The Agency and Wholesale Models in Electronic Content Markets

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Abstract. I analyze a model of dynamic competition between retail platforms which exhibit consumer lock-in. Two different revenue models are considered, one in which platforms set final retail prices for complementary goods and one in which the suppliers of these goods set final retail prices. I show that platforms and suppliers of complementary products have qualitatively different long-term (or strategic) pricing incentives, which implies that the inter-temporal price path faced by consumers differs markedly depending on the revenue model in place. When suppliers set prices instead of platforms, prices are higher in early periods but lower in later periods. The overall price paths are such that consumers prefer it when suppliers rather than platforms set prices. I relate my results to events in the market for electronic books.

I consider a model of dynamic competition between platforms for complementary products such as content, when there is consumer lock-in to platforms. I investigate the inter-temporal path of prices and how this path depends on the revenue model that platforms use. In particular, I consider the consequences of platforms using as a revenue model either the "wholesale model" or instead the "agency model" in the pricing of complementary products.

By definition, an important difference between the wholesale model and the agency model is that in the wholesale model it is the platforms that determine the final prices faced by consumers for complementary products, whereas in the agency model it is the suppliers of the complementary products that determine the final prices faced by consumers. Another difference is that in the wholesale model suppliers (of complementary goods) receive compensation in the form of per-unit wholesale prices paid by the platform whereas in the agency model suppliers and platforms split sales revenue according to pre-specified revenue sharing agreements.

For several reasons, the equilibrium prices faced by consumers for complementary products vary according to which revenue model is in effect. Additionally, for a given revenue model, prices may (but need not) vary over time as a consequence of consumer platform lock-in.

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The main goal of my analysis is to assess these price paths and report on their impact on consumer surplus.

I show that the agency model leads to higher prices in initial periods but lower prices in future periods. Because of this tradeoff, it is shortsighted to conclude that consumers are harmed simply because prices increase following a move to the agency model. Indeed I argue that, considering the overall inter-temporal impact on prices, consumers are better off under the agency model. An implication is that a correct regulatory perspective ought to consider not only the immediate impact on prices from a change in revenue models but also an assessment of longer term impacts.

The intuition for my results builds on the fact that platforms have different strategic motivations for their pricing behavior compared to suppliers of complementary products. In particular, when there are two periods and consumers become locked into whichever platform they use in the initial period, platforms have strong incentives to offer consumers low prices in the initial period. That is, under the wholesale model, platforms set prices to consumers themselves and therefore platforms compete intensely in the initial period to lock consumers in; platforms then charge these consumers high prices in later periods. Thus, under the wholesale model, prices are low initially but high later.

Under the agency model, owners of complementary goods set prices and these suppliers have different pricing incentives than platforms. In particular, because lock-in occurs at the platform level and because suppliers provide products to all platforms, suppliers of complementary products have no strategic motivations to price low in early periods for the simple reason that these suppliers do not gain (or lose) when consumers are locked into one platform or instead the other. Thus, under the agency model, prices do not change over time, with the first-period price being higher and the second-period price being lower than under the wholesale model.

Put slightly differently, the reason why prices are lower under the agency model in future periods compared to the wholesale model is as follows. The agency model ensures that in future periods prices are low compared to the wholesale model. Prices are low because the agency model ensures that robust competition exists directly between suppliers of complementary products. In contrast, once consumers are locked in, because the wholesale model allows the platform to set the final prices to consumers, the platform internalize competition between suppliers in the second period so as to more fully harvest locked-in consumers.

The total effect on consumer surplus from the different revenue models clearly depends on the complete path of prices; the observation of price increases following the adoption of the agency model is not sufficient to conclude that consumers have been injured. In my model, taking into the account this entire price path, consumers typically prefer the agency model.

In addition to providing an analysis of platform pricing with consumer lock in under different revenue models, as part of my analysis I provide an extension of the standard spatial models of Hotelling (1929) and Salop (1979) that allows for bilateral oligopoly. In particular, in a model of multiproduct retailing, I allow consumers to care both about the product they buy and from whom they buy it, and also allow for market power both at the supplier and retailer level. The resulting model leads to simple linear results that are familiar from the existing workhorse models of oligopoly at a single layer of the supply chain. Salinger (1988), Reisinger and Schnitzer (2010), and Kourandi and Vettas (2012) consider models that feature both intermediate and final goods markets in their investigations of vertical structure. These models are very useful, but do not address the case in which final consumers care (directly) about both the manufacturer and the (multiproduct) retailer. Also, neither revenue-sharing, manufacturer retail-price setting, nor consumer lock-in are examined.

My analysis provides some possible insight into events in the electronic book ("e-book") market and extends the analysis of Johnson (2017), where I provide an assessment of the agency model that is more general except that it does not consider dynamic competition or consumer lock-in but does consider retail price-parity (or "most-favored nation") restrictions.

In the US, there was an antitrust case in which Apple and some book publishers (who adopted the agency model) were accused of conspiring to raise prices for e-books. More precisely, following the adoption of the agency model in 2010, the prices of many e-books significantly increased, leading to global antitrust scrutiny; the EC has already pressured industry players to abandon the agency model because of these price increases.

In the e-book market, lock-in may exist because a consumer becomes accustomed to using, for example, Amazon's e-book store or e-book reading app. In some cases, lock-in exists because hardware either ties consumers to or guides them towards particular e-book reading apps.[1]

My work is related to the literature on strategic managerial delegation.[2] As first emphasized by Schelling (1956, 1960), it may be beneficial to delegate decisions to another agent when so doing provides commitment power. Vickers (1985), Fershtman and Judd (1987), and Sklivas (1987) expand upon this point.

