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We study the effects of retailer in-store media on distribution channel relationships. Retailers open in-store media (ISM) and allow manufacturers to advertise to shoppers. Our results suggest that ISM has an important role in coordinating a distribution channel on advertising volume and product sales, and on mitigating supplier competition. Improved channel coordination is achieved through the internalization of advertising decisions from commercial forms of media (e.g., radio, TV, newspaper). A retailer may strategically subsidize manufacturers for their advertising on ISM. This subsidy is optimal even if ISM is more effective than commercial media. With manufacturer competition, a retailer can strategically use a "competitive premium" to ration excessive advertising between competing suppliers in a category. When manufacturers are asymmetric with preadvertising brand awareness, a retailer has an incentive to price discriminate by charging lower prices to manufacturers whose brand awareness is higher.

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1. Introduction

An interesting phenomenon in modern retailing is that many retailers are starting to open in-store media (ISM). With advanced communication technology, it is now practical and feasible for retailers to offer media platforms and manufacturers to advertise on them. Walmart, for instance, launched Walmart TV in 1999 and placed 100,000 screens in more than 2,650 stores, reaching 336 million shoppers every month. Walmart TV attracts many manufacturers, including Kraft Foods, Gillette, and Frito-Lay, to advertise through Walmart TV. According to Forrester Research (Baird 2005), Walmart TV has the fifth-largest reach of any network, trailing only the big broadcasters ABC, CBS, NBC, and Fox.

ISM has also been adopted by other retailers including Best Buy, Costco, Albertsons, CompUSA, Borders, and Kroger. Manufacturers pay these retailers to advertise through ISM. Note that ISM by retailers may not only be for cooperative advertising purposes. For instance, Costco's in-store network is supported entirely by national advertising and marketing dollars rather than co-op or trade funds (Baird 2005). According to Mark C. Mitchell, executive vice president for advertising sales at Premier Retail Network (PRN), ISM makes itself very attractive as an advertising platform to marketers because up to 70% of purchase decisions are made inside the store (Hays 2005). In fact, Nielsen Media Research found brand recall among Walmart TV viewers was 65%, a significant improvement over the 23% average recall among in-home viewers (Thomas 2004). Despite these advantages, ISM often has advertising rates much lower than commercial media. For instance, while the advertising rate is $412K for 30 seconds on *Survivor: Vanuatu* by CBS, and $620–$650K for 30 seconds on *American Idol* by Fox, Walmart TV charges only $50–$300K per four-week run (Baird 2005). Although some analysts attribute the low rates for in-store media to possibly lower effectiveness of ISM, retailing managers view ISM as a significant improvement to current retailing practices because the separation of consumer awareness and purchase is removed (Baird 2006).

ISM or "retailer-generated media" is distinguished from commercial media (CM) such as radio, television, Internet, newspaper, or magazine because it is operated by the retailer (or a party thereof) rather than by independent third parties. This ownership structure means that retailers who use ISM profit from the additional ad revenue that otherwise would end up with CM. Additionally, as our research finds, the retailer stands to benefit further from ISM because of the ability to manage product sales and competition within its store through its setting of ad prices. For the

retailer, establishing an ISM network also requires an upfront investment in costly technology. Consequently, an objective of this work is to identify the sources of ISM's benefits to properly compare against its costs.

There are additional managerial issues for a retailer with ISM. Because ISM ads affect sales and competition within a category, there are implications for the interaction between channel members and the distribution of channel profits. Moreover, this interaction may depend on consumers' predisposition to certain brands in a category. An important objective in this research is to investigate how ISM pricing can be used to manage product sales in the presence of supplier competition within the product category.

The availability of ISM is also a challenge for consumer goods manufacturers who traditionally advertise on independent commercial media. For instance, is ISM a good thing or a bad thing for these manufacturers? The answer is not obvious, particularly against a backdrop of heightened retail leverage over manufacturers (Kadiyali et al. 2000). In addition, when both ISM and CM are available, how should a manufacturer decide on its media plan? Should the manufacturer advertise on ISM, CM, or both? This question is particularly important noting that advertising through ISM may lead to duplicate advertising to the consumers exposed to CM. In this research we evaluate the potential trade-offs to a retail supplier who contemplates the use of retailer ISM.

It has also been observed that ISM can play a crucial role in the launch of new products by consumer goods manufacturers. For example, more than 150 new products were introduced on Walmart TV in 2006 (Petrecca 2007). In fact, PRN, the firm that manages ISM for Walmart, Albertsons, and other retailers, focuses their efforts on getting new brands to advertise with ISM.[1] Our research suggests a rationale for this observation.

In this paper, we study these issues by focusing on the effects of ISM on the distribution channels. Specifically, we address the following questions: When should a retailer introduce ISM? What are the effects of ISM on the profits of distribution channel members? What factors affect the optimal advertising rate for ISM? How does the distribution of channel power (e.g., bargaining power) affect a retailer's decision about establishing ISM, the optimal advertising rate, and firms' profits?

To answer the above questions, we set up a simple but insightful game-theoretical model of a retailer who establishes ISM as an advertising alternative for its suppliers. In the model, we account for the difference in ad effectiveness of ISM from commercial media CM. This allows us to set our investigation in the context of declining effectiveness of CM

advertising to influence purchase decisions. With our model, we can offer an explanation for the emergence of ISM and how ISM changes manufacturers' advertising incentives for consumer products. We also incorporate preadvertising brand awareness on ISM pricing and indicate how retailers should price discriminate across competing suppliers whose brands differ. In addition, we study the implications of retail competition on ISM by evaluating advertising activities before and after ISM is available. We first study the case of one manufacturer and one retailer. Later, we extend the model to assess the case of competing retailers and competing manufacturers.

A number of intriguing results emerge. First, we find that ISM can help the channel coordinate on a jointly optimal level of advertising. In particular, by offering ISM, the channel generates more sales and higher profits for both channel members. There are two sources of benefits. One comes from internalizing media spending that was once spent on outside media, and the other comes from coordinating the ad pricing structure towards the channel optimum. We show that the internalized decision of the advertising rate induces the retailer to offer discounts on ISM advertising relative to CM—even if ISM is more effective than CM. In general, we establish the coordinating role of ISM in the distribution channel, and this role holds when ISM is either more or less effective than CM.

Second, we show that a retailer who offers ISM to competing suppliers should raise ad prices relative to the single supplier. Interestingly, this is not because of market power in advertising but rather that price can be used as a rationing device. By internalizing the advertising decision, the retailer raises ad prices to mitigate the business-stealing externality prominent in competitive advertising (e.g., Grossman and Shapiro 1984). The notion of a "competitive premium," therefore, reinforces the benefits of ISM on the coordination of a distribution channel.

Third, we show that the level of preadvertising brand awareness affects the efficacy of ISM for category management. For many product categories, consumers may be more aware of certain brands than of others. Our results suggest counterintuitively that a retailer who offers ISM should set higher ad prices to the supplier with *less* brand awareness. The reason for disparate pricing reflects the higher marginal value a relatively unknown brand has for an advertisement. In addition, the rationing principle discussed above suggests an additional channel benefit from discriminating in price. A lesser-known brand's advertising message is more likely to influence a consumer with knowledge of the well-known brand than to generate a new sale. Discriminatory pricing in favor of the well-known brand, therefore, partially mitigates wasteful advertising. This result may be counter to

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[1] *Source.* PRN promotional video (available at http://www.prn.com).

the notion that "starter" brands should be offered a discount and may explain the observed push for new products to be promoted on ISM.

Finally, our model offers results concerning the implication of ISM on social welfare. Clearly, if ISM is more efficient in its ability to inform consumers, then social welfare is unambiguously higher as a result of better advertising means and better channel coordination. Interestingly, however, even when ISM is less effective than commercial media, a retailer's use of ISM can still increase social welfare. This stems from to improved channel coordination from the retailer's subsidization of manufacturer advertising. Such efficiency gains are limited, however. If ISM effectiveness is significantly low, a retailer may introduce ISM for its own benefit with the sacrifice falling on social welfare.

This research relates closely to the retail distribution and channel management literature. In line with many papers in this literature, we examine how actions by a channel member serve to coordinate the channel by improving overall profits. For example, Jeuland and Shugan (1983), Moorthy (1987), Lal (1990), Gerstner and Hess (1995), and Raju and Zhang (2005) evaluate the impact of various marketing decisions by firms on channel efficiencies; however, none of these studies suggests how the option of ISM offered by the retailer affects channel coordination. There is also some research on the effects of cooperative advertising on distribution channel coordination (Berger 1972, 1973; Dant and Berger 1996; Bergen and John 1997; Jorgensen et al. 2000; Huang et al. 2002). This stream of research, however, focuses on advertising through commercial media that maximizes their own profits. In this paper, the effects of ISM on channel coordination are different from cooperative advertising in CM because CM does not have incentives to coordinate the distribution channel. ISM by a retailer, however, internalizes the advertising rate to the distribution channel, thereby permitting retailer subsidization, which coordinates the distribution channel on advertising, product sales, and supplier competition. There is also a good deal of work investigating the implications of channel structure for marketing choices (McGuire and Staelin 1983, Coughlan 1985, Moorthy 1988). These papers focus on the implications of channel structure for wholesale transactions and retail pricing, while holding other marketing variables constant. In contrast, we examine how the extent of competition among suppliers or competition among retailers alters the price of the retailer's ISM service.

