the relevant *vector* of downstream marginal costs is thus $\hat{\mathbf{k}}_n$, where $k_n = \hat{k}_n$ for downstream firm n, and $k_j = c_j + w_j$ for all other downstream firms $j \neq n$, $j \in \{1, \ldots, N\}$.

To solve for the incumbent's equilibrium contracts when one or more downstream firms have credible outside options, we proceed in two steps. We first derive the respective fixed transfers t_n for all $n \in \{1, \ldots, n\}$. We then turn to the derivation of the marginal wholesale prices w_n. The respective downstream firm n accepts the incumbent's offer only if

$$\pi_n(\mathbf{k}) - t_n \geq \pi_n(\hat{\mathbf{k}}_n).$$

By optimality for the incumbent, this participation constraint will be binding, which yields

$$t_n(\mathbf{k}) = \pi_n(\mathbf{k}) - \pi_n(\hat{\mathbf{k}}_n). \tag{4}$$

Using the expression for $t_n(\mathbf{k})$ in (4), the incumbent's overall profits are thus

$$\Pi = \sum_{n=1}^{N} [t_n(\mathbf{k}) + q_n(\mathbf{p}) w_n] = \Omega(\mathbf{k}) - \sum_{n=1}^{N} \pi_n(\hat{\mathbf{k}}_n). \tag{5}$$

We see here that the benchmark case in which the incumbent extracts everything and sets its wholesale prices to maximize overall channel profits arises as a special case of (5) when $\pi_n(\hat{\mathbf{k}}_n) = 0$ for all $n \in \{1, \ldots, N\}$. As we shall see, however, this will no longer hold when one or more downstream firms have credible outside options. Not only will the incumbent not be able to extract everything from the downstream firms when $\pi_n(\hat{\mathbf{k}}_n) > 0$ for some n, it may also no longer want to set its wholesale prices to maximize the channel profits.

The latter can be seen by differentiating Π with respect to w_j, and noting that w_j may affect not only $\Omega(\mathbf{k})$ but also the off-equilibrium profits of downstream firm j's rivals. We thus have the incumbent's first-order condition for the optimal wholesale price w_j:

$$\frac{d}{dw_j} \Omega(\mathbf{k}) = \frac{d}{dw_j} \sum_{n=1}^{N} \pi_n(\hat{\mathbf{k}}_n). \tag{6}$$

Analogous conditions hold for the other wholesale prices. Assuming that Π is quasi-concave, and that all downstream firms are active in equilibrium, the resulting system of first-order conditions pins down the unique equilibrium wholesale prices, $w_1^*, \ldots, w_N^*$.[17]

To answer whether the incumbent should both distort its marginal wholesale prices and lower its fixed transfers when faced with downstream firms that have credible outside options, or just lower its fixed transfers, note first that $w_1^*, \ldots, w_N^*$ maximize channel profits if and only if at these prices, the right-hand side of (6) is zero for all $j \in \{1, \ldots, N\}$. Note second that this can only happen for one of two reasons: either no downstream firm's outside option is credible, and thus $\pi_n(\hat{\mathbf{k}}_n) = 0$ for all n when evaluated at the channel-profit-maximizing wholesale prices, or the profits of the firms that have credible outside options are unaffected by w_j, so that $d\pi_n(\hat{\mathbf{k}}_n)/dw_j = 0$ for all j and $n \neq j$. However, the latter holds only if the respective downstream firms compete in different markets (because the incumbent's choice of w_j, and thus of firm j's marginal cost k_j, will in general affect the price p_j set by firm j).

We focus on the case of substitutes and assume that for all $q_j > 0$ and $\pi_n(\hat{\mathbf{k}}_n) > 0$,

$$\frac{d\pi_n(\hat{\mathbf{k}}_n)}{dk_j} \geq 0 \quad \text{for all } j \neq n, \tag{7}$$

with a strict inequality whenever the sales of firm n depend on the price of firm j (because competing downstream firms that sell substitute goods gain when their rivals have higher per-unit costs and thus are compelled to charge higher final prices).[18] It follows that when firm n has a credible outside option, and at least one other firm's product competes against it, the incumbent's respective choice of each w_j must trade off two conflicting objectives. One is to maximize overall channel profits, $\Omega(\mathbf{k})$, given that the incumbent is the "residual claimant" through its respective choice of the transfer payments t_j. The other is to minimize the value of the *other* downstream firms' outside options. These objectives correspond to the left- and the right-hand sides of condition (6), respectively.

If w_j were set to maximize channel profits, a marginal change in w_j would have no first-order effect on $\Omega(\mathbf{k})$. However, from (7), a marginal decrease in w_j, and thus in $k_j = c_j + w_j$, would have a negative first-order effect on $\pi_n(\hat{\mathbf{k}}_n)$ for each rival firm n for whom $\pi_n(\hat{\mathbf{k}}_n) > 0$. It follows that the incumbent will not generally find it optimal to set its wholesale prices to coordinate the channel. We have thus arrived at the following result.

Proposition 1. *Suppose the downstream firms' outside options are to carry products that compete with the incumbent's product* (*so that condition* (7) *holds strictly when the outside option is credible*). *Then the incumbent's optimal choice of wholesale prices, $w_1^*, \ldots, w_N^*$, maximizes channel profits if and only if no downstream firm has a credible outside option. If one or more of firm j's rivals have a credible outside option, then, taking firm j's rivals' wholesale prices as given, the incumbent's choice of w_j* (*which must satisfy condition* (6)) *is lower compared to the case in which none of firm j's rivals have credible outside options.*

The incumbent benefits from a decrease in firm j's wholesale price below the level that would coordinate the channel given its wholesale prices to the other firms. This is because when the conditions in Proposition 1 hold, the outside option value of the downstream firms that have profitable outside options and compete against firm j is reduced. Intuitively, the incumbent knowingly induces lower retail prices (through its choice of a lower wholesale price) in order to harm any downstream firm that defects to one of the competitive sources.

Note that Proposition 1 leaves open the possibility that not all wholesale prices in equilibrium will be lower than the channel profit-maximizing levels—even if all firms have credible outside options.[19] Nevertheless, the presumption is that if all firms have credible outside options, then all wholesale prices will decrease relative to the channel profit-maximizing levels. This is the case, for example, when the downstream firms' demands are symmetric and $c_n = c$ for all n. Under symmetry, a common wholesale price, w^m, maximizes channel profits, and a common wholesale price, w^*, solves the first-order condition in (6). Evaluating both sides of (6) at the former, w^m, we see that the left-hand side is zero but the right-hand side is positive. It follows that w^* must be less than w^m.

A managerial implication is that the incumbent should optimally respond to the emergence of an upstream rival both by reducing its fixed transfers and by lowering its marginal wholesale prices. It optimally reduces its fixed transfers because it must compensate the downstream firms to keep them from switching to the new supplier, and it optimally reduces its wholesale prices in order to make selling the new supplier's product less attractive.

Another managerial implication concerns how the incumbent should react to a downstream firm's newly acquired ability to produce the product for itself. Suppose, for example, that a powerful downstream firm is threatening for the first time to replace the incumbent's product with one of its own. Suppose also that no other downstream firm credibly has this ability.[20] Then, in addition to reducing its fixed fee to the firm that has the credible threat, Proposition 1 implies that the incumbent should also reduce its wholesale prices—not to the retailer with the threat, but to the other downstream firms.[21] Again, this is consistent with the idea that the incumbent should compensate the retailers that have credible outside options, and also attempt to reduce the value of these options.[22]

We conclude this section by noting that we have assumed that the competitive sources offer to sell their inputs at a constant per-unit price of $\hat{m}$. This allows for a broader interpretation of the competitive sources beyond just third-party entities. As we have seen, $\hat{m}$ can, for example, also be interpreted as the internal production cost (and hence efficient transfer price) of a downstream firm that integrates backward and produces the input for itself. Our assumption is also for convenience. If instead offering more complex contracts were feasible (e.g, a two-part tariff that specifies a high wholesale price but gives back the surplus in the form of a negative fixed fee),[23] we could obtain our results simply by reinterpreting $\pi_n(\hat{\mathbf{k}}_n)$ as the *net* (off-equilibrium) profit of firm n. As long as the downstream firms have positive margins (so that the off-equilibrium profits depend on how much is sold), the incumbent would still be able (and want) to reduce $\pi_n(\hat{\mathbf{k}}_n)$ by offering lower marginal wholesale prices.

In what follows, we will use the characterization of wholesale prices in (6) to obtain additional implications. In the next section, we obtain comparative-statics results across downstream firms with different cost efficiencies and thus different sizes. There, we also extend our results to the case where the suppliers' inputs are differentiated instead of being homogeneous (albeit still provided at different costs). In Section 6, we analyze how competition in the upstream and downstream markets affects wholesale and final-goods prices.

