THE AGENCY AND WHOLESALE MODELS IN ELECTRONIC CONTENT MARKETS

JUSTIN P. JOHNSON[*]

July 11, 2018

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. 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 may be higher in early periods but lower in later periods, suggesting that appropriate antitrust enforcement ought to consider more than initial price changes when an industry shifts to the agency model. Indeed, consumers may (but need not) prefer the agency model even when prices increase in initial periods. However, a potential harm of the agency model is that it may align the incentives of suppliers and platforms and thereby encourage platforms to lower the competitiveness of the supplier market and harm consumers; no such incentives exist under the wholesale model. I relate my results to events in the market for electronic books.

I consider a model of dynamic competition between retail 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. I also consider how the choice of revenue model influences the incentives of platforms to either increase or decrease competition among suppliers. Overall, my analysis allows me to assess the effect of the agency model and wholesale model on consumer welfare.

By definition, one 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. This means that the primary determinant of retail prices under the agency model is the differentiation between suppliers, whereas under the wholesale model both supplier and retailer differentiation influence final retail prices. Additionally, because platforms may have strategic pricing incentives related to consumer lock-in that suppliers do not possess, such incentives can express themselves in retailer prices under the wholesale model but not under the agency model. A second importance difference between the two models is that in the wholesale model suppliers 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.

As already suggested, 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. A 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 may lead 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 in some cases, considering the overall inter-temporal impact on prices, consumers may be better off under the agency model even when it raises prices in initial periods.

An implication is that, because the overall price paths that emerge may differ significantly under the two sales models, 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, most particularly in situations where consumer lock-in is important and likely to lead to different future prices.

Although as indicated one possibility is that consumers prefer the agency model, it is also possible that some or all consumers may instead prefer the wholesale model. Indeed, it is possible that the agency model will lead to price increases in all periods, thereby harming all consumers. Other possibilities also exist and are considered in my analysis. In all cases, key determinants include the structure of pricing contracts between suppliers and retailers and also differences in differentiation between platforms compared to differentiation between suppliers.

I also identify another new and potentially anticompetitive effect of the agency model. I show that in certain circumstances the agency model leads to an alignment of incentives between suppliers and retailers that can harm consumers. In particular, I extend the model to allow each retailer to make a decision that both increases the gross value that consumers place on using that retailer's platform and which also lowers the margins that suppliers are

able to claim. For example, a retailer may be able to alter the number of suppliers on its platform or change consumer search costs on its platform.

Because retailers share in the profits generated by suppliers' pricing decisions under the agency model, there may be an alignment of incentives between suppliers and retailers that causes retailers to make decisions that limit consumer choice and raise prices, for example by making consumer search more difficult or limiting the number of suppliers. In other words, this alignment encourages retailers to take steps to lower the competitiveness of the supplier market, potentially undoing any otherwise positive effects of the agency model on prices. Importantly, this potentially harmful alignment of incentives does not exist under the wholesale model. An implication is that a complete analysis of the consumer welfare effects of the agency model must also involve an assessment of the incentives of platforms to influence the supplier market. These incentives may well differ depending on the revenue model in effect.

The intuition for many of my results builds on the fact that platforms have strong strategic motivations to charge low prices in initial periods. The reason is simply that lock-in is assumed to exist at the platform level and so platforms increase their future profits—by raising their future prices—when they are able to lock-in many consumers early on. These incentives need not exist when suppliers set prices, because lock-in is assumed not to exist at the product level.

Put slightly differently, the reason why prices may be 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 internalizes 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 may prefer either model but interestingly even when prices increase in initial periods under the agency model it is possible that consumers prefer the agency model.

My analysis provides some possible insight into events in the electronic book ("e-book") market and complements 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.[1] More precisely, following the introduction of the iPad and industry adoption of the agency model for e-books in 2010, the prices of many e-books significantly increased, leading to global antitrust scrutiny. The EC pressured many 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.[2]

My work is related to the literature on strategic managerial delegation.[3] 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.

Recent work on the agency model includes Gans (2012), Edelman and Wright (2015), Boik and Corts (2016), Johnson (2017), Johansen and Vergé (2016), Foros, Kind, and Shaffer (2013), Hagiu and Wright (2015), Gaudin and White (2014a), Gaudin and White (2014b), Wang and Wright (2017), and Loertscher and Niedermayer (2015).

The remainder of my paper is structured as follows. Section 1 presents the main model, which is based on two periods. This model is meant to capture that there is an important initial period of time in a new market and to identify the role played by different sales models in influencing industry outcomes. Section 2 instead considers an infinite-horizon model of overlapping generations.

---

[1]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.

[2]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.

[3]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.

1. A Two-Period Model

Here I consider a two-period model of platform competition with two cohorts of consumers and platform switching costs. There are two competing retail platforms, A and B, which share a discount factor $\delta \in (0, 1)$.

Let P_i^t denote the price of buying a unit of some good sold on platform i in period t. The exact process by which this price is determined depends on whether the agency or instead the wholesale model is in effect and is considered in detail in the subsections below.

The timing is as follows. In period 1, prices are determined. Then, facing prices P_A^1 and P_B^1, each member of a unit-mass cohort of consumers chooses whether to buy a product from platform A or instead from B. In the second period, prices P_A^2 and P_B^2 are determined. All consumers from the first period are still present but face switching costs. In particular, a consumer who purchased from platform i in the first period can purchase only from platform i in the second period and will do so as long as $P_i^2 \leq v$, where $v > 0$ denotes the maximum second-period willingness to pay of these consumers. Additionally, a second cohort of consumers arrives in period two. Each member of this second unit-mass cohort of consumers chooses whether to buy a product from platform A or instead from B.

