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Turning the Page on Business Formats for Digital Platforms: Does Apple's Agency Model Softening Competition?

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Abstract

The agency model used by Apple and other platform providers such as Google allows upstream firms (content providers like book publishers and developers of apps) to choose the retail prices of their products (RPM) subject to a fixed revenue-sharing rule. We show that (i) this leads to higher prices if the competitive pressure is higher downstream than upstream; (ii) upstream firms earn positive surplus even when platform providers have all the bargaining power; and (iii) with asymmetric business formats (where only some platform providers use the agency model), a retail most-favored-nation clause leads to retail prices that resemble the outcome under industry-wide RPM.

JEL-Code: L130, L410, L420.

Keywords: the agency model, resale price maintenance, most-favored nation clauses, revenue sharing.

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1 Introduction

The business format that Apple uses for its application providers in App Store and ebook publishers in iBookstore is called the agency model. In this model, the upstream firms (content providers like book publishers and developers of apps) choose the retail prices of their products and the downstream firms (Apple as well as other platform providers such as Google) specify how the revenue is to be split. It is a relatively new business format and already it is controversial.¹

There are three key ingredients of the agency model and the downstream firms that use it. First, the firms are typically large and can often dictate contract terms.² Second, the content providers determine the retail prices of their products. In effect, the downstream firms cede control over retail prices to the upstream firms, allowing them to engage in resale price maintenance (RPM). Third, the contract terms specify revenue-sharing splits (as opposed to wholesale prices in which a downstream firm announces how much it is willing to pay per unit). It is known, for example, that Apple applies a 70-30 revenue split, where 70% of the revenue that a service generates goes to the upstream firm and 30% goes to Apple.

In this paper, we address several questions that arise in relation to the agency model and the downstream firms that adopt it. First, why would firms that can dictate their contract terms cede control over anything, particularly something as fundamental as their retail prices? Second, why would these firms not push the upstream firms close to indifference, allowing them to earn only enough revenue to cover their costs? In other words, why give the upstream firms any profit? Third, what determines when a downstream firm will adopt the agency model versus a more

¹On July 10, 2013, a federal judge ruled that Apple was guilty of conspiring with book publishers to fix e-books prices. A key issue was whether Amazon was pressured into using the agency model (United States v. Apple Inc, 12 Civ. 2826 (DLC)). See also Manne (2013) and Bobelian (2013).

²That Apple can often dictate contract terms to developers of apps is surely true. But it is also the case that Apple wields considerable bargaining power with book publishers, even the large ones. This is evident at numerous points in the judge's decision (see above footnote). For example, after noting that HarperCollins, a large book publisher, suggested that Apple take a 20% commission rather than a 30% commission, she wrote (p. 58) "*Apple refused to budge. This was the same commission it charged in the App Store. It would give Apple only a single digit positive margin and, in Apple's view, was necessary to generate the revenue Apple needed to build a great iBookstore. The 30% commission was ultimately adopted across all of Apple's final Agreements.*"

standard business format without RPM. Fourth, to what extent would one expect there to be a cascade of agency adoption, in which one firm adopting the agency model is followed closely in time by another firm adopting the agency model, etc.

We examine these issues from a competition-based perspective. In this sense, the model we use to obtain our insights is similar to the vast majority of vertical-contracting models in which one side makes the offers and there is competition at some level in the distribution chain. However, we go a step beyond and assume there is competition at both the upstream and the downstream levels. Among the stylized facts we consider are (i) Apple uses the agency model for apps and e-books, but not for music in its iTunes Store, where it has remained in control of retail prices,³ (ii) other firms such as Google and Amazon have followed Apple in adopting the agency model, sometimes so quickly that it has led to inquiries into whether they were pressured into doing so,⁴ and (iii) the agency model is sometimes bundled with ancillary contract provisions such as retail most-favored nation clauses (MFNs).⁵

We obtain our results in three parts. First, we consider a model in which two upstream firms sell their products to two downstream firms, and each downstream firm sells both upstream firms' products. We compare a setting in which the downstream firms decide retail prices with a setting in which the upstream firms decide retail prices, taking as given the revenue-sharing splits. We find that retail prices will be higher in equilibrium under the latter (i.e., RPM) if and only if competitive pressures are lower upstream (cf. Proposition 3). Thus, to answer our first motivating question, why would downstream firms ever cede control over something as fundamental as their retail prices, the reason may be as simple as the downstream firms want to induce higher prices.⁶ In particular, we find that control over retail