5. Heterogeneous Downstream Firms

We now analyze how the incumbent's wholesale prices are affected by cost differences among the downstream firms. To keep things simple, we will focus on the case of two downstream firms and assume that $c_1 < c_2$.[24] We will also assume that the firms' demands are symmetric (i.e., $q_i = q(p_i, p_j)$ for $i, j = 1, 2$, $j \neq i$), thus ensuring that our results in this section are driven solely by the differences in the firms' costs.

It is useful to begin by writing out the left-hand side of condition (6) more explicitly and assuming initially that the right-hand side is zero (which holds when the incumbent's cost advantage is sufficiently large that it can effectively act as an unconstrained monopolist).

5.1. Maximizing Channel Profits

Using the downstream firms' first-order conditions with respect to p_1 and p_2, which imply that $\partial\pi_1/\partial p_1 = \partial\pi_2/\partial p_2 = 0$, conditions $d\Omega/dw_1 = 0$ and $d\Omega/dw_2 = 0$ can be written as

$$\frac{\partial\pi_1}{\partial p_2}\frac{dp_2}{dw_1} + \frac{\partial\pi_2}{\partial p_1}\frac{dp_1}{dw_1} + w_1\left[\frac{\partial q_1}{\partial p_1}\frac{dp_1}{dw_1} + \frac{\partial q_1}{\partial p_2}\frac{dp_2}{dw_1}\right] + w_2\left[\frac{\partial q_2}{\partial p_1}\frac{dp_1}{dw_1} + \frac{\partial q_2}{\partial p_2}\frac{dp_2}{dw_1}\right] = 0, \tag{8}$$

$$\frac{\partial\pi_2}{\partial p_1}\frac{dp_1}{dw_2} + \frac{\partial\pi_1}{\partial p_2}\frac{dp_2}{dw_2} + w_2\left[\frac{\partial q_2}{\partial p_2}\frac{dp_2}{dw_2} + \frac{\partial q_2}{\partial p_1}\frac{dp_1}{dw_2}\right] + w_1\left[\frac{\partial q_1}{\partial p_2}\frac{dp_2}{dw_2} + \frac{\partial q_1}{\partial p_1}\frac{dp_1}{dw_2}\right] = 0. \tag{9}$$

The first two terms in (8) and (9) correspond to the indirect effects on the *downstream firms*' profits from an increase in w_1 and w_2, respectively, (after taking into account the effect of the increase on the equilibrium choices of p_1 and p_2). They are indirect effects because they are not accounted for in either downstream firm's first-order condition. An increase in w_1, for example, would be expected to increase p_2, which would have an indirect, positive effect on firm 1's profit (first term in (8)), and similarly, an increase in w_1 would be expected to increase p_1, which would have an indirect, positive effect on firm 2's profit (second term in (8)). In contrast, the third and fourth terms in (8) and (9) correspond to the indirect effect on the *incumbent*'s profit from an increase in w_1 and w_2, respectively. These terms operate through the expected changes in the quantities demanded of both downstream firms once retail prices adjust. They are indirect in the sense that, as with the first two terms in (8) and (9), the downstream firms do not account for the impact of these changes in demand on the incumbent's profits when setting their prices. Note that there is no direct effect of an increase in w_1 and w_2 in (8) and (9), respectively. Holding prices p_1, p_2 fixed, these are just pure transfers from the downstream firms to the incumbent.

Simplifying (8) and (9) and combining the respective conditions yields[25]

$$\left[\frac{dp_1}{dw_1} - \frac{dp_1}{dw_2}\right]\left[(p_2 - c_2)\frac{\partial q_2}{\partial p_1} + w_1\frac{\partial q_1}{\partial p_1}\right] = \left[\frac{dp_2}{dw_2} - \frac{dp_2}{dw_1}\right]\left[(p_1 - c_1)\frac{\partial q_1}{\partial p_2} + w_2\frac{\partial q_2}{\partial p_2}\right]. \tag{10}$$

Notice that this condition must hold if w_1 and w_2 are to maximize channel profits. Notice also that the first term in brackets on both sides of (10) captures the difference in the pass through to a firm's final price of a change in a firm's own marginal wholesale price compared to a change in its rival's marginal wholesale price. Although these terms are the same under symmetry (i.e., when evaluated at the same quantities and final prices), they will generally not be the same when there are cost differences. This follows because the quantities and final-goods prices may differ. As a result, without some restrictions on demand, it is not possible to determine a priori for which downstream firm the difference is larger.

To obtain further results, and to isolate the new effects we wish to examine, we now turn our attention to the case of linear demands. This allows us to use the fact that the respective marginal effects on both sides of (10) are independent of the realized demand. This means that the pass-through effects will be the same for both firms, regardless of the different quantities sold, as will the own-price and cross-price effects, which we denote by

$$\frac{\partial q_i}{\partial p_i} = \beta < 0 \quad \text{and} \quad \frac{\partial q_i}{\partial p_j} = \gamma > 0.$$

With this simplification, condition (10) can thus be rewritten as

$$(p_2 - c_2)\gamma + w_1\beta = (p_1 - c_1)\gamma + w_2\beta, \tag{11}$$

or equivalently as

$$(w_1 - w_2)(\beta - \gamma) = ((p_1 - k_1) - (p_2 - k_2))\gamma. \tag{12}$$

The latter implies that the difference in wholesale prices must be inversely proportional to the difference in markups.[26] It follows that the more efficient firm (firm 1) must be given a strictly lower marginal wholesale price ($w_1 < w_2$) if channel profit is to be maximized. To understand this result intuitively, note that firm 1 will have a strictly higher markup, $p_1 - k_1$, in equilibrium. This means that firm 1's marginal cost advantage will not be reflected one for one in a reduction in final prices. By shifting sales at the margin from the less efficient firm to the more efficient firm, the incumbent can thereby increase overall channel profit.

To sum up, in focusing on the case in which wholesale prices are chosen to maximize channel profits, we have shown that with linear demand it is optimal for the supplier to offer higher wholesale prices to less efficient firms and lower wholesale prices to more efficient firms, with the aim of steering sales to the latter. As we show next, however, when binding outside options drive a wedge between the supplier's profits and overall channel profits (i.e., when the right-hand side of condition (6) is greater than zero), so that maximizing channel profits is no longer the sole focus, a countervailing effect arises.

In what follows, we isolate this countervailing effect and again turn to the case of linear demand, for which we can work out explicitly which effect dominates.

5.2. Reducing Outside Options

Suppose now that the right-hand side of condition (6) is greater than zero, so that it becomes optimal for the incumbent to offer wholesale prices that are below the levels that maximize channel profit. Should the incumbent continue to favor the more efficient firm?

To answer this, it is important to consider the effect that a given price reduction would have on the value of the outside options of the two firms, and to ask for which firm this effect would be stronger (note that the value of firm 1's outside option would decrease by more than the value of firm 2's outside option would decrease if $d\pi_1(\hat{\mathbf{k}}_1)/dw_2 > d\pi_2(\hat{\mathbf{k}}_2)/dw_1$). Determining for which firm the "outside option effect" would be stronger turns out to be straightforward once it is recognized that the more efficient firm (firm 1) always has the lower marginal operating cost in equilibrium (i.e., $c_1 < c_2$ implies $k_1 < k_2$ in equilibrium). It follows that the effect will be stronger for the more efficient firm if and only if it is stronger for the firm that has the lower marginal operating cost. The latter holds when[27]

$$\frac{d^2\pi_i(\cdot)}{dk_i dk_j} < 0 \quad \text{for } j \neq i. \tag{13}$$

Condition (13), which is commonly used in the economics literature, is satisfied by many functional specifications (cf. Athey and Schmutzler 2001) including linear demand. The intuition for it is as follows: (i) a decrease in firm j's operating cost will cause firm j to reduce its final price p_j, which takes demand away from firm i because the products are substitutes; and (ii) this reduction in demand harms firm i more when it is more efficient because more efficient firms have higher per-unit markups (see our previous discussion).

When (13) holds, a reduction in firm j's operating cost will have a larger negative effect on firm i's profit when firm i has a lower operating cost than when it has a higher operating cost. Applying this to our setting, we are interested in the respective interaction between a change in one firm's wholesale price, w_j, and another firm's cost effectiveness, c_i. The following lemma provides a restatement of condition (13) applied to this question.