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[1]The actual e-book market is rather complex in this regard. Some hardware devices offer multiple reading apps, but no device offers all apps. For example, on the iPad, consumers can use either Apple's app or Amazon's app. On most Android-based devices, consumers can use either Amazon's app or Google's app, but not Apple's. And on Amazon's Kindle device, consumers must buy their e-books from Amazon.

[2]My work is connected to that on incentives in principal-agent relationships. As explained by Sappington (1991), revenue- or profit-sharing contracts have been examined in many contexts, and can provide incentives while also balancing risk. There are many important applications, including to cropsharing (Allen and Lueck (1992)) and movies (Chisholm (1997)). Much of this literature assumes there is a single agent on one or both sides of the market, and focuses on optimal incentive schemes. In contrast, my main question is how the identity of the firms chosen to make the key strategic decisions matters, when there is competition both upstream and downstream.

Gans (2012) also investigates pricing under the agency model, similarly motivated by markets such as those for e-books and apps. He identifies a hold-up problem when app providers set prices after consumers invest in joining a new and more efficient platform. This problem may be so significant that consumers do not adopt the new platform in equilibrium, but most-favored-nation clauses can solve this problem by imposing a price cap on the app.

My results are consistent with several key facts surrounding the e-book market, and generate additional insight into that market. In 2010, Apple entered the e-book market as it introduced its tablet computer, the iPad. Prior to Apple's entry, Amazon was the the only significant player in the market, selling e-books for its dedicated e-book reader, the Kindle.

Publishers had been unhappy dealing exclusively with Amazon. One reason is that Amazon had been selling many e-books, most notably best sellers and new releases, at substantial discounts to the prices of physical copies of such books. Indeed, Amazon priced many e-books beneath its wholesale cost.

Apple convinced publishers to adopt the agency model as a condition of its entry into e-book retailing, and publishers then pressured Amazon to do so as well. Following this, the price of many e-books significantly increased, in particular for those books that previously had been highly discounted.

In April, 2012, the US Department of Justice accused Apple and five major publishers of conspiring to increase the price of e-books. The Justice Department did not claim that the agency model itself was anticompetitive, instead pointing to meetings between publishers, and of course the increase in e-book prices, as evidence of a conspiracy.

The remainder of my paper is structured as follows. Section 1 presents the model, Section 2 analyses this model, focusing on comparing the wholesale model to the agency model, and Section 3 concludes.

1. The Model and Preliminary Results

In this section I present a spatial model that extends the classic models of Hotelling (1929) and Salop (1979) in two ways. First, it allows for bilateral oligopoly power so that, for example, both retailers and manufacturers have market power.[3] Second, it incorporates multiple periods and consumer lock-in.

I begin with an overview before separately considering the demand and supply sides in detail. There are two symmetric retailers, labeled A and B, and N symmetric suppliers indexed by n. Each supplier sells its product through both retailers (or "multihomes"). The products

[3]In Johnson (2017), I present a random-utility model that features bilateral oligopoly and use it to investigate a broader set of issues related to the agency model, but do not consider consumer lock-in.

of the N suppliers are arrayed uniformly on a standard "circular city" and the retailers are situated at the ends of a unit-length Hotelling line. Costs are set to zero.

There are two periods. In the first period, consumers choose a retailer and then select a particular product. Consumers become locked into whichever retailer they purchase from in period one. Consumer lock-in provides a convenient way to generate predictions that match events in the e-book market, but as I will argue later there are other mechanisms that may be relevant for the e-book market that would generate similar predictions and intuitions. As noted earlier, the actual e-book market is somewhat complex, and lock-in may flow from a combination of factors including costs of becoming familiar with new online stores, apps, or even hardware.

1.1. **The demand side.** The first thing that a consumer does in period one is select a retailer. Upon so doing, he observes a random variable $x \in [0, 1]$ that gives his location on a circle of circumference one, where x is uniformly distributed. He next chooses from among N products, where product n sold by retailer i has price p^1_{in}—the superscript 1 indicates these are first-period prices.

A consumer x who has chosen retailer i and product n receives utility

$$v - t_u d(x, n) - p^1_{in},$$

where $d(x, n) \geq 0$ gives the distance between x and product n and $t_u > 0$ is a parameter measuring upstream differentiation. He purchases one product, unless doing so would yield negative utility, in which case he purchases no product this period. Thus, it is as if this consumer lives in a standard "circular city" as in Salop (1979), although his exact location in the city is not determined until after his choice of A or B.[4]

In the second period, this consumer again buys a product, subject to his outside option of zero, given prices p^2_{in}. He is locked into whichever retailer he chose in period one.

Consider the initial choice of retailer. Define

$$U(p) = E_x[\max_n(v - t_u d(x, n) - p) \,|x].$$

$U(p)$ gives the expected within-period utility (as x varies) of a consumer, given that all products are priced at p.[5]

Let $\bar{p}^1_i$ and $\bar{p}^2_i$ denote the average price of the products sold by retailer i in periods one and two, respectively. I assume that the mass of consumers who purchase from A, denoted by y,

[4]Such an assumption is required to generate tractable analysis, given that I allow for differentiation both between retailers and suppliers, and that I allow for consumers to have preferences over both suppliers and retailers.