Let

$$Q(P_i^t, P_j^t) = \frac{P_j^t - P_i^t + \theta}{2\theta}$$

denote the number of new consumers who join platform i in period t, given its price P_i^t in that period and its rival's price P_j^t (whenever I use both i and j in the same expression I will mean that $i \neq j$).[4] Thus, this demand function gives the number of first-cohort consumers who join platform i in period one (facing prices P_i^1) and the number of second-cohort consumers who join platform i in period 2 (facing prices P_i^2). Note that, for consumers in the first cohort, this implies that they are myopic in that they choose a platform based solely on prices in the initial period as opposed to, for example, also considering expectations about future prices. This assumption makes it easier to derive a closed-form solution to the model. Firms are not myopic and so there will be strategic dynamic effects in the model.

Observe that platforms charge no additional fees such as entry fees to join the platform. In Section **??** I consider an infinite-horizon model that also allows for upfront fees to join platforms. The approach taken in the current section is reasonable because in many real-world cases platforms do not charge upfront payments to join, or, similarly, are not be able to charge below a certain amount in terms of any upfront payment (meaning that the upfront fee ceases to be a key marginal strategic variable).[5] In other cases, a given platform may

---

[4]Assuming this is positive and less than one. Otherwise demand for firm i from cohort t is either zero or one.

[5]For example, it may not be possible to charge below zero because doing so would lead to agents joining the platform simply to receive the upfront payment.

6

support many different (and unrelated) markets, and some consumers may have no interest in them. If the upfront fee does or must apply to all markets (such as when buying a mobile phone with a certain operating system), then specializing a positive upfront fee to a market may be problematic in terms of driving away consumers who do not intend to participate in the add-on markets.

I now separately describe the details of the two distinct sales models, beginning with the wholesale model.

1.1. **The Wholesale Model.** Under the wholesale model each retailer faces a marginal cost of m to acquire products in either period. The quantity m represents the wholesale price paid to suppliers and will be taken as a parameter so that the model can speak to a wide variety of contracting possibilities. To ensure the existence of an interior symmetric pure-strategy equilibrium in prices in the second period in which both cohorts are served, I assume that $m + 2\theta < v < 4\theta$.[6]

To solve the model, I begin by considering the second period supposing that $\tilde{Q}_i$ consumers purchased from retailer $i \in \{A, B\}$ in the first period and so are locked into retailer i in the second period. Retailer i's objective function in the second period is therefore

$$(P_i^2 - m) \left[\tilde{Q}_i + Q(P_i^2, P_j^2) \right]. \tag{1}$$

Differentiating this and solving for the reaction functions of each firm readily allows equilibrium second-period prices to be found (for arbitrary first-period market shares $\tilde{Q}_A$ and $\tilde{Q}_B$). Likewise, second-period profits for arbitrary first-period market shares can be computed. Let $V(\tilde{Q}_i, \tilde{Q}_j)$ denote firm i's total second-period profits given that it sold to $\tilde{Q}_i$ consumers in the first period and its rival sold to $\tilde{Q}_j$. Because all consumers purchase a product in the first period, $\tilde{Q}_i + \tilde{Q}_j = 1$ and so where helpful I will sometimes simply write $V(\tilde{Q}_i)$ to represent firm i's second-period profits.

Lemma 1. *Given first-period market shares $\tilde{Q}_A$ and $\tilde{Q}_B$, second-period prices under the wholesale model are*

$$P_A^2 = m + \theta \left[1 + \frac{4}{3}\tilde{Q}_A + \frac{2}{3}\tilde{Q}_B \right]$$

and

$$P_B^2 = m + \theta \left[1 + \frac{4}{3}\tilde{Q}_B + \frac{2}{3}\tilde{Q}_A \right].$$

Thus, in a symmetric equilibrium in which each firm sells to half of the first cohort in the first period (so that $\tilde{Q}_A = \tilde{Q}_B$) second-period prices are

$$P_A^2 = P_B^2 = m + 2\theta.$$

---

[6]By "interior" I mean that prices will be strictly less than v under this assumption.

Given arbitrary first-period market shares, firm i's second-period profits are

$$V(\tilde{Q}_i, \tilde{Q}_j) = \frac{\theta}{18}\left(3 + 4\tilde{Q}_i + 2\tilde{Q}_j\right)^2 = \frac{\theta}{18}\left(5 + 2\tilde{Q}_i\right)^2 = V(\tilde{Q}_i).$$

There are three important things to notice about Lemma 1. First, because $\tilde{Q}_A + \tilde{Q}_B = 1$, if the size of firm A's locked-in base increases then the size of firm B's locked-in base must decrease, and this in turn means that although firm A's second-period price increases it is also true that firm B's second-period price decreases; for example firm A's second-period price is increasing in both $\tilde{Q}_A$ and $\tilde{Q}_B$. In other words, when a firm takes steps to increase its first-period market shares it not only make itself less aggressive in period-two pricing but also makes its rival more aggressive in period-two pricing. Second, despite these competing price effects, as seen in the function $V(\tilde{Q}_i)$ the overall effect on firm i's second-period profits from an increase in i's first-period market share is on balance positive. Third, in a symmetric equilibrium, the equilibrium second-period price is $m + 2\theta$ which is greater than that price would be in a setting with no switching costs. In particular, in the absence of lock-in the hotelling demand system considered here would generate equilibrium prices of $m + \theta$. Thus, as expected, lock-in raises second-period prices.