Lemma 2. *Suppose that the products are strict substitutes and condition* (13) *holds. Consider a reduction in firm j's wholesale price, w_j, holding all else constant. Then this strictly decreases firm i's outside option, $\pi_i(\hat{\mathbf{k}}_i)$, assuming it is binding, and this effect is larger* (*in absolute terms*) *when firm i is more efficient, that is, when c_i is lower.*

Recall that with binding outside options, the supplier's maximization problem trades off channel profit maximization with a reduction in the downstream firms' outside options. In focusing only on the latter part, Lemma 2 suggests that the supplier has more incentives to reduce a downstream firm's wholesale price when this firm faces more efficient rivals (because then the negative effect on these firms' outside options is larger, allowing the supplier to extract a larger share of channel profits). Lemma 2 thus isolates an effect that tends to increase the optimal wholesale prices of more efficient firms relative to those of less efficient firms. It contrasts, though, with our earlier finding, which suggests that the supplier should do the opposite when its focus is instead on maximizing channel profits.

5.3. Optimal Discriminatory Wholesale Prices

We now consider which effect is stronger, the incentive that arises from condition (12) (which suggests that the incumbent should offer a lower wholesale price to the *more* efficient firm) or the incentive that arises from condition (13) (which suggests that the incumbent should offer a lower wholesale price to the *less* efficient firm). For this purpose, we turn once again to the case of linear demand. Surprisingly, we find that the latter effect always dominates the former effect (although, as we show later, when inputs are differentiated, the effects are more nuanced).

Proposition 2. *In the case of two downstream firms, with symmetric linear demand and $\gamma > 0$, it is optimal for the supplier to offer a lower wholesale price to the less efficient firm when both downstream firms have credible outside options.*

Proof. See Appendix A.

The highlighted trade-off is as follows. On the one hand, handicapping the more efficient firm reduces channel profits for the reasons discussed above. On the other hand, by distorting channel profits in this way, the incumbent can obtain a larger share of the remaining surplus. Although it is not possible to say in general which effect will dominate, Proposition 2 makes clear that with linear demands, the latter effect dominates.

The managerial implication of this is that powerful incumbent suppliers might sometimes find it optimal to react to competitive threats by new, smaller, competitors such as private label suppliers by offering deeper price cuts to the less efficient downstream firms. As noted in the introduction, this is consistent with the observation that seemingly less competitive retailers sometimes receive better terms (UK Competition Commission 2008). It may also help to explain why evidence at the macro level that documents the effects of retailer buyer power can be difficult to obtain.

One may wonder how the incumbent goes from handicapping the *less* efficient firm when neither downstream firm has a credible outside option to handicapping the *more* efficient firm when both downstream firms have credible outside options, as it may seem to imply a discontinuity at the point where the outside options just become credible. However, the key thing to notice is that the outside options do not become credible for both downstream firms at the same time. Because firm 1 is more efficient, it will see its outside option become credible first. When $\hat{m}$ is in the range such that only firm 1's outside option is credible, firm 1 (but not firm 2) will be able to retain some of the surplus for itself. Now no longer interested in simply maximizing overall channel profits, the optimal response by the incumbent in this case will be to bring the wholesale prices of the two firms closer together and possibly reverse them so as to redirect some of the sales from the firm from whom it cannot capture all the surplus to the firm from whom it can. This is where the process of reversal starts, if it is going to happen, and what Proposition 2 implies is that in the region in which $\hat{m}$ has fallen enough for the outside options of both firms to become credible, the relative ranking of the wholesale prices will indeed have reversed.

5.4. Extensions

Differentiated Inputs. We have thus far assumed that the suppliers' inputs are homogeneous, with the incumbent enjoying a cost advantage. This specification allowed us to obtain our insights while keeping the notational complexity to a minimum (it allowed us, for example, to use the same (reduced form) notation both on and off equilibrium). In addition, it ensured that all downstream firms would procure from the incumbent in equilibrium.

With differentiated inputs, the notation is more complex and we must in addition assume that the cost advantage of the incumbent outweighs any benefits from expanding demand or reducing competition when one or more downstream firms procure from the rival supplier (i.e., the rival supplier's input cannot be too desirable).[28] Nevertheless, the main idea is the same. To see this, suppose that only downstream firm n has rejected the incumbent's offer and is thus procuring from the competitive source. Then, we assume that the resulting subgame has a unique pricing equilibrium and denote the respective equilibrium price of some firm j by $\hat{p}_j^{(n)}$, where the superscript (in brackets) denotes the fact that in the considered subgame all but firm n are supplied by the incumbent. Quantities are denoted likewise by $\hat{q}_j^{(n)}$ and respective profits by $\hat{\pi}_j^{(n)}$ (where throughout we suppress the respective arguments). With this additional notation, the characterization in (6) becomes

$$\frac{d}{dw_j}\Omega(\mathbf{k}) = \frac{d}{dw_j}\sum_{n=1}^{N}\hat{\pi}_n^{(n)}. \tag{14}$$

It then follows immediately from this that the key insight that the incumbent may wish to distort wholesale prices away from the respective levels that would maximize channel profits still holds, provided that at least one downstream firm's outside option binds. Nevertheless, there are some differences. Where we gain additional insights from allowing the inputs to be differentiated is for the case where the downstream firms are themselves heterogeneous. In this case, the two conflicting forces can be isolated more explicitly.

With undifferentiated inputs and linear demand, we characterized demand by the two parameters $dq_i/dp_i = \beta < 0$ and $dq_i/dp_j = \gamma > 0$. With differentiated inputs, this needs to be extended. To sharpen our terminology, we refer to the downstream firms simply as retailers and the inputs as products. When all retailers stock the incumbent's product, we keep the same notation. When retailer n stocks the alternative product, we denote the responsiveness of this firm's demand to any other firm's price by $\hat{\gamma} \geq 0$.[29] In particular, when $\hat{\gamma} = 0$, the demand at retailer n is independent of all other retailer's prices. One instance where this would be the case is when retailer n has to decide whether to allocate its limited shelf space to the incumbent's product or to some product in an independent product category.

We again restrict attention to two retailers. By analogy to the derivation of condition (A.1) in Appendix A, we obtain the following requirement from the two first-order conditions (14) for w_1 and w_2:

$$\begin{aligned}\beta&\left[\frac{dp_n}{dw_n}-\frac{dp_n}{dw_{n'}}\right](w_1-w_2)\\&=\gamma\left[\frac{dp_n}{dw_n}-\frac{dp_n}{dw_{n'}}\right][(p_1-c_1)-(p_2-c_2)]\\&\quad-\hat{\gamma}\frac{d\hat{p}_n^{(n)}}{dw_{n'}}[(\hat{p}_1^{(1)}-c_1)-(\hat{p}_2^{(2)}-c_2)].\end{aligned} \tag{15}$$

To interpret this, note first that p_1 and p_2 here refer to the equilibrium prices when both retailers accept their respective offers, while $\hat{p}_1^{(1)}$ and $\hat{p}_2^{(2)}$ denote the equilibrium prices for the subgames where the respective retailer, $i = 1$ or $i = 2$, instead purchases from the alternative supplier. We also use that, with linear demand and symmetry, the responsiveness of the deviating firm n's price when the cost of its rival j increases, that is, $d\hat{p}_n^{(n)}/dw_j \geq 0$, is independent of the identity of n and j. For the following argument we use as well that $dp_n/dw_n - dp_n/dw_{n'} > 0$, and that $\beta < 0$, while $\gamma > 0$ and $\hat{\gamma} \geq 0$. Recall lastly our specification that $c_1 < c_2$. Then, it follows that the more efficient retailer will obtain a lower wholesale price if and only if, in equilibrium, the right-hand side of (15) is strictly positive, while it pays a higher price when the right-hand side of (15) is strictly negative.

Now take the extreme case where $\hat{\gamma} = 0$, so that retailers are no longer in competition when one stocks the incumbent's product and the other stocks the alternative product. In this case, there is no longer an outside option effect (and formally the last line in (15) is zero). For this case we have already shown that $w_1 < w_2$. When $\hat{\gamma} > 0$, however, the outside option effect kicks in and the last line in (15), which has the opposite sign, becomes relevant.[30] As we have shown in Proposition 2, in the limit where the products are homogeneous, so that $\hat{\gamma} = \gamma$, this effect dominates and we then have that $w_1 > w_2$.[31]

Average Procurement Price. We have focused on the effects of the outside options on the incumbent's wholesale prices, because the fixed payments t_1 and t_2 are not relevant for downstream competition and final prices. However, it should be noted that firm j's marginal wholesale price is not the same as its average procurement price W_j, where W_j is given by

$$W_j = w_j + \frac{t_j}{q_j}. \tag{16}$$

Although we have shown that the incumbent can sometimes gain by making the less efficient firm relatively more competitive at the margin, this should not be taken to imply that the latter will be able to purchase its inputs at a lower average cost than the larger, more efficient firm.[32] This is because it is possible that $W_2 > W_1$ even though $w_2 < w_1$. Indeed, it may be that $w_2 < \hat{m}$, in which case firm 2 would have to pay the incumbent a fee (i.e., $t_2 > 0$), but $w_1 > \hat{m}$, implying that the incumbent would have to pay firm 1 a fee ($t_1 < 0$).