In many respects, ISM resembles a more technical version of the in-store display. ISM, however, offers the channel more control of promotional message timing and pricing than traditional in-store promotional tools. In addition, in-store displays have traditionally been associated in the literature with price promotions. Apart from these differences, our modeling may offer new insights for these classic forms of in-store advertising as well. The previous literature has examined the impact of the use of in-store displays on consumer reactions to price and promotion (Chevalier 1975, Bemmaor and Mouchoux 1991) as well as the effect of in-store displays and features on consumer purchase behavior and brand choice (Guadagni and Little 1983, Gupta 1988, Lattin and Bucklin 1989, Bucklin and Gupta 1992, Papatla and Krishnamurthi 1996). Although these empirical findings indicate that, consistent with our model, in-store displays and features tend to increase product sales, the issues of in-store display as an advertising medium for sale and its impact on distribution channel coordination have not been explored.

This paper also addresses the marketing literature on advertising and commercial media. Dukes and Gal-Or (2003) and Liu et al. (2004) illustrate the importance of the structure of the media industry on marketing decisions. Similar to these papers, our paper acknowledges that advertisers have options with respect to ad placement. However, neither of these papers is equipped to assess the situation when the seller itself—the retailer—owns the advertising medium. Godes et al. (2009), on the other hand, looks at competing firms who earn revenue from selling both products and advertising space. In that research, the product for sale is media content bundled with advertising messages promoting other, independent products. In our setting, however, the advertising messages are aimed at promoting the available product sold by the retailer.

Finally, our paper relates to the literature examining the effect of third-party advertising on the actions and profits in distribution channels. Shaffer and Zettelmeyer (2002, 2004) investigate the impact of consumer information on the distribution of channel profits. In those papers, the advertising rate and information medium are unspecified. In this paper, however, we endogenize a firm's choice of media and allow a retailer to open ISM and endogenously decide the advertising rate. Doing so allows us to internalize the advertising decision within the channel and account for economic incentives left out of previous research. Consequently, our results lead to new managerial implications for ad pricing.

2. Basic Model: One Manufacturer

In this section we investigate two issues: (1) how ISM alters a supplier's incentive to advertise, and (2) conditions that lead to ISM being profitable to a retailer. The basic intuition for our results is illustrated in the case of a single retailer. Finally, we evaluate the implication of retail competition.

2.1. Single Retailer

A single manufacturer, denoted by M, supplies a retailer, denoted by R, who then serves a set of consumers of mass 1. Each consumer values a manufacturer's product at v but is a priori uninformed of its existence. Let $\varphi \in (0, 1)$ be the portion of consumers informed of M's product, which depends on the amount of advertising by M. The manufacturer can choose to advertise on commercial media (CM) or, if available, in-store media (ISM). Specifically, denote Φ^k as the advertising volume by the manufacturer on medium $k = $ CM, ISM. Then, the probability that any given consumer becomes aware of the product is a concave and increasing function of total advertising volume, $\varphi = A(\Phi^{CM}, \Phi^{ISM})$, $\partial A / \partial \Phi^k > 0 > \partial^2 A / \partial (\Phi^k)^2$, $k = $ CM, ISM. To guarantee analytic solutions, we assume the following form for A:

$$\varphi = A(\Phi^{CM}, \Phi^{ISM}; \gamma) \equiv \min\{1, \sqrt{2(\Phi^{CM} + \gamma \Phi^{ISM})}\}, \quad (1)$$

where $\gamma > 0$ is a parameter measuring the effectiveness of ISM relative to CM as a means of reaching consumers. ISM is more effective than CM when $\gamma > 1$ and less effective when $\gamma < 1$. Here, we focus on the effect of ISM in informing the "captive audience" once consumers have entered the store.[2] The advertising technology function, A, reflects the fact that consumer awareness is a concave function of advertising volume, and at some point, additional advertising messages do not increase the likelihood of additional purchases. The chosen specification permits closed form solutions, allowing us to draw deeper insights about ISM.[3] The features that drive our results depend only on the curvature and monotonicity properties of this advertising function, which are empirically well established in the neighborhood of the optimal advertising level (Little 1979).

We assume that the market rate for advertising is $a^{CM} > 0$ for CM, and the ISM advertising rate is a^{ISM}, which is endogenously chosen by the retailer. The manufacturer may also incur a unit cost $c > 0$ for advertising. This cost encompasses any non-media costs such as agency fees or ad copy development. Of course, some (or even most) non-media costs may be fixed with respect to advertising volume. However, once the decision to advertise has been made, these costs will not affect the ad quantity decision. The parameter c, therefore, reflects any aspect of these costs that depends on the advertising volume. Throughout this paper, we focus the analyses on the

case of $a^{ISM} > c$ where a supplier's advertising decision is based more on the advertising rate rather than on the external cost. The same basic results go through when $c > a^{CM}$. However, we do not focus our discussion on this case because it emphasizes non-media advertising costs rather than the trade-off between media. We also assume $v < a^{ISM} + c$ to focus on the most interesting case where the manufacturer does not always achieve full market awareness because of high consumer value. Again, the same basic results hold if $v > a^{CM} + c$. In this case the manufacturer may optimally advertise to achieve full market awareness even with CM.

We analyze a three-stage game. In stage 1, the retailer R decides whether to offer ISM and, if so, at what price. In stage 2, the manufacturer M makes an advertising decision—with CM and, if available, with ISM. In stage 3, wholesale transactions are negotiated bilaterally between R and M. Following stage 3, consumers make their purchases. We assume that all purchasing consumers pay their value. This assumption allows us to separate out the retail pricing decisions and focus on the advertising decisions. Alternatively, one can add the optimal retail price decision for the retailer facing a downward sloping demand. However, such a setup does not alter our results.

We solve the game by starting with stage 3 to guarantee subgame perfection. In stage 3, the manufacturer and the retailer negotiate bilaterally for the wholesale transaction. We model these negotiations via Nash bargaining. For positive demand $D(\varphi)$, the Nash bargaining solution yields a wholesale price $w = \lambda v$ paid per unit sold by R to M, where $\lambda \in (0, 1)$ denotes the "bargaining power" of the manufacturer. (See the appendix for formal details.) Bargaining is efficient in the sense that the total channel profits are maximized over all levels of demand. This stems from the fact that with the absence of retail pricing, there are no inefficiencies from double-marginalization. Therefore, bargaining over more complicated contracts, such as two-part tariffs, will not lead to more channel profits.[4] This permits us to focus exclusively on the channel efficiencies generated from ISM decisions. In sum, this formulation allows us to abstract away from wholesale and retail pricing by using a single parameter, λ.

First, suppose R does not offer ISM. With a single supplier, demand for M's product is the probability that a given consumer is aware of it: $D(\varphi) = \varphi$. With

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[2] It is possible that ISM has the added effect of generating additional store traffic. We consider this possibility in §2.3.

[3] Alternatively, for example, the specification $A(\Phi) = 1 - e^{-\Phi}$ is strictly increasing and at a decreasing rate for all $\Phi > 0$. Such a specification, however, does not permit closed form solutions.

[4] We have endowed the retailer with full control of advertising price. It is possible, however, to consider this as part of the negotiations along with the wholesale price. Doing so forbids us from deriving results in later sections so we maintain this assumption throughout. Because our results suggest that channel incentives are aligned with advertising on ISM, we expect the bargaining over advertising price would lead to qualitatively similar results.

only CM available, M chooses Φ^{CM}. However, it will be convenient to formulate M's advertising problem in terms of a choice φ by inverting the advertising technology in (1). Thus, M chooses φ to maximize

$$\Pi_M(\varphi) = \lambda v D(\varphi) - (a^{\text{CM}} + c)\frac{\varphi^2}{2}.$$

The retailer is passive when not offering ISM and earns $\Pi_R(\varphi) = (1 - \lambda)v D(\varphi)$. This optimization is directly computed and leads to the following:

$$\hat{\varphi} = \frac{\lambda v}{c + a^{\text{CM}}}, \qquad \widehat{\Pi}_M = \frac{(\lambda v)^2}{2(c + a^{\text{CM}})}, \qquad (2)$$
$$\widehat{\Pi}_R = \frac{(1 - \lambda)\lambda v^2}{c + a^{\text{CM}}}.$$

Not surprisingly, the manufacturer will increase advertising on commercial media when the manufacturer's bargaining power increases. As the manufacturer gains more of the channel profit, the manufacturer has a stronger incentive to increase the product sales by advertising more in CM.