With this preliminary work done I now turn to the first period. Firm i chooses its first-period price P_i^1 to maximize its overall profits. Given the impact of first-period market shares on second-period profits as summarized by $V(\tilde{Q}_i)$, firm i maximizes

$$(P_i^1 - m)Q(P_i^1, P_j^1) + \delta V(\tilde{Q}_i).$$

Deriving first-order conditions and solving for a symmetric equilibrium leads to the following.

Proposition 1. *There exists a unique symmetric equilibrium. In it, first-period prices are given by*

$$P_A^1 = P_B^1 = m + \theta\left[1 - \frac{4}{3}\delta\right],$$

second-period prices (along the equilibrium path) are

$$P_A^2 = P_B^2 = m + 2\theta,$$

and the overall profit of each retailer is

$$\frac{\theta}{6}\left[3 + 8\delta\right].$$

Observe that, because $m > 0$ is the wholesale cost faced by the platforms, platforms suffer a first-period loss so long as the future is sufficiently valuable, in particular $\delta > 0.75$. Of course, in such cases the platforms expect to recoup these losses in the second period.

1.2. **The Agency Model.** Under the agency model, retailers take no actions and by assumption the retail price set by suppliers is given by m_a in each period. The justification for this assumption is that suppliers are assumed to sell to both retailers. Intuitively, this suggests that suppliers have no strategic dynamic incentives to lock consumers into one retailer or the other. Moreover, given that the market is covered in both periods, retailers would face no incentives to expand the total market in period two by lowering prices in period one.[7] The advantage of the approach of taking m_a to be a parameter is that it may take any value in relation to the wholesale price m that exists under the wholesale model, which will make it possible to state results more broadly that depend on the relation between these two parameters.

As far as profits, recall that suppliers keep a share r of the profits that are generated whereas retailers receive a share $1 - r$. Because the marginal costs of suppliers are assumed to equal zero, this means that the industry-wide profits across both periods total $m_a(1+2\delta)$, given that the total number of consumers in period one is one whereas the total number of consumers in period two is two. Thus, the overall profit for either retailer under the agency model is

$$\frac{1-r}{2}m_a(1+2\delta) = (1-r)m_a\left(\frac{1}{2}+\delta\right).$$

With the preliminary results above concerning the operation of the wholesale and agency models, I can now demonstrate my main comparative results involving these two sales models. These results involve (i) price trajectories, (ii) consumer welfare when supplier market structure is fixed (that is, when m and m_a are taken as given by the platforms), and (iii) consumer welfare when platforms can influence supplier market structure (that is, when m and m_a can be influenced by the platforms).

1.3. **Price Trajectories.** My first main comparative result involves prices across the two periods. Proposition 2 is stated to allow for arbitrary values of m and m_a; in Section 1.6 I consider some special cases of interest.

Proposition 2. *Compared to the wholesale model, first-period prices are higher and second-period prices are lower under the agency model if and only if*

$$\theta\left(1 - \frac{4}{3}\delta\right) < m_a - m < 2\theta.$$

All else fixed, this is more readily satisfied when:

(1) *the future is more important (δ is higher),*
(2) *retailer differentiation θ is larger, given that it is also the case that $\delta > 0.75$,*
(3) *retailer differentiation θ is smaller, given that it is also the case that $\delta < 0.75$.*

---

[7]Indeed, in an earlier version of this paper I explicitly modeled the price setting process of suppliers and showed that the outcome that I am assuming here can indeed be an equilibrium outcome.

I now separately discuss these predictions on first- and second-period prices. The first inequality displayed in Proposition 2 (that is, $\theta[1 - (4/3)\delta] < m_a - m$) ensures that the first-period price under the wholesale model is less than under the agency model. Note the connection between this condition and the condition $1 - (4/3)\delta < 0$ which ensures that platforms price beneath cost in the first period of the wholesale model. More generally, Proposition 1 indicates that when the future is more valuable firms charge less in the first period, meaning that increases in δ make it more likely that platforms not only price below cost in the first period but also make it more likely that they charge less in the first period under the wholesale model than under the agency model.

Whether higher platform differentiation as measured by $\theta > 0$ makes it more likely that prices are lower in the first period under the wholesale model depends on whether platforms price beneath cost in the first period or not (that is whether $\delta > 0.75$ or not). When they price below cost in the first period then larger values of θ expand the set of values of $m_a - m$ for which period one prices are lower under the wholesale model. The intuition is as follows. Higher values of θ reduce the sensitivity of firm i's demand to price increases by i, regardless of the period. Ignoring dynamic pricing effects, this force would tend to raise equilibrium prices in both periods. However, in the second period this effect on profits is enhanced by the larger customer base and the presence of lock-in.[8] This means increases in θ have asymmetric effects on profitability in the two periods; the effect is larger in the second period. In turn this means that, so long as the future is sufficiently important, higher levels of θ translate into more intense first-period competition under the wholesale model, and hence lower first-period prices under the wholesale model than under the agency model.

If instead $1 - (4/3)\delta > 0$, so that platforms do not price below cost in the first period, then a higher value of θ simply raises prices in both periods under the wholesale model. In this case, it follows that lower values of θ expand the set of $m_a - m$ values on which first-period prices are lower under the wholesale model.[9]

Now consider the circumstances in which second-period prices are higher under the wholesale model than under the agency model. This occurs when the second inequality of Proposition 2 holds (that is, $m_a - m < 2\theta$ or $m_a < m + 2\theta$). This condition simply says that platform differentiation plus the wholesale cost m is sufficiently high compared to the price m_a that is set under the agency model; if $m_a \leq m$ then this always holds. As one would expect, higher values of θ raise platform differentiation and so expand the set of parameters under which this condition holds.