More Than Two Downstream Firms. It should also be noted that we have focused on the case of two downstream firms in this section in order to illustrate the key ideas. However, it can be shown that the same trade-off arises more generally. When there are more than two downstream firms, it is still the case that the incumbent supplier will want to offer the lowest wholesale prices to the most efficient firms if its goal is to maximize channel profit, and it is still the case that for any pair of firms i and j such that (13) holds, the incumbent will want to handicap the more efficient firm if it is focused on reducing the value of the downstream firms' outside options. The trade-off thus arises more generally, and its resolution from the incumbent's perspective will depend on the specifics of the demand system it faces and on which downstream firms have credible outside options.

Offering Menus. Lastly, it should be noted that the incumbent would not necessarily benefit from offering different wholesale prices and fixed fees to each downstream firm on and off the equilibrium path because it would still have to make the offers "incentive compatible." Suppose, for example, that each downstream firm could choose from a menu of two-part tariffs, possibly different for each firm. Then, if the proposed menus are to be profitable for the incumbent, they would have to be designed so that each firm j chooses (t_j, w_j) when all firms accept and $(\hat{t}_j, \hat{w}_j)$ when one firm rejects, with $\hat{w}_j < w_j$ (so that an accepting firm j would price more aggressively off the equilibrium path). However, such menus of contracts are not incentive compatible when, as we have assumed, condition (13) holds. In this case, it is straightforward to show, for example, that for any number of downstream firms, it is precisely when an accepting firm is meant to choose the "more aggressive" offer $\hat{w}_j$ that it in fact will prefer the "less aggressive" offer w_j. Therefore, the incumbent's optimal menu of two-part tariff contracts $((t_j, w_j), (\hat{t}_j, \hat{w}_j))$ will be degenerate.

6. Comparative Statics

We now explore the model's predictions with respect to how varying the degree of downstream competition affects equilibrium prices, and with respect to how these equilibrium prices are affected by the attractiveness of the downstream firms' outside options (i.e., the closeness of the substitutes to the incumbent's input). We assume throughout this section that $\hat{m}$ is already initially such that all downstream firms have credible outside options.

Changes in $\hat{m}$. Consider first a reduction in $\hat{m}$, which increases the value of the downstream firms' outside options. Clearly, the incumbent would be expected to respond to this change by allowing each firm to keep more surplus. One way to do this is to keep $(w_1, \ldots, w_N)$ the same and just reduce $(t_1, \ldots, t_N)$, thereby paying each downstream firm directly for the increase in the value of its outside option without (further) distorting channel profits. However, as one might guess from our earlier results, a change in the value of the firms' outside options would also be expected to affect marginal wholesale prices.

The key to understanding why the incumbent would not just reduce $(t_1, \ldots, t_N)$ comes from condition (13). Note first that a downstream firm i that buys from one of the competitive sources becomes more competitive when its respective marginal cost, $c_i + \hat{m}$, decreases. From (13), such a deviating firm, which rejects the incumbent's offer, is hurt *more* when the incumbent lowers the marginal wholesale price of firm j, $j \neq i$. Consequently, once $\hat{m}$ decreases, the negative effect that a marginal wholesale price decrease has on the outside option of all downstream firms is larger. Given the trade-off in (6) for w_j, this induces the incumbent to place more weight on the reduction of the firms' outside options and less on the maximization of channel profits. Assuming strict quasi-concavity of the incumbent's program, our findings thus predict that the incumbent's wholesale prices would likely decrease in the face of increasingly attractive outside options.

Proposition 3. *As $\hat{m}$ decreases, that is, as the downstream firms' outside options become more attractive, the incumbent supplier will respond by offering both lower fixed payments and lower marginal wholesale prices, thereby inducing also lower final-goods prices.*

These results extend our earlier results on the effects of the emergence of an upstream rival by showing that the expected changes in fixed transfers, wholesale prices, and final prices also occur at the margin when the incumbent faces existing competitors. In addition to reinforcing the managerial implications that we discussed earlier, they also provide justification for policymakers who seek through competition policy to preserve the strength of potential competitors. Stronger competitors in this instance imply lower wholesale prices by the incumbent, which in turn lead to lower final-goods prices for consumers.

Downstream Competition. Consider next the effects of a change in downstream competition—either through a change in the number of downstream firms N or through a change in the downstream firms' degree of differentiation. As we saw previously, the characterization of the incumbent's optimal marginal wholesale prices when the downstream firms are heterogeneous generally depends on higher-order derivatives of the demand system. To abstract from this, it is once again useful to focus on the case of linear demands.

Nevertheless, before we do this, we can provide some general intuition for our results as follows. Consider first an increase in the number of downstream firms. In this case, the key thing to notice is that now in each first-order condition for the respective marginal wholesale price w_j, the marginal effect on the outside option of all other $N-1$ firms shows up. For each such firm n, this represents the change in own demand due to the induced price changes of all other firms multiplied by the firm's (off-equilibrium) margin, $\hat{p}_n - \hat{k}_n$. Similarly, consider a reduction in the degree of product differentiation. Then, the impact that a lower marginal wholesale price w_j for one firm has on the outside option of all other firms n is also larger. While these two effects go in the same direction and work toward strictly lower marginal wholesale prices for all firms when downstream competition increases, there is also a countervailing force—which is that an *unconstrained* monopolist would want to increase marginal wholesale prices in order to further dampen downstream competition. Nevertheless, as we will show in the examples below, the effect that works through the value of outside options is stronger than this countervailing force, so that a more competitive downstream market indeed results in lower marginal wholesale prices.

6.1. Hotelling Competition

In the classic Hotelling model, there are two firms, which we label as firm i and firm j, where $i, j = 1, 2$, $i \neq j$. Demand is assumed to be uniformly distributed over the unit interval with a firm located at each endpoint. Each consumer has valuation $v > 0$, and the transportation cost per-unit of distance traveled is $\tau > 0$. Given this, the demand when all consumers buy and both firms sell strictly positive quantities is then

$$q_i = \frac{1}{2} - \frac{1}{2\tau}(p_i - p_j). \tag{17}$$

Note that q_i's properties are standard. Firm i's demand is decreasing in its own price, p_i, increasing in its rival's price, p_j, and equal to $\frac{1}{2}$ when $p_i = p_j$. Substituting this into the first-order conditions from the proof of Proposition 2, we obtain the wholesale prices[33]

$$w_i = \hat{m} + \tfrac{1}{2}\left[3\tau - \tfrac{1}{3}(c_i - c_j)\right], \tag{18}$$

and the resulting induced final goods' prices[34]

$$p_i = \hat{m} + \tfrac{5}{2}\tau + c_i - \tfrac{7}{18}(c_i - c_j). \tag{19}$$

The characterization of optimal prices confirms our previous results. The minus sign in front of the term $\frac{1}{3}(c_i - c_j)$ in the expression for w_i implies that the more efficient downstream firm does indeed receive a higher marginal wholesale price from the supplier (see Proposition 2). And it is straightforward to show that for all $\hat{m}$ such that the downstream market is covered and both firms have positive market shares, marginal wholesale prices are indeed lower than what an unconstrained monopolist would charge (see Proposition 1). Note finally that the expressions in (18) and (19) also relate the marginal wholesale and final goods' prices to the degree of competition τ in the downstream market as well as to the constraint $\hat{m}$ facing the incumbent (where the latter results thus confirm Proposition 3).

Proposition 4. *With Hotelling demands, when the downstream market is covered and both firms sell positive quantities, the marginal wholesale price w_i and final-goods price p_i are increasing in τ and $\hat{m}$.*

Proposition 4 implies that if τ decreases (i.e., if downstream competition were to become more intense), or if $\hat{m}$ decreases (i.e., if the cost of obtaining the input elsewhere were to decrease), the supplier would optimally respond by offering a lower marginal wholesale price.

These results suggest that changes in supply-side constraints (as expressed by a change in $\hat{m}$) as well as changes in demand-side constraints (as expressed by a change in τ) can affect both wholesale prices and final-goods' prices. In particular, in the case of Hotelling competition, wholesale and final-goods' prices would be expected to decrease as either the downstream firms or incumbent become less differentiated compared to their competitors.

Note that with symmetry, so that $c_i = c_j = c$, the expressions in (18) and (19) become

$$w_i = w = \hat{m} + \tfrac{3}{2}\tau$$

and

$$p_i = p = \hat{m} + \tfrac{5}{2}\tau + c,$$

which implies that the margin for each downstream firm, $p - c - w$, is then simply τ. As competition increases, both the incumbent's and the downstream firms' margins decrease.