[5]Throughout, I look for equilibria that are symmetric, wherever possible, both within and across retailers, and in retail prices and (under the wholesale model) wholesale prices.

is defined implicitly by

$$U(\bar{p}_A^1) + U(\bar{p}_A^2) - t_d y = U(\bar{p}_B^1) + U(\bar{p}_B^2) - t_d(1-y).$$

If $\bar{p}_A^2 = \bar{p}_B^2$, as will be the case in equilibrium, then

$$y = \frac{\bar{p}_B^1 - \bar{p}_A^1 + t_d}{2t_d}, \tag{1}$$

corresponding to a static Hotelling demand system with prices $\bar{p}_i^1$.[6]

1.2. **The supply side and equilibrium in the agency model.** In the agency model, each supplier simultaneously sets retailer-specific retail prices in each period. The revenue generated by sales of product n through retailer i is split between n and i, with r_i denoting the share taken by the supplier. These shares are fixed and taken as given.

Consider a representative supplier, say firm 1, choosing its second-period price for, say, retailer A, p_{A1}^2, given that other suppliers are charging p_A^2 through A. Letting $x_1(p_{A1}^2, p_A^2)$ denote the proportion of consumers selecting this product amongst all consumers who buy from A, supplier 1 chooses its price to maximize

$$y r_A p_{A1}^2 x_1(p_{A1}^2, p_A^2) = y r_A p_{A1}^2 \left(\frac{p_A^2 - p_{A1}^2 + \frac{t_u}{N}}{t_u} \right).$$

This is proportional to a firm's profits in a standard circular city model, and hence leads to the same equilibrium prices. These prices are identical across suppliers and retailers, independent of the revenue shares r_i, and given by

$$p_{An}^2 = p_{Bn}^2 = \frac{t_u}{N}, \text{ for each } n.$$

Now consider the first period. Firm 1's profit function is

$$r_A y \left[p_{A1}^1 x_{A1}^1 + p_{A1}^2 x_{A1}^2 \right] + r_B (1-y) \left[p_{B1}^1 x_{B1}^1 + p_{B1}^2 x_{B1}^2 \right],$$

where the mass of consumers y purchasing from A is a function of the average price levels $\bar{p}_A^1$ and $\bar{p}_B^1$, and given by Equation (1). x_{A1}^τ and x_{B1}^τ give the proportion of consumers who demand this firm's product contingent on selecting either retailer A or B, $\tau \in \{1, 2\}$.

Incorporating what is known about second-period pricing, this reduces to

$$r_A y \left[p_{A1}^1 x_{A1}^1 + \frac{t_u}{N^2} \right] + r_B (1-y) \left[p_{B1}^1 x_{B1}^1 + \frac{t_u}{N^2} \right].$$

[6]This interpretation also requires that consumers believe each retailer is charging the same price for each product, given $\bar{p}_i$.

In this period, each supplier's prices influence which retailer consumers purchase from. Intuitively, each supplier has an incentive to bias prices to drive demand to whichever retailer is offering it a greater revenue share.

Proposition 1. *In the agency model, second-period retail prices are given by* $p_A^2 = p_B^2 = \frac{t_u}{N}$. *If* $r_i > r_j$, *then first-period retail prices satisfy* $p_i^1 < \frac{t_u}{N} < p_j^1$. *Hence,* $r_A = r_B$ *implies that* $p_A^1 = p_B^1 = \frac{t_u}{N}$ *in period one.*

1.3. **The supply side and equilibrium in the wholesale model.** Under the wholesale model, in each period τ suppliers simultaneously set retailer-specific wholesale prices w_{in}^τ, and then retailers set retail prices. To ensure that the analysis is tractable, I assume that retailers have a limited ability to price discriminate: retailers can set prices for product n to consumer x that depend on whether x is "to the left" or instead "to the right" of product n. More precisely, prices can depend on whether x lies between products $n-1$ and n or instead between n and $n+1$.[7]

In defense of this assumption, note the following. First, in equilibrium all consumers are charged the same prices for each good. Second, allowing suppliers to similarly price discriminate in the agency model has no effect on the equilibrium. Third, and most importantly, the basic results of this article are driven by economic forces that seem unlikely to hinge crucially on this particular assumption.

Suppose it is the second period, and consider a representative interval of length $1/N$ between, say, products 1 and 2. Suppressing time and retailer-specific notation, the indifferent consumer x_1 satisfies

$$p_1 + t_u x_1 = p_2 + t_u \left(\frac{1}{N} - x_1 \right) \iff x_1 = \frac{p_2 - p_1 + \frac{t_u}{N}}{2t_u},$$

which is the demand from a Hotelling interval of length $1/N$.[8]

Unlike in a standard Hotelling model, the retailer sets both prices and hence internalizes any pricing externalities; p_1 and p_2 are chosen to maximize the profits of the representative per-interval profit function of a retailer, given by

$$(p_1 - w_1)x_1 + (p_2 - w_2)\left(\frac{1}{N} - x_1 \right),$$

subject to the constraint that the marginal consumer receives non-negative utility.

[7]Without this assumption, the presence of both upstream and downstream differentiation causes the demand curve and overall objective function faced by any given supplier to be very complex. Generally a retailer would wish to adjust all N retail prices by different amounts in response to the change in a single supplier's wholesale price, and moreover this is so even fixing the retailer's overall market share.