³From Steve Jobs biography (Isaacson, 2011) there is a clear indication that he viewed the agency model in the publishing sector as a second best solution: *He [Jobs] had refused to offer the music companies the agency model and allow them to set their own prices. Why? Because he didn't have to.*

⁴A main point of contention in the recently concluded e-books case was whether Amazon's rapid shift to the agency model was an outcome of explicit collusion among major publishers and Apple. The major publishers were HarperCollins, Hachette, Macmillan, Penguin and Simon & Schuster.

⁵MFNs were included in all of Apple's agency agreements with the book publishers. The judge in the case against Apple (see footnote 1) wrote that *"The MFN guaranteed that the e-books in Apple's e-bookstore would be sold for the lowest retail price available in the marketplace."* p. 47.

⁶One may ask why can a downstream firm that wants to induce higher prices not simply retain

prices should optimally be given to the level in the distribution chain that faces the least competitive pressure if the goal is to dampen competition and increase prices.

This finding may offer some insights into Apple’s decision to adopt the agency model for e-books. At the time of its entry into the e-books market (January 2010), Apple faced a competitor, Amazon, who was selling e-books for \$9.99 (which was in many cases several dollars below the wholesale price that Amazon was paying).⁷ Apple was thus faced with a difficult decision. It could either take on Amazon directly by setting its own low prices, or it could attempt to move the industry to the agency model in which control of the retail prices was ceded to the book publishers, where competitive pressures were lower. Apple chose the latter — to dampen competition. In the words of Steve Jobs (Isaacson, 2011): *"We were not the first people in the books business,... "Given the situation that existed, what was best for us was to do this akido move and end up with the agency model. And we pulled it off"*. It was widely recognized at the time that book publishers were displeased with Amazon’s low prices in part because they felt it hindered their ability to sell hardcover books at much higher prices and accompanying profit margins.⁸

Our finding may also shed light on Apple’s decision to adopt the agency model for its application providers when the iPhone was introduced. Because apps are distributed by large numbers of upstream firms through distribution channels such as Apple’s App Store and Google’s Google Play, it seems clear that Apple would have anticipated at the time that ceding control of retail prices to the upstream firms (and thus away from Apple and its future downstream competitors) would lead to

control of the retail prices and set the higher prices itself? The reason is that it does not compete in a vacuum. By delegating pricing authority to others that face less competitive pressures (in this case, the upstream firms), the downstream firm can induce not only higher retail prices on its own products, but also higher retail prices on its rivals’ products. In this sense, our analysis ties into the vertical literature on strategic delegation (see, for example, McGuire and Staelin, 1983; Coughlan, 1985; Moorthy, 1988; Bonanno and Vickers, 1988; and Coughlan and Wernerfelt, 1989).

⁷Quoting once again from the e-books case, *"This meant that the wholesale price for e-books would equal the wholesale price for physical books, and as a result, the wholesale price that Amazon paid for an e-book would be set at several dollars above Amazon’s \$9.99 price point."* p. 17.

⁸*"The Publishers were unhappy with Amazon’s \$9.99 price point and feared that it would have a number of pernicious effects on their profits ... In the short-term, the Publishers believed the low-price point was eating into sales of their more profitable hardcover books, which were often priced at thirty dollars or more ..."* See *United States v. Apple Inc*, 12 Civ. 2826. (DLC), p. 15.

low prices.⁹ Thus, our model suggests that Apple either felt that (i) there were countervailing factors (which presumably were not present in the e-books market) that outweighed the benefits of dampening competition or that (ii) it would directly benefit from low prices. Boudreau (2012) suggests, for example, that Apple adopted the agency model for its application developers in order to create entrepreneurship and innovation by “letting a thousand flowers bloom”. It is also likely that Apple knew that it would benefit from lower prices on apps because of its iPhone sales.