---

[8]The claim that increases in θ have a larger static effect on second-period profits compared to first-period profits can be seen as follows. In a symmetric equilibrium ($\tilde{Q}_i = 0.5$), Lemma 1 shows that a firm's second-period profits are 2θ. In contrast, ignoring strategic incentives by setting $\delta = 0$, Proposition 1 shows that first-period profits would be $\theta/2$.

[9]Note that the logic for this result and others depends on the the assumption that m and m_a is unaffected by θ. This reasonable because these quantities are reasonably determined by supplier differentiation not platform differentiation especially given that each supplier is presumed to sell to both platforms.

One might imagine that any comparative pattern of relative prices could hold across the two periods. However, it is easy to see that this is false. The reason is that the left-most term displayed in Proposition 2 is always less than the right-most term (that is, $\theta[1 - (4/3)\delta] < 2\theta$ for all $\theta > 0$ and $\delta > 0$). Hence if $m_a - m$ and other parameters are such that first-period prices are higher under the the wholesale model then they are also higher in the second period. On the other hand if $m_a - m$ and other parameters are such that second-period prices are lower under the wholesale model then they are also lower in the first period.

Hence, it is never the case that the wholesale model exhibits higher first-period prices and lower second-period prices than the agency model. Rather, there are only three possibilities: prices under the wholesale model are either always lower or always higher than under the agency model, or else first-period prices are lower but second-period prices are higher under the wholesale model.

1.4. **Consumer Welfare.** I now turn to my second main comparative result, involving consumer welfare. Although consumers behave myopically I assume that the correct measure of their well-being involves the same value δ by which firms discount the future. In other words, I assume that consumers are simply naive about the underlying dynamic process driving prices in the market.

Proposition 3. *If $m_a - m > 2\theta$ then prices are higher in both periods under the agency model and so both cohorts prefer the wholesale model. If instead*

$$m_a - m < \theta\left(1 - \frac{4}{3}\delta\right)$$

then prices are lower in both periods under the agency model and so both cohorts prefer the agency model. For the remaining case, in which

$$\theta\left(1 - \frac{4}{3}\delta\right) < m_a - m < 2\theta,$$

prices are higher in the first period but lower in the second period under the agency model. In this case cohort 2 consumers are better off under the agency model whereas cohort 1 consumers are better off under the agency model if and only if it is also true that

$$(1+\delta)(m_a - m) < \theta\left(1 + \frac{2}{3}\delta\right).$$

Proposition 3 indicates that welfare effects can go in different directions depending on both the parameters but also which cohort is being considered. One interesting implication is that, if the wholesale model exhibits first-period prices that are lower but second-period prices that are higher than under the agency model, then cohort 1 consumers could be either worse or better off under the wholesale model. I return to these tradeoffs when I discuss several specials cases in Section 1.6.

1.5. **Endogenous Market Structure.** In this section I explore the idea that platforms may be able to influence the structure of the supplier market. Many retailers, perhaps especially online, make a variety of decisions that influence the supplier market and competition therein. For example, they can influence how many different suppliers' products are sold in their stores, and also influence the search costs that consumers bear on their platform when trying to evaluate different products.

My perspective in this section is that these decisions influence the supplier market in two ways. First, they influence the total value that consumers associate with this market by altering the parameter v. Second, they may influence the margins that suppliers receive, that is they may influence m and m_a. As I will show, the incentives that a platform has to alter v and suppliers' margins depends on whether the agency model or instead the wholesale model is in effect.

To explore this most easily within the context of the existing model, I suppose that each platform i makes a (non-contractible) decision by selecting the value of the parameter $v_i > 0$ in the beginning of the second period.[10] This choice then affects m and m_a as described below. After that, retail prices are determined as detailed earlier and depending on whether the agency model or wholesale model is in effect.

I augment firm i's second-period demand function as follows:

$$Q(P_i^2, P_j^2, v_i, v_j) = \frac{P_j^2 - P_i^2 + v_i - v_j + \theta}{2\theta}.$$

In addition to altering the demand that retailer i faces, v_i is assumed to lower the margins that suppliers receive. In particular, the margins of suppliers at platform i are now described by the functions $m(v_i)$ and $m_a(v_i)$. Both $m(v_i)$ and $m_a(v_i)$ are assumed to be strictly decreasing so that higher values of v_i translate both to increased demand for platform i as well as more competition amongst suppliers, such as brought about by higher numbers of suppliers or else lower consumer search costs for products sold on the platform.

Proposition 4. *Suppose that in period 2 each retailer i chooses $v_i \in [\underline{v}, \bar{v}]$ with $0 < \underline{v} < \bar{v}$. Then:*

(1) *Under the wholesale model each retailer i chooses $v_i = \bar{v}$, thereby minimizing the wholesale price $m(v_i)$ faced by retailer i and also maximizing the gross value v_i that consumers receive from shopping at i.*

(2) *Under the agency model retailer i does not necessarily choose $v_i = \bar{v}$.*

---

[10]I focus on the second period in keeping with the basic idea that my model is meant to capture an initial period of competition in which platforms seek to gain scale and lock-in, followed by a potentially longer period in which they reap the benefits of their first-period actions. From this perspective it is easier to manipulate the supplier market in the long run.

Fixing its rival's actions, an increase in v_i by firm i intensifies wholesale price competition among i's suppliers and thereby raises i's second-period profits at the expense of supplier profits—assuming that the wholesale model is in effect. Additionally, this higher value of v_i draws more second-period consumers to firm i for any given prices. Thus, both effects of raising v_i benefit firm i under the wholesale model.