[8]In the analysis of the wholesale model, x_1 refers to the demand from "one side" of a product, whereas in an abuse of notation, in the analysis of the agency model x_1 to refer to the demand from both sides of a product.

As verified in the appendix, the optimal selection of prices leads to a value of x_1 given by

$$x_1 = \frac{w_2 - w_1 + \frac{2t_u}{N}}{4t_u}. \tag{2}$$

To derive the equilibrium wholesale prices, suppose that all suppliers other than 1 are charging w. Because 1 is selling to consumers located on either side of it, it wishes to maximize

$$2w_1x_1 = w_1\left(\frac{w - w_1 + \frac{2t_u}{N}}{2t_u}\right).$$

Differentiating to obtain the first-order condition and imposing $w_1 = w$ yields equilibrium second-period wholesale prices (including full time and retailer-specific notation) of

$$w^2_{An} = w^2_{Bn} = \frac{2t_u}{N}.$$

Because each retailer will set the same second-period prices in equilibrium, in period one consumers choose between A and B based solely on average first-period prices $\bar{p}^1_A$ and $\bar{p}^1_B$. Suppliers recognize that they can influence these retail price levels, and hence y, through their own choice of wholesale prices. Because supplier's second-period profits do not depend on the outcome of the first period, in period one a supplier n maximizes first-period profits:

$$w_{An}x_{An}y + w_{Bn}x_{Bn}(1 - y).$$

As verified in the appendix, equilibrium wholesale prices are the same as in period 2.

Given symmetric wholesale prices, and suppressing retailer and time notation, retailer A chooses $\bar{p}^1_A$ to maximize

$$\left[\left(\bar{p}^1_A - w^1_A\right) + \left(p^2_A - w^2_A\right)\right] y = \left[\bar{p}^1_A - \left(w^1_A + w^2_A - p^2_A\right)\right]\left(\frac{\bar{p}^1_B - \bar{p}^1_A + t_d}{2t_d}\right).$$

This is the same profit function faced by a standard static Hotelling competitor with marginal costs $w^1_A + w^2_A - p^2_A$, given that consumers have transportation costs t_d. The same is true for B. Hence, in equilibrium

$$\bar{p_i}^1 = t_d + w^1_i - (p^2_i - w^2_i).$$

The first-period price equals the retailer differentiation parameter plus the first-period wholesale price plus less the retailer's second-period margin—retailers subsidize prices because they value locking consumers in.

Summarizing and extending the work above yields the following result. Additional details are in the appendix.

Proposition 2. *There exists a unique symmetric equilibrium under the wholesale model of sales. In it, first- and second-period wholesale prices are equal and given by*

$$w^\tau_{in} = \frac{2t_u}{N}.$$

Retail prices are given by

$$p_{in}^2 = v - \frac{t_u}{2N}, \quad \text{and} \quad p_{in}^1 = t_d + \frac{2t_u}{N} - (p_{in}^2 - w_{in}^2).$$

One interesting question is what prices would be if there were a single period and hence no consumer lock-in. Building on the work above, it is easy to neatly extend the classical models of Salop and Hotelling to incorporate (only) bilateral oligopoly. The following result emerges readily from the work in the proof of Proposition 2.

Proposition 3. *Suppose that there is a single period (and no consumer lock-in) under the wholesale model of sales. Then equilibrium wholesale prices are*

$$w_{in} = \frac{2t_u}{N},$$

and equilibrium retail prices are

$$p_{in} = w_{in} + t_d = \frac{2t_u}{N} + t_d.$$

Thus, incorporating oligopoly power at both layers of the supply chain preserves the nice linear structure of pricing familiar from earlier work. In particular, suppliers set wholesale prices that are a simple function of their differentiation parameter t_u and the number of suppliers N, and retailers then mark up these prices according to their own differentiation parameter t_d. Note that the wholesale price is higher (twice as high, in fact) than the price that would typically emerge in a Salop circle. The reason is that the presence of an oligopolistic retail market changes the pricing incentives of suppliers (in effect softening supplier competition). However, the retailer markup is the same as we would expect in a standard spatial model with oligopoly power at a single layer. Finally, note that further generalizing to the case of M retailers, and assuming also that retailers as well as suppliers were arrayed on a circle, would be straightforward—the retailer markup would then simply be t_d/M.

2. Analysis

Here I examine how moving from the wholesale model to the agency model influences the market equilibrium, including the payoffs of consumers, retailers, and suppliers. I take the revenue shares as given and equal under the agency model, so that $r_A = r_B = r \in (0, 1)$.

One might wonder whether fixing the revenue shares in this manner invalidates later results. However, most of my results are not sensitive to this; I discuss exceptions as they arise.

2.1. **Price Trajectory.** My first result deals with market prices, and follows from the results above that detail the equilibrium outcomes under the agency and wholesale models.

Corollary 1. *For v sufficiently large, moving from the wholesale model to the agency model raises first-period retail prices but lowers second-period retail prices.*

Many e-book prices rose following the move to the agency model, so that the prediction about first-period prices is consistent with the facts. The prediction that future prices should be lower under the agency model is novel and suggests that the overall effect of moving to that sales model is somewhat subtle.

The reason that first-period prices rise under the agency model is that suppliers and retailers value consumer lock-in very differently. More specifically, locking in a consumer is valuable to a retailer because so doing allows it to monopolize that consumer in the future. Retailers therefore have incentives to compete fiercely in the first-period and indeed they charge less than the wholesale price in that period so long as the second-period market is sufficiently valuable (as measured by v).