In part two of our paper, we extend the basic model to allow an initial stage of the game in which the downstream firms choose what revenue-sharing splits to offer the upstream firms. One might think that the downstream firms would be able to extract the entire surplus in this case. But, despite having no bargaining power, we find that the upstream firms always earn strictly positive profit.¹⁰ The reason is that upstream firms can always adjust their retail prices to disadvantage downstream firms that give them unfavorable terms. If one downstream firm attempted to extract all the surplus, say by demanding all or nearly all of the revenue from the upstream firms, the upstream firms would cease selling to it, thereby increasing the sales of their products at the other downstream firm (because the downstream firms are substitutes) from whom they earn positive surplus. And if both downstream firms attempted to extract all or nearly all of the revenue from the upstream firms, one or both would soon realize that it could do better by backing down from its demands. Thus, to answer our second motivating question, why would upstream firms earn positive surplus in equilibrium instead of being squeezed to the point of indifference, we suggest the reason is that the upstream firms, despite having little or no bargaining power with downstream firms, still have the ability to shift sales to rival retailers by increase the price if a downstream firm tries to extract too much.

More generally, we can show that not only will the equilibrium revenue-sharing splits be less than one, they will also depend on competition at both levels of the

⁹Google has also adopted an agency model for apps that is identical to the one used by Apple. Even the revenue split is the same; 30% to Google and 70% to the app developers (<http://support.google.com/googleplay/android-developer/answer/112622?hl=en>, December 12, 2012).

¹⁰Another reason why the downstream firms might allow the upstream firms to earn positive profit is to induce them to undertake non-contractible investments. We abstract from this by holding product qualities fixed and assuming that any such investments have already been made.

distribution chain when the upstream firms determine retail prices (cf. Proposition 4). To see why, suppose the downstream firms are symmetric except that one firm requires a higher revenue share from the upstream firms. Then, the upstream firms will have an incentive to disadvantage this firm by charging higher retail prices for the products sold by this firm than for the products sold by the rival downstream firm. The reason is that this will increase the sales of the downstream firm that offers them a larger share of the revenue. This effect will put stronger downward pressure on the downstream firms' revenue-sharing splits the better substitutes the downstream firm are in the eyes of consumers. However, the stronger the competition between the upstream firms, the weaker will be their ability to punish one downstream firm with higher prices than the other. Higher upstream substitutability therefore tends to put stronger upward pressure on the downstream firms' revenue-sharing splits.

In the last part of the paper, we extend our setting to allow the downstream firms to choose whether to adopt the agency model, possibly leading to an asymmetric structure in which one firm uses the agency model and the other does not. We ask whether both firms adopting the agency model can be supported in equilibrium. This is an important question to ask particularly in light of accusations that Apple and various book publishers pressured Amazon into adopting the agency model after it was introduced.¹¹ If industry-wide adoption arises naturally in equilibrium, then our model would predict that no pressure was needed. But, if industry-wide adoption does not arise naturally in equilibrium, then our model would predict that something in addition (e.g., "pressure" or "threats") would indeed have been needed.

We find that there would be no need to pressure firms into adopting the agency model when retail prices and industry profits would be higher with the agency model than without the agency model and competitive pressures upstream are strong enough. However, pressure would be needed to induce industry-wide adoption of the agency model when competition upstream is sufficiently weak. And, in some cases, it was found that it may even be possible that no downstream firm would adopt the agency model in equilibrium even though industry-wide adoption of the agency model might increase retail prices and industry profits (cf. Proposition 8).

¹¹This was one of the main points of contention in the e-books case. See footnotes 1 and 4.

Lastly, we consider the stylized fact that when Apple entered the market for e-books, it used a retail most-favored nation clause (MFN) in its contracts. These MFN clauses required that the publishers not set higher retail prices at Apple than the retail prices at other downstream firms, whether or not the latter's prices were controlled by the book publishers (e.g., the book publishers were not allowed to set Apple's prices higher than Amazon's prices even if Amazon could control its own prices).¹²

We find that in this setting, MFNs play an interesting role in that if the rival firm (e.g., Amazon) does not also adopt the agency model, then the MFN can lead to uniform prices that resemble the same outcome that would arise under industry-wide adoption, making Amazon's decision a moot point (cf. Proposition 9 and surrounding discussion). This may explain why, when the iPad was launched (January 2010) and Steve Jobs was asked why someone would buy a book from Apple for \$14.99 if the same book was offered for \$9.99 from Amazon, he responded confidently (Isaacson, 2011): "*That won't be the case The price will be the same*".