In contrast, under the agency model an increase in v_i has competing effects on firm i's profits. In particular, by increasing competition amongst its suppliers (and so lowering m_a), the gross profits generated by a retailer may fall. This is bad for i to the extent that it receives a share of total revenue generated on its platform under the agency model. On the other hand, given prices an increase in v_i continues to make firm i's platform more attractive to second-period consumers, just as is true under the wholesale model. Thus, one rather than both effects of raising v_i benefits firm i under the agency model.

In other words, the agency model partially aligns the preferences of suppliers and retailers, whereas in the wholesale model such alignment is always absent. Although such alignment may be good for both suppliers and retailers under the agency model, it is bad for consumers because it leads them to face a more limited selection of products (or higher search costs) and higher prices.

Proposition 4 therefore identifies a potential welfare cost of the agency model. Notably, it suggests that even if consumers prefer the agency model for any fixed structure of the supplier market, they may prefer the wholesale model when the supplier market structure is endogenous.

1.6. **Leading Special Cases for the Parameters m and m_a.** Results above clearly indicate that the predictions of the model depend heavily on what are taken as parameters in this model, namely the values m and m_a. In the real world, these values are likely to depend on endogenous features of the supplier market and also the contracting process between suppliers and platforms. The advantage of the approach taken so far is that the results preserve generality. At the same time, it is desirable to know what some possible outcomes might be, were m and m_a endogenous. To this end I discuss two special cases and how they influence the conclusions from the results presented above. I fix the structure of the supplier market so that $v_A = v_B = v$ regardless of whether the wholesale or instead agency model is in effect.

First suppose that $m > m_a$, meaning that the wholesale price under the wholesale model is greater than the retail price that suppliers would charge under the agency model. Such an outcome might occur if publicly observed linear contracts are used, insofar as selling through intermediaries in such cases tends to softens competition between suppliers. For example, this is the outcome in Bonanno and Vickers (1988).

Corollary 1. *Suppose that $m > m_a$. Then consumers in both cohorts prefer the agency model to the wholesale market.*

This result is true even though consumers in the first cohort may face lower prices in the first period under the wholesale model, depending on the parameters. Algebraically, this corollary is easily confirmed using Lemma 1 and Proposition 1. Those results indicate that when $m > m_a$ both second-period prices and the discounted sum of first- and second-period prices are higher under the wholesale model.

The intuition for this result can also be easily understood by thinking about a single-period model. In that case, it is not surprising that $m > m_a$ makes consumers better off under the agency model. After all, m is a wholesale price and in a single-period market platforms will always charge a positive markup on top of m so that the final retail price under the wholesale market must exceed that under the agency model. This logic certainly applies to the second-period of the model and hence to understanding why consumers in the second cohort prefer the agency model.

The same intuition also applies to the first cohort but requires first confirming that retailers in fact earn positive profits from these consumers under the wholesale model. In principle, this might not be the case because one reason grabbing first-period market share is valuable is that it leads to higher second-period prices that are also borne by consumers in the second cohort. But as is readily confirmed from Proposition 1, firms indeed earn positive profits from first-cohort consumers. Given that the total variable cost of serving these consumers is $(1 + \delta)m > (1 + \delta)m_a$, where $(1 + \delta)m_a$ is the total price paid by these consumers under the agency model, it follows that these consumers must also prefer the agency model.

Although this is good news for consumers' assessment of the agency model, Proposition 4 should still give some pause when assessing consumer welfare. The reason is that, if v_i is endogenous, then the equilibrium values of v_i may be higher under the wholesale model. Even if these equilibrium values are such that $m(v_i) > m_a(v_i)$, so that the corollary above still holds, gross consumer surplus is higher under the wholesale model if v_i is higher under the wholesale model. If this is so then prices alone are no longer a sufficient indicator of consumer welfare.

The second leading special case that I consider is where $0 = m < m_a$, which says that suppliers charge marginal cost (assumed to be zero) under the wholesale model but set a positive retail price under the agency model. This circumstance may arise when two-part tariffs are used. In a variety of situations, two-part tariffs lead to such bilaterally efficient bargaining outcomes, including when there are multiple suppliers and private contract negotiations as in O'Brien and Shaffer (1992). Note that two-part tariffs would not imply that $m_a = 0$ because m_a is the final price paid by consumers not an intermediate price as m is under the

wholesale model. I also assume $\delta > 0.75$ so that retailers suffer a first-period loss under the wholesale model.

Corollary 2. *Suppose that $\delta > 0.75$ and that $0 = m < m_a$.*

(1) *If $2\theta < m_a$ then all consumers prefer the wholesale model,*
(2) *If $\hat{m}_a < m_a < 2\theta$ then cohort two consumers prefer the agency model, but cohort one consumers prefer the wholesale model, where $m_a < \hat{m}_a$ is some particular value satisfying $0 < \hat{m}_a < \theta$,*
(3) *If $m_a < \hat{m}_a$, then all consumers prefer the agency model.*

This corollary indicates that efficient bilateral contracting under the wholesale model can but need not make the wholesale model more appealing than the agency model to some or even all consumers. The reason some or all consumers may prefer the wholesale model is clearly that the variable cost paid by retailers is zero and so there is only the markup charged by the platforms.

When $m_a > 2\theta$, supplier differentiation is so strong compared to platform differentiation that allowing suppliers to set prices leads all consumers to be worse off compared to the wholesale model. But, the lower that m_a becomes, the more consumers instead prefer the agency model to the wholesale model. After all, the wholesale model still exhibits second-period pricing influenced by lock-in, even when $m = 0$. The corollary above shows there is a range of m_a where first-cohort consumers prefer the wholesale model but second-cohort consumers prefer the agency model. This happens because $\delta > 0.75$ so that first-cohort consumers are still getting a sufficient first-period discount that the overall discounted price they pay under the wholesale model is less than under the agency model (even though the second-period price under the wholesale model is higher). However, for even lower values of m_a, both cohorts prefer the agency model.