Comparison to Benchmarks. To conclude our analysis of the Hotelling model, we compare the characterization of w_i and p_i to the benchmark case in which the incumbent is unconstrained. In this case, where w_i is chosen to maximize $\Omega(\mathbf{w})$, we obtain[35]

$$w_i^{\text{Mon}} = v - \tfrac{3}{2}\tau - \tfrac{1}{4}(c_i + 3c_j),$$

where Mon stands for monopoly, and the resulting induced final-goods' prices

$$p_i^{\text{Mon}} = v - \tfrac{1}{2}\tau + \tfrac{1}{4}(c_i - c_j).$$

The difference in the marginal wholesale prices between firms 1 and 2 in this case is $(c_1 - c_2)/2$, which is strictly negative when $c_1 < c_2$ (i.e., when firm 1 is more efficient than firm 2). In contrast, the respective difference was strictly positive for the constrained supplier (cf. expression (18)). Further, as transportation costs decrease, making the downstream firms closer substitutes, both wholesale and final-goods' prices *increase*. Again, this is the opposite of what we obtained for the constrained supplier (cf. expression (18) and (19)).

6.2. Shubik–Levitan Demand

The Hotelling model and assumption of full-market coverage implies that demand is fixed. While this may be a reasonable approximation for some markets, for other markets, it is useful to consider a demand system that allows the number of consumers to vary. It is also useful to consider a demand system that allows the number of downstream firms N to be easily parameterized. One such demand system follows from the symmetric, linear-quadratic specification of utility in Shubik and Levitan (1980). Specifically, for each downstream firm $n \in \{1, \ldots, N\}$, Shubik and Levitan derive the following demand function:

$$q_n = \frac{1}{N}\left[1 - p_n - \theta\left(p_n - \frac{\sum_{n' \in N} p_{n'}}{N}\right)\right] \tag{20}$$

and indirect demand function

$$p_n = 1 - \frac{N + \theta}{1 + \theta} q_n - \frac{\theta}{1 + \theta} \sum_{n' \neq n} q_{n'}.$$

This demand system has the attractive property that when changing the degree of substitution, θ, the sum of the individual quantities demanded does not change when firms charge symmetric prices.[36] The same is true when the number of firms N increases. Hence, the degree of competition along both dimensions can be varied without affecting the size of the market.

To obtain explicit expressions when there are more than two downstream firms, we focus on the symmetric case $c_n = c$. And, to make production profitable, we assume that $c < 1$.[37] Given these restrictions, we derive in the proof of Proposition 5 an explicit characterization of the equilibrium final-goods' prices and profits as a function of the marginal wholesale prices. In the symmetric case with $w_n = w$, for example, we obtain

$$p_n = p = \frac{1}{2 + \theta - (1/N)\theta}\left[1 + (c + w)\left(1 + \theta - \frac{1}{N}\theta\right)\right] \tag{21}$$

and

$$\pi_n = \pi = \frac{1}{N}\frac{1 + \theta - \theta/N}{(2 + \theta - (1/N)\theta)^2}(1 - c - w)^2. \tag{22}$$

For a given marginal wholesale price w, it follows that both prices and profits strictly decrease as either θ or N increase. Furthermore, it follows that $p \to c + w$ as $\theta \to \infty$.[38]

To complete the characterization, we use the first-order conditions in (6) to find the incumbent's optimal marginal wholesale price $w_n = w$.[39] We then substitute this price into (21) to obtain the equilibrium final-goods price $p_n = p$ as a function of exogenous parameters. Differentiating with respect to $\hat{m}$, θ, and N yields the following comparative-static results:

Proposition 5. *With Shubik–Levitan demands, when the downstream firms are equally efficient, the marginal wholesale price w and final price p have the following properties:*

- *The marginal wholesale price w and final price p are increasing in $\hat{m}$.*
- *The final price p is decreasing in θ and N.*

Proof. See Appendix A.

Proposition 5 implies that if the cost of the other inputs were to increase (decrease), the incumbent would respond by raising (lowering) its marginal wholesale price, thus inducing a higher (lower) final price. It also implies that if the downstream market were to become more (less) competitive, final prices would decrease (increase). This holds whether the goods become less (more) differentiated or the number of firms increases (decreases).

These results are consistent with our findings under Hotelling competition. They imply that prices would be expected to decrease when the value of the downstream firms' outside options increases (the incumbent becomes more constrained) or the downstream market becomes more competitive (the goods become more substitutable or the number of firms increases).

We further note that $\lim_{\theta\to\infty} p = \hat{m} + c$ in this case.[40] That is, as the goods become less and less differentiated, final-goods prices converge in the limit to the downstream firms' marginal operating costs under the *alternative* supply option. It follows that as the incumbent's cost advantage Δ_m goes to zero, the outcome becomes perfectly competitive, with $p = c$.

The intuition for this limiting case is straightforward and does not depend on the restriction to linear demands. To see this, note that the incumbent's ability to maintain a strictly positive gap $w > \hat{m}$ in its input price becomes unsustainable as the downstream goods become (almost) perfect substitutes—because a deviating downstream firm would then be able to capture the entire market by turning to its alternative source of supply.

Comparison to Benchmarks. As we did in the Hotelling case, it is useful to compare the characterization of the equilibrium w_n and p_n for the constrained supplier to the benchmark case of an unconstrained monopolist. In this case, the incumbent will optimally choose w_n to maximize channel profit. This yields the profit-maximizing wholesale prices

$$w^{\text{Mon}} = \frac{1}{2}\theta\frac{N-1}{N}\frac{1}{1+\theta-(1/N)\theta}(1+c)$$

and the resulting induced final-goods' prices

$$p^{\text{Mon}} = \tfrac{1}{2}(1+c).$$

As can be seen from these expressions, the induced final-goods price p^{Mon} is independent of downstream competition (and thus does not vary with either θ or N).[41] This outcome holds because, as in the Hotelling case, the marginal wholesale price strictly increases when downstream competition intensifies (i.e., w^{Mon} strictly increases when either θ or N increase). In the case of independent downstream firms ($\theta = 0$), the monopolist would choose $w^{\text{Mon}} = 0$. In the case of perfect competition downstream ($\theta = \infty$), the monopolist would choose $w^{\text{Mon}} = p^{\text{Mon}}$. And for intermediate levels of competition, the monopolist would choose $0 < w^{\text{Mon}} < p^{\text{Mon}}$, compensating for higher intrabrand competition in the downstream market by increasing the marginal wholesale price to dampen competition.

Once again, our results for the constrained supplier case (cf. Proposition 5) differ markedly. We find that in the face of an increase in competitive pressure in the upstream or downstream markets, either the incumbent would be expected to adjust by decreasing its marginal wholesale price and/or the final-goods' prices would be expected to decrease.

7. Concluding Remarks

The channel-coordination literature typically focuses on how a supplier needs to overcome channel inefficiencies stemming from misaligned pricing incentives. We have shown in contrast that a supplier may purposely want to create inefficiencies when faced with competition from other suppliers for the downstream firms' patronage. Specifically, we considered how an incumbent upstream firm should optimally manage its distribution channel when it is constrained by the ability of the downstream firms to switch to other sources of supply. We showed that in this simple setting, the incumbent will use its marginal prices strategically to extract a larger share of the profits from the downstream firms.

We also showed that an upstream firm that is constrained by downstream competition and the threat of alternative suppliers faces a trade-off between maximizing channel profit and extracting surplus. This trade-off leads to lower wholesale prices than what is needed to eliminate intrabrand competition. By inducing more downstream competition, namely, by reducing the wholesale prices of the downstream firms, the upstream firm can increase its profit by extracting a larger share of a smaller industry profit. This follows because by making each firm more competitive, the profits that would be earned from switching to another supplier are reduced for all other downstream firms.

Our finding that the upstream firm does not want to maximize channel profits led to two further implications. We showed that an incumbent that is constrained by the threat of competing products, but that can still choose wholesale prices strategically, may want to disadvantage the more efficient downstream firms so as to create a more level playing field. There are two opposing forces. To generate a larger channel profit, the incumbent should offer the more efficient downstream firms a *more* competitive contract. However, the negative impact on a firm's outside option when rivals are made more competitive is also larger when the respective firm is more efficient. This suggests that the incumbent should offer the more efficient firms a *less* competitive contract. We showed that, with linear demands, the second effect always dominates the first effect. The incumbent can therefore gain from partially ironing out the cost disadvantage of the less efficient firms.

We also derived comparative-statics results with respect to the constraints on competition that upstream and downstream firms face. We showed how, in contrast to other benchmark cases, our setup with two-part tariff contracts and a binding constraint for the incumbent generates monotonic comparative-statics results that intuitively map such competitive constraints into a change in both wholesale and final-goods prices.

Specifically, we showed that an increase in competitive pressures, whether it be at the upstream or downstream level, would be expected to result in lower wholesale and final-goods prices.