Thus, to answer our last motivating question, to what extent would one expect there to be a cascade of adoption of the agency model, we suggest the answer depends, among other things, on the degree of competitive pressures upstream, and the use or the non-use of ancillary contract provisions such as retail MFN clauses.

The rest of the paper is organized as follows. In Section 2, we provide an overview of the related literature. In Section 3, we present the model. First, we compare an industry-wide adoption of business formats where revenue-sharing splits are given. Then we analyze a setting where downstream firms determine their revenue-sharing splits. Finally, we consider asymmetric market structures in which only one downstream firm uses the agency model. In Section 4, we allow the downstream firms to choose their business format. Finally, in Section 5, we offer concluding remarks.

¹²As noted in the e-books case (footnote 1) "*While Publishers could theoretically raise e-book prices in the iBookstore above the \$9.99 price point to the top of the Apple pricing tiers, unless the Publishers moved all of their e-tailers to an agency model and raised e-book prices in all of those e-bookstores, Apple would be selling its e-books at its competitors' lower prices.*" p. 48

2 Related Literature

We are aware of four papers that have been inspired by Apple’s use of the agency model. They are Gans (2012), Abhishek et al. (2012) and Johnson (2013a, 2013b). All have significant differences from our work. Gans’ (2012) focus is on the hold-up problem that may arise if consumers must undertake specific investments in order to have platform access prior to the upstream firms’ choosing prices. Abhishek et al. (2012) focus on the relationship between printed books and e-books. Johnson (2013a) is interested in consumer lock-in, and looks at a two-period model of purchases. Like us, Johnson (2013b) analyzes the effects of Apple’s MFN. He shows that the MFN eliminates firms’ incentives to compete in revenue shares. When revenue shares are given, the MFN has no effect on retail prices in his model. In contrast, we show that an MFN can have real effects in an asymmetric business structure, where only one firm uses the agency model (even if revenue shares are given).

Another key difference concerns the benchmark used for comparisons. Both Johnson (2013a, 2013b) and Abhishek et al. (2012) compare the outcome under the agency model in which (i) the downstream firms have all the bargaining power, (ii) the upstream firms set the retail prices, and (iii) revenues are shared according to a fixed revenue-sharing rule, to the outcome under an alternative model in which (i) the upstream firms have all the bargaining power, (ii) the downstream firms set the retail prices, and (iii) unit wholesale prices are used instead of revenue splits. In contrast, we compare the outcome under the agency model to the outcome under an alternative model in which the downstream firms set the retail prices, with all else being equal. This allows us to keep the focus solely on the competitive effects of transferring the control of retail prices upstream. It also allows us to avoid double marginalization, which is the main factor that leads to lower retail prices under the agency model in their frameworks. Here, when conditions are such that the agency model leads to lower retail prices, it is not because double marginalization is avoided.

Our assumption that contract terms are always set prior to retail prices contrasts with the assumptions in Dobson and Waterson (2007), who were the first to consider the effects of industry-wide RPM. They assume that the timing of the game depends

on which side sets the prices. If retail prices are determined by the downstream firms (no RPM), they assume that prices are chosen after the wholesale prices are determined (there is no revenue sharing in their model). However, they assume the opposite timing with RPM. We discuss briefly this alternative timing in Section 3.2.2, although we note here that although such an extensive form may be appropriate in some cases, it does not seem to fit the cases which have motivated this paper. Apple's 70%/30% revenue-sharing rule, for instance, is certainly set prior to retail prices.