In contrast, a supplier has no incentive to subsidize first-period consumption, because it sells through both retailers in both periods. This unwillingness to subsidize implies that first-period prices are higher under the agency model.

The reason that second-period prices are lower under the agency model is that the agency model ensures that retail competition is left in the hands of all N suppliers as opposed to monopoly retailers. That is, because of consumer lock-in, when retailers set prices they act as monopolists in the second period, internalizing the competition between rival suppliers that would otherwise prevail, and charging high retail prices. In contrast, the agency model maintains direct retail price competition between suppliers, causing lower retail prices.

Lock-in provides a dynamic explanation for why e-book prices increased following the move to the agency model, but also predicts that prices would eventually be lower under the agency model. These predictions differ from those in a static model— if there were a single period, prices would always decrease moving to the agency model, at least when costs are zero as is the case here.[9]

There are several strategic incentives other than lock-in that might also provide a motive for retailers to charge low prices in early periods. In such cases, moving to the agency model would still have similar effects to those discussed above. In the e-book market in particular, there are two leading possibilities.

First, there might be predatory intent, with Amazon in particular hoping to weaken or eliminate "brick and mortar" rivals. Second, there might be network effects; if it is costly

[9]This need not be the case when marginal costs are positive, as shown in Johnson (2017).

to support multiple versions of e-books that work with different retailers' e-book apps, then retailers may desire to build initial market share to secure a future competitive advantage.

If either predatory intent or network effects are present, then retailers who set their own prices have incentives to charge low prices early on, with the expectation of having greater market power in the future. Because suppliers do not share these pricing incentives, moving to the agency model has the same price effects as identified in Corollary 1—higher first-period prices and lower second-period prices.

2.2. **Consumer welfare.** Corollary 1 indicates that consumers face higher initial prices under the agency model, but lower future prices. A natural question is which model consumers prefer.

Proposition 4. *Consumer welfare is higher under the agency model.*

Consumers are unambiguously worse off under the wholesale model, even though the intense first-period retail price competition that accompanies it causes retailers to dissipate—indeed, transfer to consumers—the entirety of their second-period monopoly profits.

Proposition 4 follows from two observations. First, under the agency model, there is no retailer markup and so conceptually it is as if suppliers compete through a perfectly competitive retail segment in which wholesale prices are passed directly to consumers. More precisely, and as noted in Johnson (2017), because each supplier sells through both retailers, suppliers don't care which retailer a consumer visits and this leads them to ignore retailer differentiation when setting retail prices.[10] Maintaining the interpretation that agency prices are wholesale prices that are not marked up, this logic implies that the sum of wholesale prices across the two periods is higher under the wholesale model than the agency model.

The second observation is that the total retail prices that consumers pay over time must at least weakly exceed the total wholesale prices. In other words, although retailers may be willing to subsidize initial purchases, they will not choose negative profits across the two periods combined. It follows that consumers prefer the agency model. Note that Proposition 4 does not merely follow from the familiar idea of double marginalization under bilateral monopoly. After all, when retailers set final prices, there is a negative retailer markup in the first period.

Relating Proposition 4 to the market for e-books suggests that one cannot conclude that consumers were harmed by the price increases following the move to the agency model.

[10]In this spatial model, this effect is exacerbated because supplier competition is more intense when suppliers do not sell through retailers. Put the other way, under the wholesale model supplier competition is softened because wholesale price cuts are less effective at stealing market share than retail price cuts are in this model. This effect is similar to that identified in Bonanno and Vickers (1988), but is absent from the random-utility approach of Johnson (2017).

That is, this result suggests that the agency model would have led to lower future prices such that the overall effect on consumers would have been positive.

Due to intense regulatory scrutiny, however, the agency model was quickly abandoned in the EU e-book market and, as of this writing, partially abandoned in the US as well. Counter-intuitively, regulators may have harmed consumers in their response to increased prices.

2.3. **Supplier profits.** Suppliers are worse off under the agency model.

Proposition 5. *The profits of suppliers are lower under the agency model.*

To see the intuition for this result, consider the best-case scenario for suppliers, which is that $r = 1$ so that they keep all revenue from the market. As mentioned above, one way of thinking about the agency model is that suppliers set wholesale prices to a perfectly competitive downstream, so that the retail markup is zero. Compared to the wholesale model (with an duopolistic downstream), price cuts are perfectly transmitted to the consumer and are therefore more effective at stealing business from rivals, so that supplier competition is more intense under the agency model.

This result might seem to be at odds with the facts surrounding the e-book market. After all, suppliers agreed to move to the agency model, following Apple's lead. However, this fact does not actually contradict Proposition 5 (indeed, publishers were well aware that their per-unit profits would be higher under the wholesale model). The reason is that Apple demanded the agency model as a condition of its entry into the e-book market, suggesting that the appropriate question is whether suppliers prefer a monopoly retailer under the wholesale model or multiple retailers under the agency model.