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Appendix A. Omitted Proofs

Proof of Proposition 2. In a slight abuse of notation, where the terms "with a hat" are understood to relate to prices and costs when n' rejects the incumbent's offer, we have

$$\frac{d\pi_{n'}(\hat{\mathbf{k}}_{n'})}{dw_n} = -\frac{d\hat{p}_n}{dw_n}(\hat{p}_{n'} - c_{n'} - \hat{m})\frac{\partial \hat{q}_{n'}}{\partial \hat{p}_n}.$$

With linear demand, we can express this more simply as

$$\frac{d\pi_{n'}(\hat{\mathbf{k}}_{n'})}{dw_n} = -\frac{dp_n}{dk_n}(\hat{p}_{n'} - c_{n'} - \hat{m})\gamma.$$

(It is more instructive to express the derivative of the downstream price with respect to overall operating costs, $k_n = c_n + w_n$, instead of with respect to w_n.) Together with the derivative of total industry surplus, this yields, from combining the first-order conditions:

$$\begin{aligned}\beta&\left[\frac{dp_n}{dk_n} - \frac{dp_n}{dk_{n'}}\right](w_1 - w_2)\\ &= \gamma\left[\frac{dp_n}{dk_n} - \frac{dp_n}{dk_{n'}}\right][(p_1 - c_1) - (p_2 - c_2)]\\ &\quad + \frac{dp_n}{dk_n}\gamma[(\hat{p}_2 - c_2 - \hat{m}) - (\hat{p}_1 - c_1 - \hat{m})].\end{aligned} \tag{A.1}$$

The right-hand side of (A.1) can be rewritten as

$$\gamma\frac{dp_n}{dk_{n'}}[(p_1 - c_1) - (p_2 - c_2)] + \gamma\frac{dp_n}{dk_n}[(p_1 - \hat{p}_1) - (p_2 - \hat{p}_2)].$$

With linear demand, we have that

$$p_n - \hat{p}_n = (w_n - \hat{m})\frac{dp_n}{dk_n},$$

so that

$$(p_1 - \hat{p}_1) - (p_2 - \hat{p}_2) = \frac{dp_n}{dk_n}(w_1 - w_2)$$

as well as

$$(p_2 - p_1) = (k_2 - k_1)\left(\frac{dp_n}{dk_n} - \frac{dp_n}{dk_{n'}}\right).$$

Then, substituting this into (A.1) yields

$$\begin{aligned}(w_1 - w_2)&\left[\left(\beta + \gamma\frac{dp_n}{dk_{n'}}\right)\left(\frac{dp_n}{dk_n} - \frac{dp_n}{dk_{n'}}\right) - \gamma\left(\frac{dp_n}{dk_n}\right)^2\right]\\ &= \gamma\frac{dp_n}{dk_{n'}}(c_2 - c_1)\left[\left(\frac{dp_n}{dk_n} - \frac{dp_n}{dk_{n'}}\right) - 1\right].\end{aligned}$$

We now substitute for the derivatives dp_n/dk_n and $dp_n/dk_{n'}$, which are readily obtained as

$$\frac{dp_n}{dk_n} = \frac{2\beta^2}{4\beta^2 - \gamma^2} \quad \text{and} \quad \frac{dp_n}{dk_{n'}} = -\frac{\beta\gamma}{4\beta^2 - \gamma^2}.$$

With this at hand, we finally obtain after some transformations that

$$(w_1 - w_2) = (c_2 - c_1)\frac{\gamma^2}{2\beta}\frac{2\beta^2 - \beta\gamma - \gamma^2}{4\beta^3 - 2\beta\gamma^2 - \gamma^3}, \tag{A.2}$$

which, from $\beta < 0$ and $-\beta \geq \gamma$, implies $w_1 > w_2$ as long as $c_1 < c_2$. Q.E.D.

Proof of Proposition 5. Denote $p_\varnothing := \sum_n p_n/N$ and $w_\varnothing := \sum_n w_n/N$. Recall that $c_n = c$ in this case. To derive final prices, we maximize for each n the respective profits

$$\pi_n = \frac{1}{N}\left[1 - p_n - \theta\left(p_n - \frac{\sum_{n' \in N} p_{n'}}{N}\right)\right](p_n - w_n - c).$$

From the first-order condition we obtain, after making use of the average price $p_\varnothing$,

$$p_n = \frac{1 + \theta(p_\varnothing - p_n) + (c + w_n)(1 + \theta - (1/N)\theta)}{2 + \theta - (1/N)\theta}.$$

Aggregating over all n firms, this yields the system of optimal prices

$$\begin{aligned}p_n(\mathbf{k}) = \frac{1}{2 + \theta - (1/N)\theta}&\left[1 + (c + w_n)\left(1 + \theta - \frac{1}{N}\theta\right)\right.\\ &\left. + (w_\varnothing - w_n)\theta\frac{1 + \theta - (1/N)\theta}{2 + 2\theta - (1/N)\theta}\right].\end{aligned} \tag{A.3}$$

To calculate equilibrium profits, we have from $d\pi_n/dp_n = 0$ that, after substituting for dq_n/dp_n,

$$q_n = (p_n - w_n - c)\frac{1}{N}\left[1 + \theta\left(1 - \frac{1}{N}\right)\right].$$

Substituting this back into π_n yields

$$\begin{aligned}\pi_n(\mathbf{k}) &= \frac{1}{N}\frac{1 + \theta - \theta/N}{(2 + \theta - (1/N)\theta)^2}\\ &\cdot\left[1 - c - w_\varnothing - (\theta + 1)(w_n - w_\varnothing)\frac{2 + \theta - (1/N)\theta}{2 + 2\theta - (1/N)\theta}\right]^2.\end{aligned} \tag{A.4}$$

In light of subsequent calculations, it is useful to write this alternatively as

$$\begin{aligned}\pi_n(\mathbf{k}) &= \frac{1}{N}\frac{1 + \theta - \theta/N}{(2 + \theta - (1/N)\theta)^2}\\ &\cdot\left[1 - c - \frac{w_n}{N}\left((\theta + 1)\frac{2 + \theta - (1/N)\theta}{2 + 2\theta - (1/N)\theta}(N - 1) + 1\right)\right.\\ &\quad\left. + \frac{\sum w_{n'}}{N}\theta\frac{1 + \theta - (1/N)\theta}{2 + 2\theta - (1/N)\theta}\right]^2.\end{aligned}$$

Next, we derive total industry profits, $Nq(p - c)$, from which we obtain

$$\left.\frac{d\Omega(\mathbf{k})}{dw}\right|_{w_n = w} = \frac{1 + \theta - (1/N)\theta}{2 + \theta - (1/N)\theta}(1 + c - 2p). \tag{A.5}$$

We can substitute p from (21).

From (A.4), the outside option of some firm n, provided that all rival firms $n' \neq n$ face a marginal wholesale price of $w_{n'} = w$, is given by

$$\hat{\pi}_n = \frac{1}{N}\frac{1+\theta-(\theta/N)}{(2+\theta-(1/N)\theta)^2} \cdot \left[1-c-\frac{\hat{m}}{N}\left((\theta+1)\frac{2+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}(N-1)+1\right) + w\frac{N-1}{N}\theta\frac{1+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\right]^2.$$

At an interior equilibrium for w, it holds that

$$\left.\frac{d\Omega(\mathbf{k})}{dw}\right|_{w_n=w} = N\frac{d\hat{\pi}}{dw}, \tag{A.6}$$

so that, together with (A.5), we have the requirement that

$$\begin{aligned}&\frac{1+\theta-(1/N)\theta}{2+\theta-(1/N)\theta}\,\frac{\theta((N-1)/N)(1-c)-2w(1+\theta-(1/N)\theta)}{2+\theta-(1/N)\theta}\\ &=2\frac{N-1}{N}\theta\frac{1+\theta-(1/N)\theta}{(2+\theta-(1/N)\theta)^2(2+2\theta-(1/N)\theta)}\\ &\quad\cdot\left[1-c-\frac{\hat{m}}{N}\left((\theta+1)\frac{(2+\theta-(1/N)\theta)}{(2+2\theta-(1/N)\theta)}(N-1)+1\right) + w\frac{N-1}{N}\theta\frac{1+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\right].\end{aligned}$$

This can be solved for w to obtain

$$\begin{aligned}w = {}&\frac{N-1}{N^2}\theta\left[\theta(1-c)-2\hat{m}\frac{1+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\right.\\ &\left.\cdot\left((\theta+1)(N-1)\left(2+\frac{N-1}{N}\theta\right)+\left(2+\theta+\frac{N-1}{N}\theta\right)\right)\right]\\ &\cdot\left(\left(1+\frac{N-1}{N}\theta\right)\left[\left(2(1+\theta)-\frac{1}{N}\theta\right)\right.\right.\\ &\left.\left.+\left(\frac{N-1}{N}\theta\right)^2\frac{1+\theta-(1/N)\theta}{2(1+\theta)-(1/N)\theta}\right]\right)^{-1}.\end{aligned} \tag{A.7}$$

While the comparative-static result for $\hat{m}$ follows immediately, substituting w to obtain p and then differentiating with respect to θ or N turns out to be unwieldy. We therefore proceed indirectly. For this we return to the incumbent's objective function, but suppose now that the control variable is p. Note that any given p is supported by wholesale price

$$w = \frac{p(2+\theta-(1/N)\theta)-1}{1+\theta-(1/N)\theta} - c. \tag{A.8}$$

Instead of (A.6), we thus consider now the first-order condition

$$\frac{d\Omega}{dp} = N\frac{d\hat{\pi}}{dw}\frac{dw}{dp}, \tag{A.9}$$

where we have somewhat abbreviated the notation. Note first that the left-hand side of (A.9) equals $1-2p+c$, which is independent of θ. A sufficient condition for the assertion to hold is thus that for any p the right-hand side of (A.9) is strictly *increasing* in θ.