Suppose R introduces ISM and offers an advertising rate of a^{ISM}. The manufacturer can split advertising between two media, CM and ISM. This leads to a manufacturer advertising cost of $(c + a^{\text{CM}})\Phi^{\text{CM}} + (c + a^{\text{ISM}})\Phi^{\text{ISM}}$. Note, however, that since M views advertising between CM and ISM as substitutes, one medium will be chosen exclusively except possibly in parametrically knife-edge situations.[5] In fact, with endogenous ISM pricing, as long as $a^{\text{ISM}} \leq \gamma a^{\text{CM}} + (\gamma - 1)c$, the manufacturer will advertise exclusively on ISM.[6] Therefore, we can specify M's profits to be

$$\Pi_M(\varphi; a^{\text{ISM}}) = \lambda v D(\varphi) - (a^{\text{ISM}} + c)\frac{\varphi^2}{2\gamma}$$

when using ISM. Then R's pricing problem is to set a^{ISM} to maximize its profits,[7] which we denote as Π_R and formulate as follows:

$$\max_a \ (1 - \lambda)v D[\varphi^*(a)] + \frac{a}{2\gamma}(\varphi^*(a))^2$$
$$\text{subject to} \quad \varphi^*(a) = \arg\max_\varphi \Pi_M(\varphi; a). \qquad (3)$$

To illustrate the main results, it is sufficient to focus on the interior solution[8] of the above program and examine the first-order condition of the maximization in (3):

$$\frac{\partial \Pi_R}{\partial a} = (1 - \lambda)v\frac{d\varphi^*}{da}$$
$$+ \frac{1}{2\gamma}\left[(\varphi^*(a))^2 + 2a\varphi^*(a)\frac{d\varphi^*}{da}\right] = 0. \qquad (4)$$

The first term in (4) denotes the internalization created by ISM. By offering ISM, R has the ability to capture profits that would have otherwise gone to CM. But, by choice of a^{ISM}, the retailer can "throttle" advertising from the manufacturer. In particular, the first term in (4), which is the marginal effect of ad prices on product sales, is negative ($d\varphi^*/da < 0$). Therefore, it is optimal for the retailer to set a price below that of a pure media provider (who would set the bracketed term to zero) to induce more advertising and product sales. Despite lower prices, the manufacturer will not find it optimal to advertise with ISM unless it is sufficiently effective: $\gamma > \underline{\gamma} \equiv 2c\lambda/((a^{\text{CM}} + c)(2 - \lambda))$. The threshold $\underline{\gamma}$ is less than unity for all $\lambda \in (0, 1)$, which means that the manufacturer may benefit from advertising on ISM even if it is relatively less effective than CM. The results when R offers ISM are summarized in Proposition 1.

PROPOSITION 1. *If* $\lambda > 2 - 2c/(v\gamma)$, *then a unique interior solution to* (3) *exists. If R offers ISM and $\gamma > \underline{\gamma}$, then the implied equilibrium is described as follows.*

(i) *The retailer offers a discount relative to* CM: $a^{\text{ISM}} = ((3\lambda - 2)/(2 - \lambda))c < a^{\text{CM}}$.

(ii) ISM *leads to uniformly more advertising than* CM *does:* $\varphi^*(a^{\text{ISM}}) = ((2 - \lambda)/2)\gamma v/c > \hat{\varphi}$.

(iii) *Profits with* ISM *are expressed by* $\Pi_M(\varphi^*) = (2 - \lambda)\lambda(\gamma v^2/4c)$ *and* $\Pi_R^*(2 - \lambda)^2(\gamma v^2/8c)$.

The immediate implication of this proposition is that R will set the ISM ad rate below the rate at CM when the ISM is less effective ($\gamma < 1$), which is not surprising given the ineffectiveness of the ISM. Interestingly, however, R sets the ISM ad rate below the rate at CM, even when ISM advertising is more effective than CM ($\gamma > 1$). Indeed, the retailer may even be induced to subsidize ISM advertising. If the manufacturer bargaining power is not too high ($2 - 2c/(\gamma v) < \lambda < 2/3$), the actual ISM ad price is negative, and the retailer actually subsidizes part of the manufacturer's cost of advertising.[9] The intuition

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[5] This does not mean that CM and ISM are generally substitutable outside this model. Indeed, CM may offer a way for manufacturers to communicate to consumers who are not present in a retailer with ISM. We illustrate a scenario of this in §2.3.

[6] This assumes that CM is not responsive to the introduction of retailer ISM. We discuss the implications of relaxing this assumption in §5.

[7] Without loss of generality, it is assumed that the retailer incurs no marginal cost associated with advertisements on ISM. Later, we consider the impact of a fixed cost of ISM (e.g., installation).

[8] The condition guaranteeing a unique interior solution is given in Proposition 1. The basic results remain when this condition is relaxed to allow for boundary solutions.

[9] Note that even with a retailer subsidy, the sum cost of advertising to the manufacturer is still positive (since $a^{\text{ISM}} + c = (2\lambda/(2 - \lambda))c > 0$).

behind the subsidization of advertising through ISM is as follows. With ISM, a retailer's profit has two sources: product sales and advertising revenue. When product sales are very important to the retailer, the retailer may sacrifice advertising revenue by reducing its ISM rate. By doing so, the retailer can motivate the manufacturer to advertise more, as indicated in part (iii) of the proposition, which, in turn, benefits the retailer in product sales. This motivation is particularly strong with low manufacturer bargaining power, which implies the retailer retains a significant portion of product sales. The subsidization role of manufacturer advertising through ISM also results when ISM is less effective that CM ($\gamma < 1$). With the less effective ISM, the retailer further lowers its advertising rate to keep the ISM advertising rate competitive. In fact, it can be shown that both M and R benefit from ISM for values of $\gamma < 1$. However, as we will discuss in §4, advertising through the less effective media may lead to a reduction in overall welfare.

When ISM benefits the retailer beyond installation costs (see §2.2), Proposition 1 implies that ISM can coordinate the channel on advertising and increased product sales. Note that the benefits of ISM on channel coordination do not preclude other instruments by firms to coordinate their distribution channels. Cooperative advertising, for instance, may also enable coordinating a distribution channel to some extent. However, with cooperative advertising through CM, the advertising rate is out of the control of distribution channel members. In other words, CM maximize their own benefits without the incentive to maximize the benefits to the manufacturer and the retailer. Thus, cooperative advertising through CM between a manufacturer and a retailer may not achieve the same channel coordination effect of retailer ISM.

The results of Proposition 1 allow us to investigate the impact of channel bargaining power on the advertising rate of ISM. As M's bargaining power increases ($\lambda \uparrow$), the optimal ISM ad price increases. When M has a greater share of the product margin, the retailer has less and will rely more on the advertising source of revenue. In addition, the manufacturer will have a stronger incentive to advertise because it has a greater share of the product margins. Therefore, the retailer will raise ISM ad prices to the manufacturer. Generally, while R enjoys higher ad revenue with higher manufacturer bargaining power, Proposition 1 indicates that, overall, R does not benefit from an increase in M's bargaining power. Similarly, with higher manufacturer bargaining power, the manufacturer pays more for advertising, but the benefits of increased share from product sales dominate the advertising expenditure increase, resulting in a higher manufacturer profit. As this discussion suggests, channel bargaining power is a crucial factor

in the retailer's decision to install ISM. We investigate this in the next section.

2.2. Retailer Decision to Open ISM

When will ISM be an equilibrium outcome? As noted above, the manufacturer can benefit from ISM because the retailer has an incentive to subsidize manufacturer advertising. The retailer is also better off with ISM, provided it covers any fixed cost $f > 0$ of installing it. As we show, the bargaining power of the manufacturer affects the retailer's decision on opening ISM. We compare the retailer's profit before and after implementing ISM, and define $\Delta_R(\lambda) \equiv \Pi_R^* - \widehat{\Pi}_R$ as the benefit of ISM relative to CM, gross of fixed cost f. Thus, offering ISM will be an equilibrium outcome for any λ such that $\Delta_R(\lambda) - f > 0$.

We first start with the case that the ISM is more effective than the CM ($\gamma > 1$). Using profit expressions from Proposition 1, part (iii), and Equation (2), we can directly show that $\Delta_R(\lambda)$ is U-shaped, achieving a minimum when the manufacturer's bargaining power equals

$$\dot{\lambda} \equiv (2(a^{CM} + c)\gamma + 4c)/((a^{CM} + c)\gamma + 8c).$$

Note that if $a^{CM}/c > 4/\gamma - 1$, then $\dot{\lambda} > 1$ and $\Delta_R(\lambda)$ is strictly decreasing for all λ. Therefore, lower bargaining power for the manufacturer implies that ISM is more likely to be offered because R can retain enough surplus from product sales to cover the cost of installing it. This situation is represented in Figure 1, where the dotted line representing $\Delta_R(\lambda)$ is decreasing in λ. If the fixed cost, f, of ISM is such that $\Delta_R(0) > f > \Delta_R(1)$ (represented by the horizontal line in Figure 1), then ISM will be provided in equilibrium for bargaining powers that favor the retailer (low λ).