1.7. **Profits of Suppliers and Retailers.** Here I explore the relation between the sales model and the profits of suppliers and retailers. In a related setting with a single period but a richer demand, supply, and contracting environment, Johnson (2017) analyzes the wholesale and agency models, including addressing the question of which business model retailers and suppliers prefer. An important part of that analysis is that the marginal cost of suppliers exceeds zero, which means that the (endogenously determined) revenue shares influence the perceived costs of suppliers and hence the prices that suppliers set. This effect that is absent when supplier costs are zero as in the present analysis. Rather than pursuing endogenous revenue shares here, I continue to assume that r is fixed and explore the effect of changes in market differentiation parameters on retailer and supplier profits.

Proposition 5. *Retailers earn higher profits under the agency model if and only if*

$$(1 - r)m_a(1 + 2\delta) > \frac{\theta}{3}\left[3 + 8\delta\right].$$

The left-hand side of the inequality in Proposition 5 simply says that retailers jointly receive a $1 - r$ share of the total industry revenue, where that revenue is m_a per consumer discounted appropriately and to acknowledge that there are twice as many consumers in the second period. The right-hand side gives industry retailer profits under the wholesale model and follows from doubling the per-retailer profits given in Proposition 1.

To interpret Proposition 5, recall that m_a is a measure of supplier differentiation, whereas θ is a measure of retailer differentiation. Thus this result indicates that retailers prefer the agency model whenever supplier differentiation m_a is strong relative to retailer differentiation θ. Note that although the retail price under the wholesale model is influenced by supplier differentiation as measured by m, in equilibrium that portion of it is captured by suppliers through wholesale prices and so does not appear in the computation of retailer profits.

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, retailer differentiation is the main determinant of their profits, whereas when suppliers set them it is the differentiation between suppliers that is crucial.

Proposition 5 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 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.

2. An Infinite Horizon Model

In this section I consider a variant of the model considered above. There are several changes of importance. First, it is an infinite-horizon model with overlapping generations, and consumers are not myopic. Second, each platform is able to charge consumers an upfront fee to join the platform (I discuss the appropriateness of this assumption below). Third, the market is not necessarily covered; there is a smooth downward-sloping aggregate demand curve. I now provide details.

Consider the following discrete-time infinite horizon model of dynamic platform competition with overlapping generations of consumers and consumer platform lock-in. There are two

competing platforms, A and B. All players share a common discount factor $\delta \in (0,1)$ (consumers are not be myopic in this model).

In each period $t \in \{0, 1, 2, ...\}$ a unit mass of new consumers enters the market. New consumers must choose whether to join a platform or not, and if so which one. For a new consumer, joining platform $i \in \{A, B\}$ in period t entails paying a one-time upfront fee F_i^t charged by platform i and also paying the price p_i^t for some product available on the platform; the upfront fee can be charged whether the wholesale or instead the agency model is in effect. Consumers who choose to join platform i at time t become old consumers in period $t+1$ and are locked into platform i in that period (and then exit the market before period $t+2$ begins). In period $t+1$ these consumers again buy a product at price p_i^{t+1}; for all old consumers their willingness to pay for such a product is $v > 0$.

I will look for a Markov-perfect equilibrium (MPE) where the state variable at time t is (Q_A^t, Q_B^t), where Q_i^t is the mass of locked-in, old consumers on platform i. To determine how many consumers actually join platform i in period t, note that joining platform i leads to a total expected expenditure of P_i^t, with

$$P_i^t = F_i^t + p_i^t + \delta \mathrm{E} p_i^{t+1}.$$

The number of new consumers joining platform i is assumed to be given by $Q(P_i^t, P_j^t)$, where j indexes the platform other than i. Unless otherwise noted I assume that Q is strictly decreasing in its first argument and strictly increasing in its second argument, and that it is sufficiently well-behaved so as to admit a unique, symmetric equilibrium in the pricing games that I study.[11] Any new consumers who do not join a platform in period t immediately exit the market, purchasing nothing, and so serve no further role.

There are also suppliers of the products that consumers buy on the platform. These suppliers each have zero marginal costs of production, as do the platforms. Each supplier is presumed to sell its products on both platform A and platform B.

2.1. The Wholesale Model.

Under the wholesale model, each supplier charges a wholesale price or markup denoted by $m \leq v$. As before, I take this as exogenously given so as to preserve flexibility in comparing the wholesale model to the agency model.

In each period t platform i chooses price for products p_i^t and also the entry fee F_i^t, where the entry fee is only paid by new consumers. Recall that I am restricting attention to MPE where the state variable is the pair (Q_A, Q_B) of consumers locked into the two platforms at time t. Intuitively, with the possible exception of the first period $t = 1$, it is strictly optimal for the platforms to use one price (p_i^t) to extract surplus from old, locked-in consumers and

---

[11]In particular, I assume that $-Q(P_i^t, P_j^t)/Q_1(P_i^t, P_j^t)$ is strictly decreasing in P_i^t, and that at symmetric prices $P = P_i^t = P_j^t$ the function $-Q(P, P)/Q_1(P, P)$ is strictly decreasing in P (except in the special-case of the hotelling specification in which case this term is invariant to P).

the other price (F_i^t) to compete for new consumers, meaning that $p_i^t = v$ for $t > 1$. In period $t = 1$, it is not strictly optimal to do so because the platforms have two pricing instruments where one is sufficient, but it is without loss of generality to assume that p_i^1 also equals v.