After substituting from condition (A.8) the expression for w, we obtain for the right-hand side of (A.9), after some further transformation, the expression

$$\begin{aligned}&\frac{2(N-1)}{N}\theta\frac{1+\theta-(1/N)\theta}{(2+\theta-(1/N)\theta)(2+2\theta-(1/N)\theta)}\\ &\cdot\left[p\frac{2+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\frac{N-1}{N}\theta\right.\\ &-\frac{\hat{m}}{N}(\theta+1)(N-1)\frac{2+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\\ &\left.-c\frac{N-1}{N}\theta\frac{1+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}+\left(1-c-\frac{m}{N}\right)\right].\end{aligned} \tag{A.10}$$

In the rest of the proof, we show that (A.10) is indeed strictly increasing in θ. For this we provide sufficient conditions by analyzing the different terms in (A.10) in turn. Note first that the term in rectangular brackets is strictly positive. To see next that the multiplier, which comprises the first line in (A.10), is increasing in θ, note that, using a further transformation,

$$\frac{d}{d\theta}\left(\frac{1/\theta+1-1/N}{2/\theta+1-1/N}\right)>0 \quad\text{and}\quad \frac{d}{d\theta}\left(\frac{1}{2/\theta+2-1/N}\right)>0.$$

Next, we turn to the term in rectangular brackets in (A.10). To show monotonicity in θ, we clearly have to deal only with the first line. This can be further transformed to

$$\begin{aligned}&c\left(\frac{\theta}{2+2\theta-(1/N)\theta}\right)-\frac{N-1}{N}\hat{m}\left(\frac{2+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\right)\\ &+(p-\hat{m}-c)\frac{N-1}{N}\theta\left(\frac{2+\theta-(1/N)\theta}{2+2\theta-(1/N)\theta}\right).\end{aligned} \tag{A.11}$$

Take now the three terms in (A.11) in turn. First, we already know that the term multiplied by c is strictly increasing in θ. For the second term, which is multiplied by $\hat{m}$, note that

$$\frac{d}{d\theta}\left(\frac{2/\theta+1-1/N}{2/\theta+2-1/N}\right)<0.$$

Regarding the last term, note that $p-\hat{m}-c>0$, while it is immediate that the respective multiplier is strictly increasing in θ. This concludes the comparative analysis in θ.

With respect to a change in N, we can be brief by following the preceding argument. We thus need to show now that the right-hand side of (A.10) is strictly increasing in N. To show this first for the multiplier (i.e., the first line in (A.10)), note that this transforms to

$$2\theta\left(\frac{(1+\theta)N-\theta}{(2+\theta)N-\theta}\right)\left(\frac{N-1}{2(1+\theta)N-\theta}\right), \tag{A.12}$$

where we can show for each of the two terms that they are indeed strictly increasing in N. We next transform the term in rectangular brackets, which is strictly positive, to obtain

$$\begin{aligned}&1-\hat{m}\left(\frac{(2+\theta)N}{2(1+\theta)N-\theta}\right)+(p-c)\frac{N-1}{N}\left(\frac{(1+\theta)N-\theta}{2(1+\theta)N-\theta}\right)\\ &+p\left(\frac{N-1}{2(1+\theta)N-\theta}\right).\end{aligned} \tag{A.13}$$

Here, the term multiplied by $-\hat{m}$ is strictly decreasing in N. The term multiplied by $p-c>0$ is also strictly increasing in N, as this holds for both parts. Finally, once again, the term multiplied by p is strictly increasing in N, as was used also for (A.12). Q.E.D.

Appendix B. Additional Calculations

Hotelling Case. Solving the model of Hotelling competition, we obtain for the price of $n = 1$

$$p_1 = \frac{2}{3}k_1 + \frac{1}{3}k_{2'} + \tau$$

and for the firm's downstream profits

$$\pi_1 = \frac{1}{2\tau}\left(\tau + \frac{1}{3}(k_2 - k_1)\right)^2, \qquad \hat{\pi}_1 = \frac{1}{2\tau}\left(\tau + \frac{1}{3}(k_2 - \hat{k}_1)\right)^2.$$

Expressions for $n = 2$ are symmetric. (Again, in a slight abuse of notation we denote by $\hat{\pi}_1$ the profits when only firm $n = 1$ turns to the alternative source of supply.) Equilibrium marginal wholesale prices can be obtained immediately from combining the respective first-order conditions in (6). (Alternatively, we can use the expressions from Proposition 2, such as (A.2), after noting that, with Hotelling competition, $\beta = 1$ and $\gamma = 1$.) Q.E.D.

Differentiated Inputs. Take the profit of retailer $i = 1$. Recall that in equilibrium the respective profit, gross of the fixed fee t_1, is $\pi_1 = (p_1 - c_1 - w_1)q_1$. Off equilibrium, when retailer $i = 1$ stocks the alternative product, the profit is $\hat{\pi}_1^{(1)} = (\hat{p}_1^{(1)} - c_1 - \hat{m})\hat{q}_1^{(1)}$. Note that prices and quantities denote the respective equilibrium levels (of the respective subgame), which are a function of notably the respective marginal costs of retailers, namely, $c_1 + \hat{m}$ for retailer $i = 1$ and $c_2 + w_2$ for retailer $i = 2$ (who stocks the incumbent's product). With linear demand and the respective parameters, we have notably

$$\frac{d\pi_1}{dw_2} = \frac{dp_2}{dw_2}(p_1 - c_1 - w_1)\gamma,$$
$$\frac{d\hat{\pi}_1^{(1)}}{dw_2} = \frac{d\hat{p}_2^{(1)}}{dw_2}(\hat{p}_1^{(1)} - c_1 - \hat{m})\hat{\gamma}.$$

Proceeding now as in the proof of Proposition 2, the first-order condition (14) for w_2 becomes

$$\frac{dp_2}{dw_2}(p_1 - c_1)\gamma + \frac{dp_1}{dw_2}w_1\beta + \frac{dp_1}{dw_2}(p_2 - c_2)\gamma + \frac{dp_2}{dw_2}w_2\beta = \frac{d\hat{p}_2^{(1)}}{dw_2}(\hat{p}_1^{(1)} - c_1 - \hat{m})\hat{\gamma}.$$

We can likewise derive the first-order condition for w_1. Subtracting one from the other, we finally obtain the requirement (15) (which in turn generalizes (A.1), derived for $\hat{\gamma} = \gamma$).

Endnotes

[1] See, for example, Jeuland and Shugan (1983), McGuire and Staelin (1983), Mathewson and Winter (1984), Shugan (1985), Moorthy (1987), Iyer (1998), Villas-Boas (1998), Desai et al. (2004), and Cui et al. (2007).

[2] Suppliers are often constrained by the ability of downstream firms to switch to competing sources if they are unhappy with the terms and conditions they receive. It may be, for example, that the downstream firms can purchase the same input from smaller upstream firms that may not be as cost efficient. Or, other suppliers may offer competing goods that, because of shelf-space constraints, can only be carried if the downstream firms do not carry the incumbent's good. Lastly, a downstream firm might be able to constrain the incumbent's market power by threatening to integrate backward and produce its own good.

[3] Using the terminology defined in Dukes et al. (2006), the source of each downstream firm's power in our setting stems from its "bargaining position" (i.e., the value of the downstream firm's outside option).

[4] See the UK Competition Commission (2008) report, and the references cited therein, in which the Commission attempted to document the effects of buyer power in the UK grocery markets.