Outside of this immediate circle of literature, there exists a broader literature which focuses on how to find the minimum number of vertical restraints sufficient to maximize total channel profit. In a recent paper, Hagiu and Wright (2013) analyze the interplay between who decide retail prices and the incentives to undertake non-contractible effort like marketing activities. However, they do not focus on the agency model. Mathewson and Winter (1984) show how a combination of a two-part tariff and RPM may be used to achieve the integrated channel outcome in a setting in which downstream firms undertake market expanding sales effort with potential spillovers (see also Iyer, 1998). In addition, revenue-sharing rates which are set prior to price competition have been shown to be an alternative to lump-sum fixed fees. Lal (1990), for example, shows that revenue-sharing may be used as an additional instrument to a two-part tariff in a context where upstream and downstream firms undertake non-contractible sales efforts (see also Rao and Srinivasan, 1995). However, our approach is different, since we aim to analyze what outcomes may be achieved with the instruments actually incorporated in the agency model. Like our paper, Cachon and Lariviere (2005), Dana and Spier (2001), and Mortimer (2008) are motivated by observed contracts.¹³

Lastly, as we alluded to earlier, one can think of the transfer of pricing control to the upstream firms as a commitment device to dampen competition. In this sense, our analysis ties into the vertical-contracting literature that looks at strategic delegation (for example, see McGuire and Staelin, 1983; Coughlan, 1985; Moorthy, 1988; Bonanno and Vickers, 1988; and Coughlan and Wernerfelt, 1989; among others).

¹³These papers focus on the revenue-sharing contracts used in the video rental industry, and show how they may be used to solve channel coordination problems related to inventory choices.

3 The Model

We consider a market with two competing upstream firms, $j = 1, 2$ (superscripts on the variables), and two competing downstream firms, $i = 1, 2$ (subscripts on the variables). The upstream firms could for instance be ebook publishers or developers of apps and the downstream firms could be platform providers such as Apple, Google and Amazon. For simplicity, we assume that each upstream firm j produces a single good, good j , which it then distributes to both downstream firms for subsequent resale to final consumers.¹⁴

We assume the following inverse demand curve for good j at downstream firm i :

$$P_i^j = 1 - (q_i^j + \beta q_{-i}^j) - \gamma (q_i^{-j} + \beta q_{-i}^{-j}). \quad (1)$$

This then gives rise to the following direct-demand system:

$$q_i^j = \frac{(1 - \gamma)(1 - \beta) - P_i^j + \gamma P_i^{-j} + \beta (P_{-i}^j - \gamma P_{-i}^{-j})}{(1 - \gamma^2)(1 - \beta^2)}. \quad (2)$$

This demand system has been used by Dobson and Waterson (1996, 2007) and others and found to be tractable in settings like ours with upstream and downstream competition. Importantly, it allows for independent parameters to capture differences in the intensity of rivalry between downstream firms and between products.

In particular, the parameter $\gamma \in [0, 1)$ captures how similar consumers perceive goods 1 and 2 to be when sold by the same downstream firm. The goods are demand independent if $\gamma = 0$ and perfect substitutes if $\gamma \rightarrow 1$. One can thus think of γ as a measure of the degree of inter-brand rivalry. Similarly, the parameter $\beta \in [0, 1)$ captures the substitutability between downstream firms when they sell the same goods. For brick-and-mortar retailers (e.g. bookstores), the size of β may reflect a geographical dimension. If $\beta = 0$, the downstream firms are sufficiently far from each other that they do not compete, while if $\beta \rightarrow 1$, they are co-located and perceived as perfect substitutes. In contrast, for digital platforms (selling e.g. e-books or apps), which do not have a geographic dimension, the size of β may reflect

¹⁴Our set-up differs from that of most of the vertical-contracting literature, which typically assumes that either (i) an upstream monopolist sells its product through multiple competing retailers or (ii) multiple competing upstream firms sell their products through exclusive dedicated retailers.

how differentiated their services are. If consumers perceive the services to be good substitutes, then β is high. If not, then β is low. One can thus think of β as a measure of the degree of intra-brand rivalry. The perceived similarity of goods 1 and 2 when sold by different retailers is thus increasing in the interactive term $\beta\gamma$.