Lemma 2. *Under the wholesale model, $p_i^t = v$ in every period t for each $i \in \{A, B\}$.*

All that remains is to determine the upfront fee F_i^t that platform i charges. Platforms select this fee to maximize their profits associated with each cohort of consumers, given the prices that its rival is selecting. Recall that P_i^t is the total expected outlay consumers associate with platform i, given by $P_i^t = F_i^t + p_i^t + \delta \mathrm{E} p_i^{t+1} = F_i^t + (1 + \delta)v$. In turn, the total expected per-consumer costs that a platform bears is simply the discounted value of the wholesale costs it faces, $(1 + \delta)m$. Therefore, to maximize the profits associated with cohort t platform i wishes to maximize

$$[P_i^t - (1 + \delta)m]Q(P_i^t, P_j^t).$$

Observe that this is independent of the state variable. This is again a consequence of the lemma above and the fact that each platform has two pricing instruments at its disposal. As such, the pricing problem is very straightforward, with the optimal P_i^t satisfying the first-order condition

$$P_i^t - (1 + \delta)m = -\frac{Q(P_i^t, P_j^t)}{Q_1(P_i^t, P_j^t)}. \tag{2}$$

Given the assumption that the right-hand side is decreasing in P_i^t for each P_j^t and the assumption that at symmetric prices P the function $Q(P, P)/Q_1(P, P)$ is strictly decreasing in P, there is a unique pricing equilibrium.

Proposition 6. *In the unique symmetric Markov Perfect Equilibrium of the wholesale model, in each period t each platform i sets a price for products of $p_i^t = v$ and charges an upfront payment $P_i^t = P_w^*$ where P_w^* satisfies*

$$P_w^* - (1 + \delta)m = -\frac{Q(P_w^*, P_w^*)}{Q_1(P_w^*, P_w^*)}.$$

2.2. **The Agency Model.** Under the agency model the suppliers of the products sold on the platforms set the prices for these products. As before, I fix these prices exogenously at $m_a \leq v$ as so doing will allow me to compare outcomes with the wholesale model taking m and m_a as parameters.

Platforms continue to charge upfront fees. Additionally, each platform keeps a share $1 - r$ of revenue from the sales of products, with the remaining r share going to suppliers. The value r is also exogenously fixed.

For a new consumer, the implications of the agency model are that a consumer joining platform i in period t anticipates a total outlay of $P_i^t = F_i^t + (1 + \delta)m_a$. In particular this

consumer's second-period outlay is independent of the state variable. Therefore, platform i wishes to maximize

$$\left[F_i^t + (1+\delta)(1-r)m_a\right] Q(F_i^t + (1+\delta)m_a, F_j^t + (1+\delta)m_a)$$
$$= \left[P_i^t - (1+\delta)rm_a\right] Q(P_i^t, P_j^t).$$

The final expression above indicates that, on a per-consumer basis, platform i receives the total discounted price P_i^t that each con pay minus the total discounted revenue $(1+\delta)rm_a$ that suppliers receive.

Deriving the first-order condition and considering a symmetric equilibrium in which $P_a^* = P_i^t = P_j^t$, the following must hold,

$$P_a^* - (1+\delta)rm_a = -\frac{Q(P_a^*, P_a^*)}{Q_1(P_a^*, P_a^*)}.$$

Proposition 7. *In the unique symmetric Markov Perfect Equilibrium of the agency model, in each period t the price of products sold on each each platform is given by m_a and the total discounted outlay of each consumer, $P_i^t = P_a^*$, satisfies*

$$P_a^* - (1+\delta)rm_a = -\frac{Q(P_a^*, P_a^*)}{Q_1(P_a^*, P_a^*)}.$$

2.3. **Comparison of the Two Sales Models.** Here I report various results involving the two sales models. A key observation is that the ability of the platforms to charge upfront fees ensures that they have a pricing instrument regardless of whether the agency or wholesale model is in effect. This means that market outcomes are determined by the effective variable costs that platforms face, that is the amount that suppliers extract, either given by m under the wholesale model or rm_a under the agency model.

My first result involves consumer welfare and firm profitability.

Proposition 8. *The following statements are true if and only if $rm_a < m$.*

(1) *The total discounted outlay of each consumer in each period is strictly lower under the agency model: $P_a^* < P_w^*$,*
(2) *The per-consumer profit and the discounted total profit of each platform is strictly higher under the agency model.*

Proposition 8 provides a simple necessary and sufficient condition for both consumers and platforms to prefer the agency model. The condition is simply that the final margin $(1-r)m_a$ suppliers receive under the agency model is lower than the margin m that they receive under the wholesale model. Note that in a static model with a single cohort of consumers, the same result would emerge. Hence, Proposition 8 is best seen as showing that these static properties carry over to a more complicated dynamic setting.

Proposition 8 raises the question as to whether the underlying condition $rm_a < m$ is likely to be satisfied or not. However, as discussed earlier, different microfoundations for these variables may lead to different conclusions, suggesting that the answer depends very much on the particular circumstance. For example, in some models involving rivalry among suppliers the presence of an intermediary that marks up wholesale prices leads to a softening of competition among suppliers, suggesting that $m_a < m$ and hence $rm_a < m$. But, if two-part tariffs were used between suppliers and platforms, then some models (such as those based on private contracting) predict that the wholesale price m will equal marginal cost, so that $m = 0 < rm_a$.