[5] Even though the incumbent has the ability to make take-it-or-leave-it offers, and thus already has all the bargaining power, it must still be cognizant of the downstream firms' outside options. As we explain below, there are two conflicting forces at work, given that the objective of maximizing channel profits alone would tend to induce the supplier to handicap the less efficient firms (cf. Inderst and Shaffer 2009).

[6] There may be legal constraints on what the manufacturer can do. In the United States, the Robinson–Patman Act of 1936 (Pub. L. No. 74-692, 49 Stat. 1526, 15 U.S.C. § 13) prohibits price discrimination in wholesale markets *where the effect of the discrimination is to lessen competition*. Its interpretation, and what is deemed permissible, has evolved over the years as courts have granted manufacturers increasing latitude.

[7] Conceptually, this point goes back to Spengler (1950).

[8] Villas-Boas (1998) looked at an upstream firm's product-line decisions and showed that an uncoordinated channel would lead the manufacturer to widen its product line, making the firms worse off.

[9] Iyer (1998) questioned the assumption in Mathewson and Winter and others that the manufacturer would want to treat all retailers the same, noting circumstances in which the manufacturer might strategically induce retail price and service differentiation. Chu and Desai (1995) focused on channel coordination in a duopoly downstream setting where the nonprice variable to be controlled was customer satisfaction.

[10] Lastly, it is useful to draw a link between our work and the literature on strategic decentralization (see, e.g, McGuire and Staelin 1983, Coughlan 1985, Moorthy 1988, Bonanno and Vickers 1988, Rey and Stiglitz 1988). In this literature, competing manufacturers set their wholesale prices above marginal cost as a commitment to dampen competition in a duopoly game. The contrasts are (i) in this literature, the departure from supply chain profit-maximization is for reasons of strategic commitment in an upstream game; and (ii) the departure is to higher wholesale prices, rather than to lower wholesale prices, as it is in our paper, because of strategic complementarity upstream.

[11] In O'Brien and Shaffer's (1992) model, for example, the upstream firm's wholesale price gets competed down to marginal cost in equilibrium, resulting in a reduction in total channel profits. While total channel profits are reduced by cross-contract (cross-retailer) externalities in this literature, as they are in our paper, in our paper, this works through the impact on the profit of the downstream firms' outside opportunities rather than the inability of the manufacturer to commit because of the private-information contracting.

[12] There is substantial ongoing debate about the desirability of the Robinson–Patman Act and how vigorously it is enforced (see, e.g, Luchs et al. 2010, who find that as a result of recent Supreme Court rulings, there is less than a 1 in 20 chance that a court will find a defendant guilty of violating the Act). Moreover, unlike in the settings considered by Ingene and Parry (1995, 1998, 2000), in our setting, the incumbent's discriminatory terms would not violate the Robinson–Patman Act because they serve to level the playing field, which is what the Act was intended to do: protect small businesses. In other words, courts would not find a violation in our setting because they would find that competition was enhanced, not lessened.

[13] In many cases, for example, with linear demands, the difference is simply a matter of reinterpreting variables.

[14] Allowing the competitive sources to also offer two-part tariffs would not affect our qualitative results.

[15] Recall that the incumbent's marginal costs of production have been normalized to zero.

[16] Since the suppliers' inputs are identical, only the lower cost one will be purchased.

[17] The incumbent's maximization problem is quasi-concave, for example, when demand is linear.

[18] Under standard regularity conditions, this follows when the cross-price effect is positive (substitutes). In the case of complements, our qualitative findings would have the opposite sign.

[19] For this to hold, more structure would be needed to ensure that demand elasticities for the incumbent's product do not jump around in unusual ways once the incumbent begins to distort its wholesale prices.

[20] Although our benchmark model allows for differences between downstream firms only in terms of their marginal costs or asymmetries in demand, it can readily be seen that our results extend to the case in which the downstream firms differ in their costs of accessing the alternative source of supply (indexed by $\hat{m}_i$). Also, (different) fixed costs from switching to the alternative source of supply are readily accommodated.

[21] For more on the case where only a subset of the firms' outside options binds, see also the subsequent case with heterogeneous downstream firms and notably the discussion after Proposition 2.

[22] It can also explain why documenting that powerful downstream firms receive lower *marginal* wholesale prices (as opposed to lower average wholesale prices) has sometimes proven to be elusive. Our results suggest that the most powerful downstream firms may not receive the lowest marginal wholesale prices.

[23] See Shaffer (1991) for a model in which competitive upstream firms use two-part tariffs with negative fixed fees (i.e., slotting allowances) in order to dampen competition on behalf of the downstream firms.

[24] It is straightforward to show that our qualitative results extend to any number of downstream firms.

[25] Recall that $\pi_i = (p_i - c_i - w_i)q_i$, so that $\partial\pi_i/\partial p_j = (p_i - c_i - w_i) \cdot (\partial q_i/\partial p_j)$, for $i, j = 1, 2$, and $i \neq j$.

[26] To see this, suppose that $k_1 < k_2$, so that firm 1's operating cost is lower. Then, firm 1 will have the lower price in equilibrium, $p_1 < p_2$, which implies that it will have the larger markup $p_1 - k_1 > p_2 - k_2$ (this follows from the first-order condition $(p_1 - k_1)(\partial q_1/\partial p_1) + q_1 = 0$, where $\partial q_1/\partial p_1 = \beta$). In particular, when $w_1 = w$, so that, together with $c_1 < c_2$, this implies $k_1 < k_2$, the right-hand side of (12) would be strictly positive, while the left-hand side would be zero. To equalize the two sides, it must hold that $w_1 < w_2$.

[27] Note that (13) is calculated at arbitrary values k_1 and k_2, not just at equilibrium values.

[28] An implicit assumption here is that the downstream firms will either be purchasing from the incumbent or the rival supplier, but not both. This might be the case, for example, if the underlying setting is one in which the downstream firms are retailers that have room (shelf space) for only one supplier's inputs.

[29] Clearly, when one retailer stocks a different product, demand is no longer symmetric. For our equilibrium characterization we need not specify all cross-price derivatives. Note as well that for notational simplicity we still assume the own-price derivative is equal to β. This simplification seems justified as we do not undertake a comparative analysis in some underlying primitives of demand in what follows.

[30] Note that the difference $(\hat{p}_1^{(1)} - c_1) - (\hat{p}_2^{(2)} - c_2)$ compares the two firms' margins when retailer 1 has taken up the outside option, $\hat{p}_1^{(1)} - c_1$, versus when retailer 2 has taken up the outside option, $\hat{p}_2^{(2)} - c_2$ (where the respective cost of supply $\hat{m}$ has dropped out). Retailer $i = 1$ is more efficient with $c_1 < c_2$.

[31] While we can show that $w_1 > w_2$ explicitly for the case of $\hat{\gamma} = \gamma$, for all intermediate cases $0 < \hat{\gamma} < \gamma$ the respective equations in (15) do not lend themselves easily to such an explicit comparison.

[32] To the contrary, much of the literature on buyer power is focused on showing the opposite effect. This literature looks for reasons why there may be size-related advantages in procuring lower input prices. For instance, Katz (1987) and Inderst and Valletti (2009) show that switching costs can give rise to size-related advantages because larger buyers can distribute these costs over a larger volume. Our setup abstracts from this and suggests there may be countervailing forces in play that have not previously been identified.

[33] Note that for this characterization to apply, the consumers' utility from purchasing the product must be sufficiently high that, under the characterized equilibrium prices, the market is indeed fully covered.

[34] Details of the calculations for the Hotelling model can be found in Appendix B.

[35] To obtain these expressions, it is convenient to solve first for the *retail* prices that maximize $q_1(p_1 - c_1) + q_2(p_2 - c_2)$, where q_i is given by (17). (The market is covered by at least one product when $p_1 + p_2 \leq 2v - \tau$.) This yields p_i^{Mon}. Requiring then that these prices are obtained from $p_i = \tau + (2k_i + k_j)/3$ yields w_i^{Mon}.

[36] Goods are independent if $\theta = 0$ and become increasingly substitutable as θ increases.

[37] This restriction on the downstream firms' marginal costs is needed because the overall market size is equal to one and we have stipulated, for convenience only, that the incumbent's own marginal cost is zero.

[38] Interestingly, p does not converge to $c + w$ as $N \to \infty$, although downstream profits satisfy $\pi \to 0$.

[39] We relegate an explicit characterization of the expression for w_n to the proof of Proposition 5.

[40] This follows immediately from inspecting expression (A.10) in the proof of Proposition 5. Because this expression is always equal to $1 - 2p - c$ (cf. the derivation in the proof), it is easily verified that this can only be the case when $p - (\hat{m} + c) \to 0$. Otherwise, expression (5) would not be bounded as $\theta \to \infty$.

[41] The calculations are straightforward and obtained from the expressions in the proof of Proposition 5.

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