Because a monopoly retailer might be able to dictate prices or other terms of trade to suppliers, it is plausible that publishers would be willing to accept the agency model if so doing would encourage entry by additional retailers. In addition to entry allowing publishers to secure better wholesale prices, it is possible that such entry would more generally allow publishers to maintain control of the market.[11]

A closely related reason that suppliers might prefer the agency model is that it may induce favorable marketing and promotional activities in existing retailers. Such marketing activities may affect the set of products that consumers consider, and hence influence supplier profits. In the case of e-books, retailers can readily make suggestions to consumers or otherwise guide them to consider options that they otherwise would not. One reason is that it is easy to "personalize" the experience that a repeat consumer has when visiting an online store. For

[11]A second reason, put forth by publishers, is that low retail prices would undermine the longer-term willingness to pay of consumers, which would ultimately harm publishers.

example, an online retailer may know a repeat consumer's purchase or search history, and be able to guide him to additional purchasing options of relevance.

To explore this most easily within the context of the existing model, suppose that there are two potential levels of competition, measured by N, among suppliers, N_L and $N_H > N_L$. In period one, $N = N_L$, but in period two each retailer separately chooses $N \in \{N_L, N_H\}$ as a proxy for being able to influence the competitiveness of the supplier market.

For uninteresting reasons, it is also necessary to suppose that all players put a weight of $\beta > 1$ on period two payoffs. Equivalently, the model could be extended to allow for more than one period of lock-in.

Proposition 6. *Suppose that in period 2 each retailer chooses $N \in \{N_L, N_H\}$, where $N_L < N_H$, and that second-period payoffs are weighted by $\beta > 1$. Then:*

(1) *Each retailer chooses N_H under the wholesale model, but chooses N_L under the agency model. Total supplier profit is always higher with $N = N_L$.*
(2) *Everything else fixed, and for N_H and β sufficiently large, (total) supplier profit is higher under the agency model than the wholesale model.*

An increase in N intensifies wholesale price competition and thereby raises second-period retailer profits at the expense of supplier profits—assuming that the wholesale model is in effect. In contrast, under the agency model, this increase in competition between suppliers is bad for retailers because the profits of a retailer are a share of (gross) supplier profits.

In other words, the agency model aligns the preferences of suppliers and retailers, whereas in the wholesale model they are at odds. Although such alignment may be good for suppliers, it is bad for consumers because it leads them to face a more limited selection of products. Proposition 6 therefore identifies a potential welfare cost of the agency model, in addition to providing an explanation for why suppliers may prefer that model.

The basic concept underlying Proposition 6 is broadly consistent with evidence from the book market. Major publishers are concerned that the move to e-books, especially with a dominant retailer, will reduce their ability to influence which books consumers purchase, possibly leading to lower profits. Indeed, brick and mortar stores are sometimes seen as vassals of dominant publishers in that these publishers have sway over what products are marketed to consumers. If true, this is a privileged position that these publishers may not wish to lose.

2.4. **Retailer profits.** Propositions 4 and 5 indicate that the effect of the agency model on consumer welfare and supplier profits does not depend on the assumed revenue share r. In contrast, the effect on retailer profits depends very much on r. This is somewhat problematic because I have taken r as a parameter, whereas in reality it is endogenous.

In Johnson (2017), I allow for endogenous contracting and show that retailers always prefer the agency model when they non-cooperatively set revenue-share contracts and $c > 0$. An important part of the reasoning there is that revenue shares influence the perceived costs of suppliers, an effect that is absent when $c = 0$ as in the present analysis. Rather than pursuing that line of inquiry there, I continue to assume that r is fixed and explore the effect of changes in market differentiation parameters on retailer profits. Recall that t_d measures retailer differentiation and t_u measures supplier differentiation.

Proposition 7. *There exists a value ρ^* such that the profits of retailers are higher under the agency model than under the wholesale model if and only if*

$$\frac{t_u}{t_d} > \rho^*.$$

Proposition 7 indicates that retailers prefer the agency model whenever upstream differentiation is strong relative to downstream differentiation. To understand this result, first note that, under the wholesale model, the profits that retailers capture are determined by t_d.[12] Second, the absence of a retailer markup under the agency model means that retail prices are the outcome of direct competition between suppliers and hence not influenced by t_d but instead determined solely by t_u. That is, because suppliers sell through both channels, the equilibrium outcome of their pricing conflict ignores retailer differentiation.

In other words, the level of retailer profits is determined by the level of differentiation in the stage of the supply chain where retail prices are set. When retailers set these prices, downstream differentiation is the main determinant of their profits, whereas when suppliers set them it is the differentiation between suppliers that is crucial.

The tradeoff that retailers face can also be explained in terms of lock-in. By placing pricing power in the hands of suppliers, retailers avoid the intense upfront competition to lock consumers in that leads to the dissipation of second-period profits, which are increasing in t_u.

On the other hand, first-period prices under the agency model effectively throw away the differentiation that exists between retailers, measured by t_d. Thus, moving to the agency model carries a benefit that is increasing in t_u, but also a cost that is increasing in t_d.

Proposition 7 is related to the literature on strategic managerial delegation. As first emphasized by Schelling (1956, 1960), it may be beneficial to delegate decisions to another agent when so doing provides commitment power. Vickers (1985), Fershtman and Judd (1987), and Sklivas (1987) expand upon this point. They argue that firms may benefit by implementing incentive schemes that reward managers for outcomes such as revenue or output, rather than

[12] Although the retail price is influenced by t_u, that portion of it is captured by suppliers through wholesale prices.

profits. By credibly changing the incentives of managers, a firm's reaction function shifts, potentially altering the market equilibrium in a way that benefits the firm.