However, if $a^{CM}/c < 4/\gamma - 1$, then $\dot{\lambda}$ is less than unity, which implies that the retailer's gain from ISM may actually be increasing in the manufacturer's bargaining power for $\lambda > \dot{\lambda}$. Recall that when R does not offer ISM, her sole source of revenue is through

Figure 1   Retailer's Benefit from Opening ISM
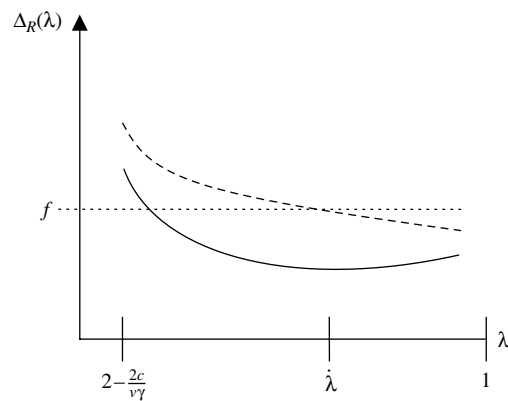
product sales. However, with ISM, she can recoup declines in bargaining power in part through higher ad prices. This implies that $\widehat{\Pi}_R$ declines faster in $\lambda > \dot{\lambda}$ than Π_R^*. This condition holds when the price of CM advertising, a^{CM}, is sufficiently low making it a very attractive advertising outlet for the manufacturer. The situation in this condition is depicted in Figure 1, where the solid curve representing $\Delta_R(\lambda)$ is increasing for large λ (represented by the horizontal line in Figure 1).[10]

Based on the above discussion, as long as $\gamma > \underline{\gamma}$ and $\Delta(\lambda) > f$, ISM will be installed and used in equilibrium. The retailer and the manufacturer benefit from internalizing advertising spending within the channel. This benefit may be sufficient compensation for a less effective medium. For media and channel management, there are several implications of the results just discussed. Although the temptation of ISM with the help of advanced technology seems strong, our results indicate that a retailer should first examine the channel power before making the decision on opening ISM. ISM may be profitable to a retailer when the retailer is very strong in terms of bargaining position in a channel. This may help to explain why power retailers like Walmart, Best Buy, or Kroger have recently offered ISM. Our results also show that retailers in a very weak position may benefit from establishing ISM. If retailers have thin margins from product sales, ISM can provide supplemental revenue through the sale of advertising.

2.3. Competing Retailers

In the previous sections, a retailer considering ISM faced no competition and the monopoly retailer was the sole beneficiary of all the manufacturer's advertising. From the manufacturer's perspective, CM offers no distinctive advantages over ISM in informing consumers. This may not be the case, however, when the manufacturer supplies multiple retailers who compete in the same broadcast market. Specifically, if some retailers do not install ISM, then CM becomes the only means to reach consumers who shop at these retailers. This consideration has implications for the relative benefits of ISM. In particular, given the broadcast nature of CM, a manufacturer's advertisement on CM may be received by a consumer already bound for a retailer with ISM. The same advertisement, if seen again by this consumer on ISM, is then wastefully duplicated. In this section, we study an extension of our model in which the retailer faces competition for consumers, and we illustrate the implication for the retailer in her decision to open ISM. The extension shows that, even with such duplication, as long as there is the possibility that ISM generates additional sales, ISM provides benefits to the channel.

It is also possible that the presence of ISM makes the retailer a more (or less) attractive place to shop. For example, consumers may be attracted to a retailer who uses ISM because of its informative advertising or because of retailer-provided content. If so, then a retailer using ISM may experience an increase in shoppers either by a market expansion effect or at the cost of a competing retailer. We incorporate this aspect of ISM into our model of competitive retailers. A competitive retailing environment is implemented as follows. There are two retailers, R_1, the focal retailer, and R_2, the competing retailer. We evaluate the benefits of R_1 opening ISM when R_2 does not. A single manufacturer can advertise in both ISM (when available) and CM, as before. Assume the retailers face demands given by

$$D_1(\varphi^{\mathrm{ISM}}, \varphi^{\mathrm{CM}}) = \left(\sigma\varphi^{\mathrm{ISM}} + \tfrac{1}{2}\varphi^{\mathrm{CM}} + \mu_1\right),$$
$$D_2(\varphi^{\mathrm{CM}}) = \left(\tfrac{1}{2}\varphi^{\mathrm{CM}} - \mu_2\right),$$

where μ_1, μ_2 denote fixed effects of ISM at retailer 1. If $\mu_1 \geq \mu_2 > 0$, then the presence of ISM at R_1 draws additional shoppers to R_1, some of which, μ_2, come from R_2. A key parameter in this model extension is $\sigma \geq 0$, which measures the extent to which ISM duplicates advertising on CM. We assume that an advertisement on CM is broadcast to the entire market and therefore retailers split the marginal increase in demand φ^{CM} generated from an advertisement on CM. When R_1 offers ISM, then $\sigma > 0$; otherwise, $\sigma = 0$. When $\sigma \in (0, 1/2)$, duplication may occur with ISM. For example, a shopper in R_1 buying the manufacturer's product may have seen advertisements already via CM. When $\sigma \geq 1/2$, there is no slippage and ISM is at least as likely to generate an additional sale as CM.

We first suppose that R_1 offers ISM and assume $\sigma > 0$. As before, we analyze a three-stage game in which R_1 sets the ISM ad rate, a^{ISM}, in stage 1. In stage 2, M chooses a "media plan" $(\varphi^{\mathrm{ISM}}, \varphi^{\mathrm{CM}})$. Finally, in stage 3, retailers set retail prices at v. As before, we assume a constant share λ of the channel margin accruing to the manufacturer.

In stage 2, advertising demand is determined by the optimal media plan of the manufacturer. Specifically, M maximizes

$$\Pi_M(\varphi^{\mathrm{ISM}}, \varphi^{\mathrm{CM}}) = \lambda[\sigma\varphi^{\mathrm{ISM}} + \varphi^{\mathrm{CM}} + \mu_1 - \mu_2]$$
$$- (a^{\mathrm{ISM}} + c)\frac{(\varphi^{\mathrm{ISM}})^2}{2} - (a^{\mathrm{CM}} + c)\frac{(\varphi^{\mathrm{CM}})^2}{2}$$

when using ISM. Note that in the maximization above, advertising demands are independent across media: $\varphi^*(a^{\mathrm{ISM}}) = \sigma\lambda v/(a^{\mathrm{ISM}} + c)$ and $\hat{\varphi} = \lambda v/(a^{\mathrm{CM}} + c)$. This implies that we can write R_1's stage 1 problem

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[10] Similar results hold when $\lambda \leq 2 - 2c/v\gamma$.

as choosing a^{ISM} to solve

$$\max_a \quad (1-\lambda)\left(\sigma\varphi^*(a) + \frac{1}{2}\hat{\varphi} + \mu_1\right) + a\frac{[\varphi^*(a)]^2}{2},$$

$$\text{subject to} \quad (\varphi^*(a), \hat{\varphi}) = \arg\max_{\varphi^{\text{ISM}}, \varphi^{\text{CM}}} \Pi_M(\varphi^{\text{ISM}}, \varphi^{\text{CM}}). \quad (5)$$

By solving (5), we determine the equilibrium of the subgame starting in stage 2 when R_1 offers ISM. It is described in the following proposition.

PROPOSITION 2. *Suppose R_1 offers* ISM.
(i) *The retailer sets* ISM *price $a^{\text{ISM}} = ((3\lambda-2)/(2-\lambda))c$ and earns*

$$\Pi^*_{R_1} = \frac{(2-\lambda)^2(v\sigma)^2}{8c} + (1-\lambda)v\mu_1 + \frac{\lambda(1-\lambda)v^2}{2(a^{\text{CM}}+c)}.$$

(ii) *By using* ISM, *there are more sales of M's product through R_1 for all $\sigma > 0$ if $\mu_1 \geq \mu_2$.*
(iii) *The manufacturer finds it profitable to use both* ISM *and* CM *over* CM *alone for all $\sigma > 0$ if $\mu_1 \geq \mu_2$.*

Note from part (i) of Proposition 2, ISM price a^{ISM} is constant in media slippage and reflects the same intuition as in the single retailer case. In particular, even when ISM is not a substitute for CM, the retailer charges the same price for advertising on ISM.