For simplicity, we normalize all production and distribution costs to zero. Thus, the profit of downstream firm i given revenue share s_i is given by

$$\Pi_{Di} = s_i (P_i^1 q_i^1 + P_i^2 q_i^2), \quad (3)$$

and the profit of upstream firm j given revenue shares s_1 and s_2 is given by

$$\Pi^{Uj} = (1 - s_1) P_1^j q_1^j + (1 - s_2) P_2^j q_2^j. \quad (4)$$

In these expressions, downstream firm D_i keeps share $s_i \in [0, 1)$ of the revenue it earns from selling both products, whereas upstream firm U_j keeps share $1 - s_1$ of the revenue D_1 earns, and $1 - s_2$ of the revenue D_2 earns, from selling product j . For now, the revenue-share splits s_i are assumed to be exogenous. This assumption is consistent with Apple’s “one size fits all” approach, in which the same revenue share is used in different industries (Apple’s split is 70/30 for music, apps, and e-books).

In what follows, we compare the outcome where the downstream firms determine retail prices (no RPM) to the outcome where the upstream firms do so (RPM). In the case of Apple, we note that it has used the former business format when entering music distribution with iTunes, whereas it has used the latter format for apps in its App Store and e-books in its iBookstore. Following convention, we will refer to the format where the upstream firms determine the retail prices as the “agency model”.

As a benchmark, it is straightforward to show using the demands in (2) that industry profits are maximized by setting $P_i^j = P_I = \frac{1}{2}$. The optimal prices from the industry’s point of view are thus independent of how similar consumers perceive the goods and downstream services to be. However, less diversity does decrease the size of the market. Inserting the industry-profit maximizing prices into (2) yields

$$q_i^j = q_I = \frac{1}{2(1 + \beta)(1 + \gamma)} \quad \text{and} \quad \Pi_I = \frac{1}{(1 + \beta)(1 + \gamma)}.$$

Here we see that the aggregate quantity (over all firms) and industry profits are

decreasing in both β and γ . This is a standard property of quadratic utility functions and holds quite generally when we have convex preferences/heterogenous consumers.

3.1 No RPM

Without RPM, downstream firm i 's optimization problem is

$$\max_{P_i^1, P_i^2} \Pi_{Di}. \quad (5)$$

Solving for the Nash equilibrium prices yields

$$P^{NO\ RPM} = \frac{1 - \beta}{2 - \beta}. \quad (6)$$

Since s_i is common to both goods and enters (5) multiplicatively, firm i 's profit-maximizing prices are independent of s_i . It follows that the Nash equilibrium prices will also be independent of the downstream firms' revenue shares. This yields:

Lemma 1: *Assume no RPM. Retail prices are independent of whether D_1 uses a different revenue share than D_2 ($s_1 \neq s_2$) or the same revenue share ($s_1 = s_2$).*

The case of no RPM resembles Apple's business format when they entered the music industry. According to Steve Jobs' biography (Isaacson, 2011), whereas all upstream firms (providers of music) were offered the same 70/30 split of revenues, it was Apple alone which decided that the retail price should be 0.99 cents per song.¹⁵

An immediate implication of Lemma 1 is that whether Amazon, Google, or some other downstream platform matches Apple and offers the same 70/30 split of revenues does not matter for pricing as long as the downstream firms retain control.

To push this result further, note that for there to be an effect on pricing, a platform would have to offer different revenue splits to the upstream firms (which is not, to our knowledge, how Apple's policy works). To see this, consider the possibility that downstream firm i requires different revenue shares from U_1 and U_2 (in contrast to Apple's actual policy, which requires a 70/30 split from all firms).

¹⁵Apple's retail price for iTunes may have been purposely set lower than normal to stimulate the sale of its iPods. For simplicity, we have abstracted from the sales of complementary goods.

Then, we can define $\tilde{\Pi}_{D_i} = s_i^1 P_i^1 q_i^1 + s_i^2 P_i^2 q_i^2$, and D_i 's optimization problem becomes

$$\max_{P_i^1, P_i^2} \tilde{\Pi}_{D_i}.$$

The corresponding FOCs are given by

$$\frac{d\tilde{\Pi}_{D_i}}{dP_i^1} = s_i^1 \left[q_i^1 + P_i^1 \frac{dq_i^1}{dP_i^1} \right] + s_i^2 P_i^2 \frac{dq_i^2}{dP_i^1} = 0.$$

Here, we see that the optimal level of P_i^1 , and hence the Nash equilibrium prices in this case, does indeed depend on revenue shares. This yields the following result:

Proposition 1: *Assume no RPM. Retail prices are independent of revenue shares if and only if D_i requires the same share s_i from each upstream firm for $i = 1, 2$.*

This finding contrasts with the case of RPM, to which we now turn.