Here, moving to the agency model changes the equilibrium outcome in the market because suppliers have different objectives than retailers; moving to the agency model shifts the retail competition in the market from being inter-retailer to inter-supplier. While intuitively similar, there are two key differences compared to the existing literature on managerial delegation. First, suppliers are not merely employees but instead are firms that just happen to reside in another part of the supply chain. Second, under the agency model each supplier makes pricing decisions for all retailers, not just one. That is, suppliers do not represent any given retailer in the way that managers represent given firms in the delegation literature.

3. Conclusion

In markets with consumer lock-in, one cannot conclude that consumers are hurt just because prices increase following the move to the agency model of pricing. The situation is more complex: the agency model eliminates the ability of retailers to act on their strategic desires to slash prices in early periods, and hence raises early prices. However, the agency model also ensures robust competition directly between suppliers in later periods, thereby lowering future prices. Thus, it may be possible that regulators in the US and EU moved too quickly to try and revert the e-book market back to a wholesale-based model.

Although I have focused on consumer lock-in as the operative mechanism behind retailers' desire to charge low initial prices, there are other mechanisms that may generate the same predictions. For example, retailers may wish to cut early prices so as to build market share in order to take advantage of network effects and disadvantage rivals in future periods. Inasmuch as such incentives are weaker for suppliers, moving to the agency model will initially lead to higher prices. However, future prices will be lower because the agency model leads suppliers to ignore retailer differentiation when setting retail prices.

Proofs

Proof of Proposition 1: I suppress time notation in this proof. Define $h(p_1, p) = p_1 x_1(p_1, p) + t_u/N^2$, and let $h_1(p_1, p)$ denote the partial derivative with respect to the first argument. Then, the profit of, say, supplier 1, is

$$\pi_1 = r_A y h(p_{A1}, p_A) + r_B(1-y)h(p_{B1}, p_B),$$

given that all other suppliers are charging p_A through retailer A and p_B through retailer B (and keeping in mind that this supplier's second-period profits through retailer i are $r_i t_u/N^2$.

In an abuse of notation, I will write $h(p) = h(p,p)$ and $h_1(p) = h_1(p,p)$. At an equilibrium (p_A^*, p_B^*), the following two conditions are satisfied:

$$\frac{\partial \pi_1}{\partial p_{A1}} = r_A y h_1(p_A^*) + \frac{dy}{dp_{A1}}[r_A h(p_A^*) - r_B h(p_B^*)] = 0, \text{ and} \tag{3}$$

$$\frac{\partial \pi_1}{\partial p_{B1}} = r_B (1-y) h_1(p_B^*) + \frac{dy}{dp_{B1}}[r_A h(p_A^*) - r_B h(p_B^*)] = 0. \tag{4}$$

Observe that

$$\frac{dy}{dp_{A1}} = \frac{1}{N}\frac{\partial y}{\partial \bar{p}_A} = -\frac{1}{N}\frac{\partial y}{\partial \bar{p}_B} = -\frac{dy}{dp_{B1}}.$$

Hence Equations (3) and (4) jointly imply that

$$r_A y h_1(p_A^*) = -r_B (1-y) h_1(p_B^*). \tag{5}$$

Because $h_1(p) = x_1(p,p) - p/t_u = 1/N - p/t_u$, it is positive for $p < t_u/N$ and negative for $p > t_u/N$. Thus, Equation (5) implies that p_A^* and p_B^* are (weakly) on opposite sides of t_u/N, so that, for example, if $p_A^* \geq t_u/N$ then $p_B^* \leq t_u/N$.

Let $r_A > r_B$, and suppose for the sake of contradiction that

$$p_B^* \leq \frac{t_u}{N} \leq p_A^*.$$

$h(p)$ is increasing, giving $h(p_A^*) \geq h(p_B^*)$, so that $r_A h(p_A^*) > r_B h(p_B^*)$. Using Equation (3), $h_1(p_A^*) > 0$. But as described above, this requires that $p_A^* < t_u/N$, a contradiction. ■

Proof of Proposition 2: Consider, say, retailer A in the second period. Given whatever wholesale prices it faces, it wishes to maximize the profits from a representative interval

$$\pi(p_1, p_2) = (p_1 - w_1)x_1 + (p_2 - w_2)\left(\frac{1}{N} - x_1\right). \tag{6}$$

subject to the participation constraint of the marginal consumer

$$v - p_1 - t_u x_1 \geq 0.$$

The Lagrangean for this problem is

$$L = \pi(p_1, p_2) - \lambda(v - p_1 - t_u x_1),$$

with first-order conditions

$$\frac{\partial L}{\partial p_1} = x_1 - \frac{(p_1 - w_1)}{2t_u} + \frac{(p_2 - w_2)}{2t_u} + \frac{\lambda}{2} = 2x_1 - \frac{1}{2N} + \frac{(w_1 - w_2)}{2t_u} + \frac{\lambda}{2} = 0, \text{ and}$$

$$\frac{\partial L}{\partial p_2} = \frac{(p_1 - w_1)}{2t_u} + \left(\frac{1}{N} - x_1\right) - \frac{(p_2 - w_2)}{2t_u} + \frac{\lambda}{2} = -2x_1 + \frac{3}{2N} - \frac{(w_1 - w_2)}{2t_u} + \frac{\lambda}{2} = 0.$$

Hence the optimal x_1 can be determined as follows:

$$\frac{\partial L}{\partial p_2} - \frac{\partial L}{\partial p_1} = 4x_1 - \frac{2}{N} + \frac{(w_1 - w_2)}{t_u} = 0 \Longleftrightarrow x_1 = \frac{w_2 - w_1 + \frac{2t_u}{N}}{4t_u}.$$

This confirms Equation (2).