As part (ii) of the proposition shows, ISM is a means for the manufacturer to generate more sales through the retail channel even when there is competition at the retail level as long as the market expansion effect from ISM is nonnegative (i.e., $\mu_1 \geq \mu_2$). Although this result reinforces the basic intuition of §2.1, part (iii) of the proposition offers an additional result. It says that even when the manufacturer needs CM to communicate to consumers shopping at non-ISM retailers, it still will use ISM where it is installed, provided market expansion effects are nonnegative (i.e., $\mu_1 \geq \mu_2$). Proposition 2 summarizes the outcome if the retailer offers ISM, but does it guarantee that this is the equilibrium outcome? In stage 1, R_1 will offer ISM if and only if $\Pi^*_{R_1}$ exceeds installation costs f plus its profit $\widehat{\Pi}_{R_1}$ when CM is the only medium available to the manufacturer. Formally, define

$$\Delta(\sigma, \lambda, \mu_1) \equiv \Pi^*_{R_1} - \widehat{\Pi}_{R_1}$$
$$= \frac{(2-\lambda)^2(v\sigma)^2}{8c} + (1-\lambda)v\mu_1 \quad (6)$$

as the incremental benefit of ISM, gross of installation costs, which we again denote $f > 0$. The expression (6) is positive and strictly increasing in σ and μ_1. Thus, even if $\sigma = 0$, there may be benefits from ISM exclusively from the fixed increase in sales from the nonadvertising effect of ISM captured by $\mu_1 > 0$. The intuition for σ and λ on R_1's incremental ISM benefit is analogous to intuition for γ and λ discussed in §2.1.

In sum, as the above analysis demonstrates, the basic notion that ISM can help the retailer and the supplier coordinate the channel is present in the presence of a competing retailer. Evaluating the extent to which channel members benefit, however, requires an examination of additional media market factors such as media slippage.

3. ISM with Competing Suppliers

In the previous section we considered the case when the retailer has only one supplier in a given product category. We used this model to illustrate the impact of ISM on the distribution of channel profits. However, most retailers, in particular those who use ISM, are likely to carry competing brands in many product categories. In this section we examine how pricing incentives for ads on ISM are altered in the presence of competition between advertising brands. Specifically, we modify the model developed in §2 to see how a retailer adjusts her ad prices on ISM when manufacturers compete for consumers via their advertising messages. Subsection 3.1 considers symmetric manufacturers, and §3.2 illustrates the implication for pricing when manufacturers are asymmetric with respect to preadvertising brand awareness.

3.1. The Use of a Competitive Premium

Consider a model in which there are two consumer product manufacturers, M_1 and M_2, who sell their products to the common retailer, denoted by R. The basic timing and model setup remain as in the basic model, but we modify consumer choice to reflect competing advertising messages.

With only two manufacturers, we can characterize consumers based on their information sets as in Table 1. This formulation implies the following demand for product i:

$$D_i(\varphi_i, \varphi_j) = \varphi_i(1-\varphi_j) + \frac{1}{2}\varphi_i\varphi_j; \quad i = 1, 2; \; j \neq i.$$

The negotiated outcomes in stage 3 lead to, as in the single manufacturer case, a wholesale price $w_i = \lambda v$ for $i = 1, 2$. (See the appendix.) Hence, we focus on the advertising decisions in stage 2. The important distinction with competitive informative advertising

Table 1 **Characterization of Consumers, Their Information Sets, and Purchase Decisions**

Consumer type	Portion	Information set	Purchase decision
0	$(1-\varphi_1)(1-\varphi_2)$	ϕ	No purchase
1	$\varphi_1(1-\varphi_2)$	$\{1\}$	Product 1
2	$\varphi_2(1-\varphi_1)$	$\{2\}$	Product 2
3	$\varphi_1\varphi_2$	$\{1, 2\}$	Either product with equal probability

is the business-stealing externality, which leads competing advertisers to engage in too much advertising relative to the collusive or the jointly optimal amount. To see this, we first determine the equilibrium level of advertising in the pure advertising game played by manufacturers. Maximizing payoffs

$$\Pi_i(\varphi_i, \varphi_j; a) = \lambda v D_i(\varphi_i, \varphi_j) - (a + c)\frac{\varphi_i^2}{2} \qquad (7)$$

at ad price a and finding a symmetric equilibrium gives $\hat{\varphi} = \hat{\varphi}_1 = \hat{\varphi}_2 = \lambda v/(a + c + \lambda v/2)$.

However, the jointly optimal advertising level is

$$\arg\max_{\varphi}\{\Pi_1(\varphi_1, \varphi_2; a) + \Pi_2(\varphi_2, \varphi_1; a) \mid \varphi_1 = \varphi_2 = \varphi\}$$

$$= \frac{\lambda v}{a + c + \lambda v} < \hat{\varphi}. \quad (8)$$

Note, from Table 1, that additional advertising by i reaches a Type 3 consumer with probability φ_j. Therefore, with probability $\frac{1}{2}\varphi_j$, i's advertising steals an otherwise committed customer of manufacturer j rather than bring in a new consumer. Manufacturer i does not care about this channel loss when maximizing her own profits in (7). The maximization in (8) internalizes this loss, and advertising levels are therefore lower. The retailer, when setting a price for ISM ads, mitigates these losses.

Formally, consider the case when R offers ISM. R's profit from setting its ISM price at a is given by

$$\Pi_R(a) = (1 - \lambda)v[D_1(\varphi_1^*(a), \varphi_2^*(a)) + D_2(\varphi_2^*(a), \varphi_1^*(a))]$$

$$+ \frac{a}{2\gamma}[(\varphi_1^*(a))^2 + (\varphi_2^*(a))^2].$$

The pricing problem can be formulated as follows:

$$\max_a \ \Pi_R(a)$$

$$\text{subject to} \ \ \varphi_i^*(a) = \arg\max_{\varphi \leq 1} \Pi_i(\varphi, \varphi_j^*(a); a) \qquad (9)$$

$$\text{for } i = 1, 2; \ j \neq i.$$

We focus on the interior equilibrium solution[11] to the problem defined in (9). The impact of manufacturer competition on ISM pricing incentives can be seen by comparing (4) with the corresponding first-order condition:

$$\frac{d\Pi_R}{da} = 2(1 - \lambda)v(1 - \varphi^*(a))\frac{d\varphi^*}{da}$$

$$+ \frac{1}{\gamma}\left[(\varphi^*(a))^2 + 2a\varphi^*(a)\frac{d\varphi^*}{da}\right] = 0. \quad (10)$$

[11] The condition $4c/\gamma > v(2 - \lambda) - \lambda > 0$ is necessary and sufficient. Without significant advertising costs c/γ, agents always get net positive benefits from informing additional consumers.

The first term of (10) is smaller than the corresponding term in (4). This stems from the fact that R internalizes the business-stealing externality present when manufacturers use CM. This change reflects the incentive for R to induce less advertising via a higher a^{ISM}. Thus, ISM brings manufacturers closer to the jointly maximized level of advertising. Meanwhile, the retailer benefits through higher a^{ISM}. The result is formally stated in the following proposition.

PROPOSITION 3. *If* $4c/\gamma > v(2 - \lambda) - \lambda > 0$, *then a unique interior solution to* (9) *exists. The implied equilibrium advertising price when R offers ISM is*

$$a^{\text{ISM}} = \left(\frac{3\lambda - 2}{2 - \lambda}\right)c + \left(\frac{\lambda^2\gamma}{2(2 - \lambda)}\right),$$

which is larger than when R sells to a single manufacturer.

Note from Proposition 1 that the advertising price charged to one manufacturer is $((3\lambda - 2)/(2 - \lambda))c$, which is the first term of a^{ISM} stated in Proposition 3. With competing manufacturers, the optimal ISM ad price reflects a "premium" of $\lambda^2\gamma/(2(2 - \lambda))$ charged by the retailer. Note that this competitive premium enjoyed by R is *not* a result of its relative market power for advertising space (two buyers instead of one). Rather, the premium reflects R's rationing of advertising space to mitigate the business-stealing externality.

Further reflective of the rationing principle discussed above is the fact that the premium is increasing in both the bargaining power parameter, λ, and the relative effectiveness of ISM, γ. As either of these increases, manufacturers want to advertise more in a competitive equilibrium, thereby extending the amount of business stealing. But, because part of this advertising decision is internalized by R through ISM pricing, the retailer optimally increases a^{ISM} to ration excessive advertising.

Note that we did not consider the impact of advertising on the retailer's product prices. As is well known, informative advertising tends to increase the price elasticity of demand, thereby stimulating price competition. However, ads on ISM focus on "captive" consumers making a choice between the brands while visiting the retailer. Consequently, the retailer can internalize the otherwise competitive force driving prices downward as consumers are better informed through ISM.