3.2 RPM: Industry-wide adoption of the agency model

Let us now consider the case of an industry-wide adoption of the agency model. In this case, the upstream firms determine the retail prices (RPM). U_j 's problem is

$$\max_{P_1^j, P_2^j} \Pi^{U_j}.$$

This setting accords with Apple's agency model towards upstream firms in App Store and iBookstore. The upstream firms set the retail prices and all are offered the same revenue share. For now, we assume that rival platforms have similar policies.

In what follows, we focus on pure-strategy equilibria in which both downstream firms sell both products ($q_i^j > 0$). The FOC for U_j when it determines D_1 's retail price (with a similar expression for determining D_2 's retail price) is then given by

$$\frac{d\Pi^{U_j}}{dP_1^j} = (1 - s_1) \left[q_1^j + P_1^j \frac{dq_1^j}{dP_1^j} \right] + (1 - s_2) P_2^j \frac{dq_2^j}{dP_1^j} = 0. \quad (7)$$

We see from the second term in (7) that the marginal profitability of increasing the price P_1^j is decreasing in s_2 if consumers perceive the downstream firms as (imperfect) substitutes (i.e., if $\frac{dq_2^j}{dP_1^j} > 0$). This means that for a given s_1 , the optimal level of

P_1^j will be lower the higher is s_2 . This result follows because if D_2 requires a larger share of its sales revenue, then the upstream firm will have incentives to sell more through D_1 and less through D_2 . For the same reason, P_1^j will be increasing in s_1 .¹⁶

Solving $\{P_1^j, P_2^j\} = \arg \max \Pi^{Uj}$ for $j = 1, 2$, we find

$$P_i = \frac{(1 - \gamma) (1 - \beta^2) \left[\frac{1 - s_i + \beta(1 - s_{-i})}{(1 - s_i)(1 + \beta)} + (1 - \gamma) \right]}{d}, \quad (8)$$

where $d \equiv (2 - \gamma)^2 - \beta^2 \gamma^2 - \frac{(1 - \gamma)\beta^2(2 - s_1 - s_2)^2}{(1 - s_1)(1 - s_2)} > 0$ whenever the second-order conditions hold and the revenue shares s_1, s_2 are less than one. We henceforth restrict the analysis to parameter values for which $d > 0$. Note that the term in the square bracket is positive. This implies that P_i is strictly positive if there is imperfect competition both at the upstream and the downstream levels; i.e. if $\beta, \gamma \in (0, 1)$.

Since the upstream firms are symmetric, it follows that each will set the same retail price for D_i . We have therefore omitted the superscript on P_i in equation (8). However, in accordance with FOC (7), we find that if D_i has a higher (lower) revenue share s_i than its rival, then the retail price it faces will also be higher (lower):

$$P_i - P_{-i} = (s_i - s_{-i}) \frac{(1 - \gamma) \beta (1 - \beta) (2 - s_1 - s_2)}{d (1 - s_1) (1 - s_2)} \geq 0 \text{ if } s_i \geq s_{-i}.$$

From equation (8), we can therefore verify the following:

Proposition 2 (the agency model): *Assume RPM. Retail prices differ if the downstream firms require different revenue shares ($P_i \neq P_{-i}$ if $s_i \neq s_{-i}$). Given s_{-i} , an increase in s_i induces the upstream firms to increase P_i and reduce P_{-i} . Other things equal, these price changes are greater the larger is the substitution between downstream firms β and the smaller is the substitution between upstream firms γ .*

In contrast to the case of no RPM, we thus see that if one downstream firm has a higher revenue share than its rival, it will also have higher retail prices as well.