Now consider period 1. Given the wholesale prices, A wishes to maximize the representative interval's profit as before, but now subject to the constraint that average prices equal whichever $\bar{p}_A$ it wishes to offer consumers. Equivalently, it wishes to maximize

$$\pi(p_1, p_2) = (p_1 - w_1)x_1 + (p_2 - w_2)\left(\frac{1}{N} - x_1\right),$$

subject to the constraint that

$$\frac{p_1 + p_2}{2} \leq \bar{p},$$

where $\bar{p}$ is the optimal price level in this interval.

The Lagrangean is

$$\pi(p_1, p_2) - \lambda\left(\bar{p} - \frac{p_1 + p_2}{2}\right).$$

But this generates the same first-order conditions from the analysis of period two, and hence generates the same wholesale-demand function, namely that in Equation (2).

The next step is to determine the equilibrium wholesale prices. The period two prices are derived in the text, so consider the first period. Suppose all other suppliers are charging w through both retailers, and consider supplier 1. Because this supplier's second-period profits do not depend on y, its optimal wholesale prices, w_{A1} and w_{B1}, maximize

$$w_{A1}x_{A1}(w_{A1}, w)y + w_{B1}x_{B1}(w_{B1}, w)(1 - y) = w_{A1}x_1(w_{A1}, w)y + w_{B1}x_1(w_{B1}, w)(1 - y),$$

where x_1 in either case is given by Equation (2), setting $w_2 = w$. Although w_{A1} and w_{B1} may influence y through the effect on $\bar{p}_A$ and $\bar{p}_B$, supplier 1 can do no better than to maximize the two terms in this expression independently. In other words,

$$w_{A1} = w_{B1} = \arg\max_{w_1} w_1 x_1(w_1, w).$$

Thus, equilibrium wholesale prices in period 1 are $2t_u/N$, the same as in period 2. ■

Proof of Proposition 3: This follows in a straightforward manner from the mechanics presented in the proof of Proposition 2. ■

Proof of Corollary 1: Using Propositions 1 and 2, and letting p^{τ}_{AG} and p^{τ}_{WS} denote the prices in period τ of the agency and wholesale models, gives

$$p^1_{WS} = t_d + \frac{9t_u}{N} - v,\ p^2_{WS} = v - \frac{t_u}{2N},\ \text{and}\ p^{\tau}_{AG} = \frac{t_u}{N}.$$

Hence, it follows that

$$p^1_{WS} - p^1_{AG} = t_d + \frac{7t_u}{2N} - v,\ \text{and}\ p^2_{WS} - p^2_{AG} = v - \frac{3t_u}{N}.$$

The result follows. ■

Proof of Proposition 4: Because there is no consumption distortion, the result follows if the sum (across periods) of retail prices is lower under the agency model. From Proposition 1, retail prices under the agency model are identical across periods and given by t_u/N, for a total of $2t_u/N$. Using Proposition 2, the total of prices under the wholesale model are $t_d + 4t_u/N$, which is higher. ■

Proof of Proposition 5: Suppressing retailer and product specific subscripts, Proposition 1 implies that the total profits of all suppliers (and across both periods) is $2r(p^1 + p^2) = 2rt_u/N$. From Proposition 2, the corresponding total under the wholesale model is $w^1 + w^2 = 4t_u/N$, which is higher. ■

Proof of Proposition 6: A retailer's per-customer profit in period two is given by $\beta(v - t_u/2N - 2t_u/N)$, and so in period two retailers will choose $N = N_H$. Under the agency model, this profit is $\beta(1-r)t_u/N$, and so in period two retailers choose N_L under the agency model. Total supplier profits in period one are rt_u/N, and $\beta rt_u/N$ in period two, which are decreasing in N. This proves part (1) of the proposition.

To prove part (2), and using the work in the proof of Proposition 5, total supplier profits under the wholesale model are

$$w^1 + \beta w^2 = \frac{2t_u}{N_L} + \beta\frac{2t_u}{N_H},$$

whereas under the agency model these profits are

$$r(p^1 + \beta p^2) = r\left(\frac{t_u}{N_L} + \beta\frac{t_u}{N_L}\right) = \frac{rt_u}{N_L}(1+\beta).$$

Hence, supplier profits are higher under the agency model if and only if

$$\frac{r}{N_L}(1+\beta) > \frac{2}{N_L} + \beta\frac{2}{N_H} \iff \beta\left(\frac{r}{N_L} - \frac{2}{N_H}\right) > \frac{2-r}{N_L}.$$

For N_H sufficiently large, the term in parentheses on the left-hand side is positive, and hence increasing in β. Hence, this condition holds for β and N_H large. ■

Proof of Proposition 7: Proposition 2 implies that the total retailer profits (that is, of both retailers and across both periods) in the wholesale model are (suppressing supplier and retailer-specific subscripts)

$$(p^1 - w^1) + (p^2 - w^2) = [t_d - (p^2 - w^2)] + (p^2 - w^2) = t_d.$$

In the agency model, Proposition 1 implies that the total retailer profits are

$$2(1-r)\frac{t_u}{N}.$$

The agency profits are higher if and only if

$$2(1-r)\frac{t_u}{N} > t_d \Longleftrightarrow \frac{t_u}{t_d} > \frac{N}{2(1-r)}.$$

■

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