3.2. The Impact of Preadvertising Brand Awareness

In this section we extend the analysis of the competitive model to allow for the possibility that certain brands are recognized by consumers even without advertising, while other brands are less well known. For example, consider the possibility that the retailer

Table 2   Consumer Information with Preadvertising Brand Awareness

Consumer type	Portion	Information set	Purchase decision
0	$(1-\alpha_1-\varphi_1)(1-\alpha_2-\varphi_2)$	ϕ	No purchase
1	$(\alpha_1+\varphi_1)(1-\alpha_2-\varphi_2)$	$\{1\}$	Product 1
2	$(\alpha_2+\varphi_2)(1-\alpha_1-\varphi_1)$	$\{2\}$	Product 2
3	$(\alpha_1+\varphi_1)(\alpha_2+\varphi_2)$	$\{1,2\}$	Either product with equal probability

carries an assortment consisting of an established brand alongside a new product in the same category. By extending the competitive model presented above, we can ask how asymmetries in brand awareness affect the incentives for ISM pricing. In particular, we evaluate the case in which competing manufacturers have different levels of preadvertising brand awareness and ask how R should optimally set ISM prices to each.

Let $\alpha_i \in (0,1)$, $i=1,2$, be the brand awareness parameter, which reflects the extent to which consumers are aware of brand i in the absence of informative advertising. Then, given advertising levels that correspond to φ_i, $i=1,2$, a consumer is aware of product i with probability $\alpha_i + \varphi_i \in (0,1)$. Consumers and their information sets and purchase decisions with preadvertising brand awareness are characterized in Table 2. This formulation implies the following demand for product i:

$$D_i(\varphi_i, \varphi_j; \alpha_1, \alpha_2) = (\alpha_i+\varphi_i)(1-\alpha_j-\varphi_j)$$
$$+ \tfrac{1}{2}(\alpha_i+\varphi_i)(\alpha_j+\varphi_j) \quad i=1,2; j \neq i.$$

We assume that the retailer has the ability to set discriminatory prices based on preadvertising brand awareness level. The retailer's decision in this setting is to choose a pair of prices $(a_1(\alpha_1, \alpha_2), a_2(\alpha_1, \alpha_2))$ to maximize

$$\Pi_R(a_1, a_2)$$
$$= (1-\lambda)v[D_1(\varphi_1^*, \varphi_2^*; \alpha_1, \alpha_2) + D_2(\varphi_2^*, \varphi_1^*; \alpha_1, \alpha_2)]$$
$$+ a_1 \frac{\varphi_1^*(a_1)^2}{2} + a_2 \frac{\varphi_2^*(a_2)^2}{2} \qquad (11)$$

subject to

$$\varphi_i^* = \arg\max_{\varphi \leq 1} \lambda v D_i(\varphi, \varphi_j; \alpha_1, \alpha_2) - (a_i+c)\frac{\varphi^2}{2};$$
$$i=1,2; \; i \neq j. \quad (12)$$

The analysis of this program leads to the following result.

Proposition 4. *With preadvertising brand awareness, if $\alpha_i > \alpha_j$, then $a_i^{\text{ISM}}(\alpha_1, \alpha_2) < a_j^{\text{ISM}}(\alpha_1, \alpha_2)$ around the symmetric interior equilibrium.*

Proposition 4 reveals the fact that it is optimal for R to charge a higher ISM price to the manufacturer with *less* brand awareness. The intuition is that a manufacturer with lower preadvertising brand awareness has more to benefit from each ISM advertisement.[12] The retailer can capture some of this benefit through a higher ad price. This result may be somewhat counterintuitive because it suggests that big brands be given a discount rather than be charged a premium for ISM advertising.[13]

There is an additional coordination benefit accruing to the channel as a consequence of discriminatory pricing. To see this, suppose that consumers are more aware of brand i ($\alpha_i > \alpha_j$) and the retailer sets a uniform price. Because the lesser-known brand j has a greater marginal benefit from advertising than the well-known brand i, j would advertise more than i. In fact, j will advertise more than is optimal for R because with higher φ_j, there is a greater chance that the marginal advertisement will result in a stolen customer from i rather than generating a new customer. This is suboptimal for the retailer because a stolen customer does not result in an additional sale for R. Similarly, i will advertise less than is optimal for R. This suggests that R benefits by inducing j to advertise less and i to advertise more. This is facilitated by the discriminatory pricing suggested in Proposition 4.

4.   ISM and Social Welfare

In this section, we study how ISM by a retailer affects social welfare. Recall that consumer surplus from product sales is fully extracted. Therefore, social welfare is measured by the sum of profits to the retailer, the manufacturer, and CM. The answer is straightforward when ISM is more effective than CM ($\gamma > 1$) because the retailer can use ISM to better coordinate the distribution channel on advertising and sales. In addition, with more effective media, the manufacturer can reach a high advertising level with less advertising volume, saving the fixed costs associated with the advertising volume. Consequently, the social welfare is higher.

When ISM is less effective than CM ($\gamma < 1$), ISM has two conflicting effects on social welfare. On the one hand, ISM allows a retailer to better coordinate the distribution channel on advertising and product sales. On the other hand, the retailer may nevertheless induce the manufacturer to use the less effective media ISM by keeping the price a^{ISM} sufficiently low.

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[12] This can be shown directly by examining cross-partial $\partial^2 D_i/\partial \alpha_j \partial \varphi_i$, which is negative.

[13] This result assumes equal bargaining power across brands. This result is mitigated (or strengthened), however, if a manufacturer's brand awareness is positively (negatively) correlated with bargaining power, λ.

With the less effective media, the manufacturer has to increase advertising volume to reach the same advertising level. By doing so, the manufacturer must incur higher fixed costs, which leads to lower social welfare. Actually, when the effectiveness of ISM is sufficiently low, a retailer may launch ISM to the benefit of itself but sacrifice social welfare.

To illustrate the main point, it is sufficient to focus the discussion on the interior equilibrium (i.e., when $\lambda > 2 - 2c/(v\gamma)$), but the same basic result holds with full market coverage. With ISM, the total social welfare (sum of profits) is

$$W^* = \Pi_M^* + \Pi_R^* - f = \frac{(4 - \lambda^2)\gamma v^2}{8c} - f.$$

In contrast, when ISM is not installed, the retailer earns profits only on product sales and the manufacturer optimally uses CM at the market rate of a^{CM}. The total social welfare in this case is

$$\widehat{W} = \widehat{\Pi}_M + \widehat{\Pi}_R + \widehat{\Pi}_{CM} = \frac{[2a^{CM} + (2 - \lambda)]\lambda v^2}{2(a^{CM} + c)^2}.$$

A direct comparison of these two welfare expressions indicates that $W^* > \widehat{W}$ implies a minimum threshold $\gamma^* > 0$ for the relative effectiveness of ISM to be welfare improving. It is insightful to compare this welfare threshold with the manufacturer's equilibrium minimum effectiveness threshold $\underline{\gamma}$. Recall that ISM is installed and used in equilibrium if it covers installation costs $\Delta_R(\lambda) > f$ and is sufficiently effective, $\gamma > \underline{\gamma}$. It can be shown that for small f, $\underline{\gamma} < \gamma^* < 1$. Thus, we have the possibility that ISM is offered in equilibrium to the detriment of social welfare. In particular, if the effectiveness of ISM is such that $\gamma \in (\underline{\gamma}, \gamma^*)$, introducing ISM is optimal for the retailer, but not socially optimal. In this case, the social planner prefers that advertising be done by CM, which is sufficiently more effective. The retailer, however, can afford to subsidize a relatively inefficient advertising medium to generate more product sales. Moreover, the retailer's subsidization of advertising is too tempting for the manufacturer to forego. Note, however, opening ISM is socially beneficial whenever $\gamma > \gamma^*$ even if ISM is less effective than CM ($\gamma < 1$). Because the retailer internalizes the benefits of advertising, the value of its subsidy in a^{ISM} exceeds the loss of profits to CM. Therefore, even when ISM is less effective than CM, ISM can still be socially beneficial as long as the ISM effectiveness is not too low.

5. Conclusion

In this paper, we studied the effect of ISM on distribution channel relationships. A retailer can introduce ISM to allow manufacturers to advertise in store. We examined the effect of ISM on advertising rate, advertising volume, channel member profits, and social welfare.

We emphasize several results of this research. First, we showed that ISM by a retailer can help coordinate a distribution channel on advertising, product sales, and mitigating competition among suppliers. Without ISM, the channel members are subject to the market price of advertising as determined in the CM industry. With ISM, however, the retailer internalizes the advertising decision, thereby giving the channel more control over its advertising investment. The retailer, in fact, strategically subsidizes manufacturer advertising by charging an ISM rate lower than CM. This subsidy is optimal even when ISM is more effective than CM. Second, we found that with supplier competition, the retailer can increase the advertising rate to ration excessive advertising by competing manufacturers, resulting in better coordination across channels. Third, when competing manufacturers have different preawareness levels, our results showed that the retailer has an incentive to charge a high advertising rate to a firm with a low preawareness rate. Thus, the retailer uses discriminating prices to exploit the benefit of ISM on weak brands and mitigate the business-stealing effect between manufacturers, offering benefits from additional channel coordination. Fourth, we found that ISM can benefit social welfare even when ISM is less effective than CM. However, when ISM effectiveness is very low, a retailer may still introduce ISM for its own benefit with the sacrifice falling on social welfare.