Proposition 8 exhibits less nuance than the welfare results stated earlier, in Proposition 3 and Corollaries 1 and 2. One reason is that the current model exhibits the same prices in all periods whereas the earlier model did not. Another reason is that there is no longer the same notion of equilibrium prices under the agency model being a function primarily of supplier differentiation (if such were the case here then retail prices would be given by m_a). The reason for this is that in the current setting platforms charge an upfront payment even when the agency model is in effect, meaning that platforms have a pricing instrument under both sales models. This means that the main determinant of final retail prices is simply the per-customer revenue that suppliers receive, given by m under the wholesale model and rm_a under the agency model. These values look like marginal costs to the platforms, and hence it makes sense that the ranking of final retailer prices depends entirely on these values.

This raises the question of whether it makes sense to include an upfront fee in the model. On the one hand, in some cases it seems an upfront fee makes sense, such as when consumers buy a piece of hardware or when they can be charged for an app. On the other hand, in many circumstances the optimal upfront price may be zero and it may not be feasible to charge less than zero, in which case the upfront fee ceases to be a relevant pricing instrument. Even more, the hardware product may have many functions, as is the case with an iPad. Some consumers may not care about, say, reading e-books, and this may dramatically limit the ability of the platform to tweak the upfront fee to optimize profits related to any particular functionality such as e-books.

Proposition 8 doesn't speak to supplier profits. But it may be reasonable to assume that competition amongst suppliers is such that m is less than the value that would maximize suppliers' joint profits under the wholesale model. If this is the case, and assuming quasi-concavity of profits, then if $rm_a < m$ it follows that the profits of suppliers are lower under the agency model.

I now consider how the agency model impacts the trajectory of payments. Let F_w^* and F_a^* represent the equilibrium upfront payments under the wholesale and agency models, respectively.

Proposition 9. *A sufficient condition for $F_w^* < F_a^*$ is that $v - m > m_a(1 - r)$.*

This says that, under certain conditions, the wholesale model leads to lower upfront payments than the agency model, a conclusion similar to that in Proposition 2. The condition has a straightforward interpretation: $v - m$ is the profit that the platform expects to make from any given consumer in that consumer's second period in the market under the wholesale model, and $m_a(1 - r)$ is the corresponding profit under the agency model. Thus, when the platform expects higher future per-customer profits under the wholesale model it charges a lower upfront fee today.

I close with a discussion of the incentives of platforms to limit competition, along the lines articulated in Proposition 4. In the present model, because the platform has a pricing instrument (the upfront fee) regardless of which sales model is in effect, it does not have materially different incentives to change the structure of the supplier market. All else fixed, it always gains from reduced values m and m_a that it faces on its platform, because this reduces its perceived costs. In other words, the upfront fee means that under the agency model it is not the case that the platform's profits may be increasing in m_a. This is different from the earlier analysis.

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.

References

Allen, D., and D. Lueck (1992): "Contract Choice in Modern Agriculture: Cash Rent versus Cropshare," *Journal of Law and Economics*, 35(2), 397–426.

BOIK, A., AND K. S. CORTS (2016): "The effects of platform most-favored-nation clauses on competition and entry," *Journal of Law and Economics*, 59(1), 105–134.

BONANNO, G., AND J. VICKERS (1988): "Vertical Separation," *Journal of Industrial Economics*, 36(3), 257–265.

CHISHOLM, D. C. (1997): "Profit-Sharing versus Fixed-Payment Contracts: Evidence from the Motion Pictures Industry," *Journal of Law, Economics, & Organization*, 13(1), 169–201.

EDELMAN, B. G., AND J. WRIGHT (2015): "Price coherence and excessive intermediation," *Quarterly Journal of Economics*, 130, 1283–1328.

FERSHTMAN, C., AND K. L. JUDD (1987): "Equilibrium Incentives in Oligopoly," *American Economic Review*, 77(5), 927–940.

FOROS, Ø., H. J. KIND, AND G. SHAFFER (2013): "Turning the Page on Business Formats for Digital Platforms: Does Apple's Agency Model Soften Competition?," *CESifo Working Paper Series*.

GANS, J. (2012): "Mobile Application Pricing," *Information Economics and Policy*, 24, 52–59.

GAUDIN, G., AND A. WHITE (2014a): "On the Antitrust Economics of the Electronic Books Industry," *Working Paper*.

——— (2014b): "Unit vs. Ad valorem Taxes under Revenue Maximization," *Working Paper*.

HAGIU, A., AND J. WRIGHT (2015): "Marketplace or Reseller?," *Management Science*, 61(1), 184–203.

JOHANSEN, B. O., AND T. VERGÉ (2016): "Platform Price Parity Clauses with Direct Sales," *Working Paper*.

JOHNSON, J. P. (2017): "The Agency Model and MFN Clauses," *Review of Economic Studies*, 84(3), 1151–1185.

LOERTSCHER, S., AND A. NIEDERMAYER (2015): "Percentage Fees in Thin Markets: An Optimal Pricing Perspective," *Working Paper*.

O'BRIEN, D. P., AND G. SHAFFER (1992): "Vertical Control with Bilateral Contracts," *RAND Journal of Economics*, 23(3), 299–308.

SAPPINGTON, D. E. M. (1991): "Incentives in Principal-Agent Relationships," *Journal of Economic Perspectives*, 5(2), 45–66.

SCHELLING, T. C. (1956): "An essay on bargaining," *American Economic Review*, 46(3), 281–306.

——— (1960): *The Strategy of Conflict*. Harvard University Press, 2nd edn.

SKLIVAS, S. D. (1987): "The Strategic Choice of Managerial Incentives," *RAND Journal of Economics*, 18(3), 452–458.

VICKERS, J. (1985): "Delegation and the Theory of the Firm," *Economic Journal*, 95, 138–147.

WANG, Z., AND J. WRIGHT (2017): "Ad-valorem platform fees, indirect taxes and efficient price discrimination," *RAND Journal of Economics*.