It may be useful to consider how our results might apply to other retailing contexts. We considered ISM an advertising network in a retail space, but can our results be seen in the context of more traditional in-store displays and features? Classic in-store displays and features have often been associated with a price promotion, which has not been examined in this paper. However, our modeling makes no distinction otherwise. Hence, the extent to which in-store displays and features inform additional consumers of a product's existence, our results may apply to this more traditional form of in-store advertising. In addition, while our model was discussed in the context of traditional retailing, it is interesting to speculate on its application to Web retailing. Home Depot, for example, began to ask suppliers to pay for ads at HomeDepot.com. In addition, Walmart also started to sell advertising space at Walmart.com to its suppliers, and two of Walmart's biggest suppliers, Unilever and Procter & Gamble, were the first to advertise online (Frazier 2006). When advertising at retailers' online stores informs online shoppers and stimulates additional sales of carried products, lessons from our model may also apply.

Many important questions about ISM remain to be answered. Most prominently, perhaps, is the impact of ISM the CM industry. In our model, we assumed that CM could not react to ISM prices. This simplified our analysis but left open many questions for future research. It is worthwhile to speculate on some possible reactions by CM. Our theory implies that ad pricing on ISM should be offered at a relative discount to CM. This may prompt CM to lower ad prices to remain competitive with ISM. Another scenario is conceivable, however. Given that in-store advertising targets shoppers already in the store, its content may be selectively different than advertising to consumers in their homes (e.g., via television). For example, consumer goods manufacturers may use ISM for informational communication with shoppers while using CM for broader brand messages. Under this scenario, the two media serve different purposes. This reasoning suggests that the emergence of ISM would tend to segment the advertising market.

Another question that remains is the strategic use of advertising content on ISM. We have assumed that advertising simply informs or otherwise reminds shoppers of a product's existence. However, one might inquire as to the role of persuasive advertising in store. Perhaps more interesting is the question of how advertisers may use CM and ISM jointly for broader advertising objectives with tailored messages to a specific medium.

Finally, while our study focused on the role of ISM channel coordination, there remain several unexplored questions about channel management. We assumed bargaining powers across channels were fixed and that ISM played no role in affecting this power. However, it may be interesting to evaluate the use and consequences of ISM in shaping channel power.

Acknowledgments

Appendix

This appendix contains the technical aspects of the paper omitted from the main text.

Wholesale Negotiations via Nash Bargaining

Consider bilateral negotiations between the retailer R and a manufacturer, M_i. Upon successful negotiations, the retailer earns $\Pi_R = \sum_i (v - w_i)D_i$ and M_i earns $\Pi_{M_i} = w_i D_i$. If negotiations lead to disagreement, then we assign payoffs $\widetilde{\Pi}_R^{-i} = 0$ and $\widetilde{\Pi}_i^{-R} = 0$. The Nash bargaining solution determines w_i by the maximization of the product $(\Pi_R - \widetilde{\Pi}_R^{-i})^{1-\lambda}(\Pi_i - \widetilde{\Pi}_i^{-R})^\lambda$. If $D_i \neq 0$, then $w_i = \lambda v$. Observe that bargaining is efficient in the sense that the total channel profits are maximized over all levels of demand. This stems from the fact that in the absence of retail pricing, there are no inefficiencies from double-marginalization. Therefore, bargaining over more complicated contracts, such as two-part tariffs, will not lead to more channel profits.

PROOF OF PROPOSITION 1. This proof follows from the maximization of (3). The proposition's parametric condition ensures that $\varphi^* < 1$ and the second-order condition $\partial^2 \Pi^R / \partial a^2 < 0$. Q.E.D.

PROOF OF PROPOSITION 2. If $\sigma > 0$, then the optimization in (6) leads to the first-order condition

$$\frac{d\Pi_{R_1}}{da} = \sigma(1-\lambda)\frac{d\varphi^{\text{ISM}}}{da} + \frac{1}{2}[\varphi^{\text{ISM}}]^2 + a\varphi^{\text{ISM}}\frac{d\varphi^{\text{ISM}}}{da} = 0,$$

where

$$\frac{d\varphi^{\text{ISM}}}{da} = \frac{-\sigma\lambda v}{(a^{\text{ISM}} + c)^2}.$$

This yields the solution a^{ISM} given in part (i) and the corresponding expression for ISM advertising:

$$\varphi^* = \frac{\sigma v(2-\lambda)}{2c}.$$

Since M chooses $\hat{\varphi}$ independently of φ^*, part (ii) follows from the fact that $\sigma\varphi^* + \hat{\varphi} > \hat{\varphi}$ under the assumption that $\sigma > 0$. Using these results, it is directly computed that

$$\Pi_M^* - \widehat{\Pi}_M = (2-\lambda)\lambda\frac{(\sigma v)^2}{4c} + v\lambda(\mu_1 - \mu_2),$$

which is positive for all $\sigma > 0$ if $\mu_1 \geq \mu_2$. This establishes part (iii). Q.E.D.

PROOF OF PROPOSITION 3. From the constraint in (9), the equilibrium choice of ISM advertising corresponds to the reach

$$\varphi^*(a^{\text{ISM}}) \equiv \varphi_1^*(a^{\text{ISM}}) = \varphi_2^*(a^{\text{ISM}}) = \left(\frac{\lambda v}{(a^{\text{ISM}} + c)/\gamma + \lambda v/2}\right). \quad (13)$$

This condition ensures, therefore, an interior equilibrium such that $\varphi^*(a^{\text{ISM}}) \in (0, 1)$ and $\partial^2 \Pi_R(a)/\partial a^2 < 0$ at a^{ISM}. Substituting (13) and its derivative

$$\frac{d\varphi^*}{da} = \frac{-\varphi^*(a)}{c + a + \gamma\lambda v/2} \quad (14)$$

into (12) and solving $d\Pi_R(a)/da = 0$ gives the expression for a^{ISM} in the proposition. This value is a maximizer of $\Pi_R(a)$ if

$$\text{sgn}\left[\frac{d^2\Pi_R(a)}{da^2}\right]$$

$$= \text{sgn}\left[\frac{2(2-\lambda)(c/\gamma) + 2(4 - 4\lambda + \lambda^2)v + (\lambda - 2)\lambda}{-4(c/\gamma) - v(2-\lambda) - \lambda}\right] < 0. \quad (15)$$

The denominator in condition (15) is always negative for $c/\gamma > 0$, while the numerator is positive since $4c/\gamma > v(2 - \lambda) - \lambda$. Hence, the second-order condition for the retailer's problem in (10) is satisfied. Q.E.D.

PROOF OF PROPOSITION 4. Let $(a_1^{\text{ISM}}(\alpha_1, \alpha_2), a_2^{\text{ISM}}(\alpha_1, \alpha_2))$ be an interior maximizer of (11) subject to (12). The maximization (12) leads to

$$\varphi_i^*(a_1, a_2)$$

$$= \frac{(\lambda v/(a_i + c))[(1 - (\alpha_j + c)/2) - (\lambda v/(a_j + c))(1 - \alpha_i/2)]}{1 - (\lambda v)^2/(4(a_1 + c)(a_2 + c))}$$

$$i = 1, 2;\ j \neq i.$$

Define the following:

$$F_i(a_1, a_2) \equiv \left\{ (1-\lambda)v \left[\frac{\partial D_i}{\partial \varphi_i^*} \frac{\partial \varphi_i^*}{\partial a_i} + \frac{\partial D_i}{\partial \varphi_j^*} \frac{\partial \varphi_j^*}{\partial a_j} + \frac{\partial D_j}{\partial \varphi_i^*} \frac{\partial \varphi_i^*}{\partial a_i} + \frac{\partial D_j}{\partial \varphi_j^*} \frac{\partial \varphi_j^*}{\partial a_i} \right] \right.$$
$$\left. + \frac{(\varphi_i^*)^2}{2} + a_i \varphi_i^* \frac{\partial \varphi_i^*}{\partial a_i} + a_j \varphi_j^* \frac{\partial \varphi_j^*}{\partial a_i} \right\}$$
$$\times \left\{ \frac{a_i}{\varphi_i^*} \left(1 - \frac{x_1 x_2}{4} \right) \right\}^{-1}, \tag{16}$$

where

$$\frac{\partial D_i}{\partial \varphi_i} = 1 - \frac{1}{2}(\alpha_j + \varphi_j) > 0, \quad \frac{\partial D_i}{\partial \varphi_j} = -\frac{1}{2}(\alpha_i + \varphi_i) < 0, \tag{17}$$

$$\frac{\partial \varphi_i^*}{\partial a_i} = \frac{-\varphi_i^*/(a_i + c)}{1 - x_1 x_2/4} < 0, \quad \frac{\partial \varphi_j^*}{\partial a_i} = \frac{x_j \varphi_i^*/(2(a_i + c))}{1 - x_1 x_2/4} > 0, \tag{18}$$

$$a_i \varphi_i^* \frac{\partial \varphi_i^*}{\partial a_i} = \left(\frac{a_i}{a_i + c} \right) \left(\frac{-(\varphi_i^*)^2}{1 - x_1 x_2/4} \right) < 0,$$
$$a_j \varphi_j^* \frac{\partial \varphi_i^*}{\partial a_i} = \frac{x_j}{2} \left(\frac{a_j}{a_i + c} \right) \left(\frac{\varphi_i^* \varphi_j^*}{1 - x_1 x_2/4} \right) > 0, \quad \text{and} \tag{19}$$

$$\frac{a_i}{\varphi_i^*} \left(1 - \frac{x_1 x_2}{4} \right) \neq 0, \tag{20}$$

for $x_i = \lambda v/(a_i + c)$, $i = 1, 2$. The expression in (16) specifies the ith derivative of the retailer's profit function in (11) subject to (12). The pair of prices $(a_1^{\text{ISM}}(\alpha_1, \alpha_2), a_2^{\text{ISM}}(\alpha_1, \alpha_2))$ must be the solution to the system

$$F_1(a_1^{\text{ISM}}, a_2^{\text{ISM}}) = 0, \tag{21}$$
$$F_2(a_1^{\text{ISM}}, a_2^{\text{ISM}}) = 0, \tag{22}$$

which implies that the expression in the first set of curly brackets in (16) is identically 0.

Although we cannot explicitly solve for the above system, we can implicitly solve for the directional change of ad prices a_i^{ISM} with respect to (α_1, α_2). First note that at the interior equilibrium, the Hessian matrix

$$H(a_1^{\text{ISM}}, a_2^{\text{ISM}}) = \begin{pmatrix} \dfrac{\partial F_1}{\partial a_1} & \dfrac{\partial F_1}{\partial a_2} \\[2mm] \dfrac{\partial F_2}{\partial a_1} & \dfrac{\partial F_2}{\partial a_2} \end{pmatrix}_{(a_1^{\text{ISM}}, a_2^{\text{ISM}})}$$

is negative semidefinite. That is, the principal minors of H satisfy

$$\frac{\partial F_1}{\partial a_1}\bigg|_{(a_1^{\text{ISM}}, a_2^{\text{ISM}})} < 0 \quad \text{and}$$
$$\left[\frac{\partial F_1}{\partial a_1} \frac{\partial F_2}{\partial a_2} - \frac{\partial F_1}{\partial a_2} \frac{\partial F_2}{\partial a_1} \right]_{(a_1^{\text{ISM}}, a_2^{\text{ISM}})} > 0. \tag{23}$$

Note that if $\alpha_1 = \alpha_2$, then $a_1^{\text{ISM}} = a_2^{\text{ISM}}$,

$$\left| \frac{\partial F_1}{\partial a_1} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}} = \left| \frac{\partial F_2}{\partial a_2} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}} > \left| \frac{\partial F_1}{\partial a_2} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}}$$
$$= \left| \frac{\partial F_2}{\partial a_1} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}}, \tag{24}$$

where the inequality follows from (23). The implicit function theorem implies that the derivatives $\partial a_i^{\text{ISM}}/\partial \alpha_j$, $i, j = 1, 2$ are

the solutions to the following:

$$\begin{pmatrix} \dfrac{\partial a_1^{\text{ISM}}}{\partial \alpha_1} & \dfrac{\partial a_1^{\text{ISM}}}{\partial \alpha_2} \\[2mm] \dfrac{\partial a_2^{\text{ISM}}}{\partial \alpha_1} & \dfrac{\partial a_2^{\text{ISM}}}{\partial \alpha_2} \end{pmatrix} = \begin{pmatrix} \dfrac{\partial F_1}{\partial a_1} & \dfrac{\partial F_1}{\partial a_2} \\[2mm] \dfrac{\partial F_2}{\partial a_1} & \dfrac{\partial F_2}{\partial a_2} \end{pmatrix}^{-1} \begin{pmatrix} -\dfrac{\partial F_1}{\partial \alpha_1} & -\dfrac{\partial F_1}{\partial \alpha_2} \\[2mm] -\dfrac{\partial F_2}{\partial \alpha_1} & -\dfrac{\partial F_2}{\partial \alpha_2} \end{pmatrix}, \tag{25}$$

where all expressions are evaluated at $(a_1^{\text{ISM}}, a_2^{\text{ISM}})$. In particular, the right-hand matrix of partials is expressed as

$$\frac{\partial F_i}{\partial \alpha_i} = \frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} \left\{ (1-\lambda)v \left[\frac{\partial \varphi_j^*}{\partial \alpha_i} - \left(1 + \frac{\partial \varphi_i^*}{\partial \alpha_i} \right) \frac{x_j}{2} \right] \right.$$
$$\left. - \frac{a_i}{2} \left(1 + \frac{x_1 x_2}{4} \right) \frac{\partial \varphi_i^*}{\partial \alpha_i} + a_j \frac{x_j}{2} \frac{\partial \varphi_i^*}{\partial \alpha_i} \right\}$$
$$+ \left\{ \frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} F_i(a_1, a_2) \right\}$$
$$\times \left\{ \frac{\partial}{\partial \alpha_i} \left[\frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} \right] \right\},$$

and

$$\frac{\partial F_i}{\partial \alpha_j} = \frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} \left\{ (1-\lambda)v \left[1 + \frac{\partial \varphi_j^*}{\partial \alpha_j} - \frac{\partial \varphi_i^*}{\partial \alpha_j} \frac{x_j}{2} \right] \right.$$
$$\left. - \frac{a_i}{2} \left(1 + \frac{x_1 x_2}{4} \right) \frac{\partial \varphi_i^*}{\partial \alpha_j} + a_j \frac{x_j}{2} \frac{\partial \varphi_j^*}{\partial \alpha_j} \right\}$$
$$+ \left\{ \frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} F_i(a_1, a_2) \right\}$$
$$\times \left\{ \frac{\partial}{\partial \alpha_j} \left[\frac{\varphi_i}{a_i} \left(1 - \frac{x_1 x_2}{4} \right)^{-1} \right] \right\},$$

for $i = 1, 2$; $j \neq i$. Note that the last additive term in each of these expressions is zero by (21) and (22). Hence, the sign of each of these partials is determined by the signs of the expressions in the corresponding first set of curly brackets. Specifically, using the signs from (17)–(20) it is shown that

$$\frac{\partial F_i}{\partial \alpha_i} < 0 < \frac{\partial F_i}{\partial \alpha_j}, \quad i = 1, 2; \ j \neq i. \tag{26}$$

Furthermore, when $\alpha_1 = \alpha_2$, it can be shown (using these expressions for the partial derivatives above) that at the symmetric equilibrium,

$$\Psi \equiv \left| \frac{\partial F_i}{\partial \alpha_i} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}} = \left| \frac{\partial F_i}{\partial \alpha_j} \right|_{a_1^{\text{ISM}} = a_2^{\text{ISM}}} \quad i = 1, 2; \ j \neq i. \tag{27}$$

Finally, evaluating the signs of entries of the left-hand matrix in (25) at the symmetric equilibrium:

$$\frac{\partial a_i^{\text{ISM}}}{\partial \alpha_i} = \frac{1}{\underbrace{\det(H)}_{+}} \left[\underbrace{\frac{\partial F_j}{\partial a_j}}_{-} \underbrace{\left(-\frac{\partial F_i}{\partial \alpha_i} \right)}_{\Psi > 0} + \underbrace{\left(-\frac{\partial F_i}{\partial a_j} \right)}_{-} \underbrace{\left(-\frac{\partial F_j}{\partial \alpha_i} \right)}_{-\Psi < 0} \right] < 0,$$

$$\frac{\partial a_i^{\text{ISM}}}{\partial \alpha_j} = \frac{1}{\underbrace{\det(H)}_{+}} \left[\underbrace{\frac{\partial F_j}{\partial a_j}}_{-} \underbrace{\left(-\frac{\partial F_i}{\partial \alpha_j} \right)}_{-\Psi < 0} + \underbrace{\left(-\frac{\partial F_i}{\partial a_j} \right)}_{-} \underbrace{\left(-\frac{\partial F_j}{\partial \alpha_j} \right)}_{\Psi > 0} \right] > 0,$$

where the inequalities follow from applying (23), (24), (26), and (27). Therefore, for any point $\{(\alpha_1, \alpha_2) \in (0, 1 - \varphi^*)^2 \mid \alpha_1 = \alpha_2\}$, there exists $\varepsilon > 0$ and a neighborhood $N_{\varepsilon > 0}(\alpha_1, \alpha_2) \subset (0, 1)^2$ such that $\alpha_i > \alpha_j$ implies $a_i < a_j$. Q.E.D.

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