Proposition 2 reflects the fact that an upstream firm which increases the retail price at one downstream firm and reduces it at the other need not lose much in aggregate sales. The main effect might rather be to shift sales to the downstream

¹⁶Note that the bracketed expression in (7) must be negative because $dq_2^j/dP_1^j > 0$ for $\beta > 0$.

firm which has become more competitive. This is more likely to be the case the closer substitutes the downstream firms are perceived to be in the eyes of the consumers. For this reason dP_i/ds_i is more negative (and dP_{-i}/ds_i more positive) the larger is β . Conversely, if the upstream firms produce goods which the consumers perceive as close substitutes, then an upstream firm which unilaterally increases its retail price at one downstream firm may lose a larger share of its sales to its upstream rival.

Now consider the special case in which $s_i = s_{-i}$ (because the firms are symmetric, one would expect this case to arise if the s 's were endogenous) and continue to assume that both goods are sold by both retailers. Then retail prices under RPM become

$$P^{RPM}|_{s_i=s_{-i}} = \frac{1 - \gamma}{2 - \gamma}. \quad (9)$$

By comparing (6) and (9) we have the following result:

Proposition 3: *Retail prices will be higher with RPM than without RPM in any equilibrium in which both goods are sold and $s_i = s_{-i}$ if and only if the degree of substitution is lower at the upstream level than it is at the downstream level ($\gamma < \beta$).*

Since equilibrium retail prices under both formats (RPM and no RPM) are below the level that would maximize industry profits ($P_I = \frac{1}{2}$), it follows that the downstream firms will uniformly prefer the format that yields higher retail prices other things equal (i.e., abstracting from (i) cost differences that might arise from implementing the different formats, and (ii) consideration of the profits that may be earned from the sale of complementary products). As a first approximation, it thus follows that:

Corollary 1: *In any equilibrium in which (i) both goods are sold, (ii) $s_i = s_{-i}$, and (iii) other things are equal, RPM will tend to increase the profit of each firm if competitive pressures are lower upstream ($\gamma < \beta$). In contrast, RPM will tend to reduce the profit of each firm if competitive pressures are greater upstream ($\gamma > \beta$).*

Transferring control of retail pricing to the level where the degree of competition is lower brings prices closer to the ones that maximize industry profit. Thus, other things equal, one would expect downstream firms to prefer the agency model when

competitive pressures are lower upstream. If competitive pressures are greater upstream, one would not expect downstream firms to prefer the agency model unless there are countervailing forces in play (e.g., sales of complementary products that would increase when retail prices are lower) and these forces are sufficiently strong.

This yields new insights when comparing the use of the agency model in the market for apps (App Store) versus its use in the market for e-books (iBookstore). Although the same format is used in both markets, the reasons why may be different.

Consider first the use of the agency model in the market for apps. Apps are distributed by large numbers of upstream firms through distribution channels such as Apple’s App Store and Google’s Google Play. It seems clear that, in these markets, transferring control of retail pricing to the upstream firms (developers of apps) is likely to increase competition. In the context of our model, this corresponds to a γ that is relatively high compared to β and is consistent with widespread complaints from app developers in Apple’s App Store that profits are low (Boudreau, 2012).

Why then does Apple use the agency model and give developers control of the retail prices? We suspect the reason may be related to factors outside the model which act as countervailing forces. For example, Boudreau (2012) suggests that Apple may have ceded control of the retail prices to encourage innovation by “letting a thousand flowers bloom”.¹⁷ It may also be the case that lower prices on apps benefit Apple (and other platforms) in ways that are not considered here (e.g., by increasing the sale of complementary products, such as the iPhone, which yield an additional source of profit for the downstream firms). Our model suggests that these factors must not only weigh in favor of the agency model, they must also be sufficiently strong to overcome the disadvantage of the increased competition we identify here.

Now consider the use of the agency model in the market for e-books. Before Apple entered the market with iBookstore, downstream firms were responsible for determining retail prices for both printed and digital books (see Department of

¹⁷Foros, Hagen, and Kind (2009) show how a monopoly platform may balance this trade-off by using a price-dependent profit sharing rule implemented by Scandinavian mobile providers in the market for mobile content messages. The business format used by mobile providers for such content messages may be considered as the first-generation app stores.

Justice (DoJ), 2012).¹⁸ After Apple’s entry in the market for e-books, however, there was a rapid (and almost) industry-wide transition to the agency model during the Spring of 2010. DOJ’s claim is that Apple’s motivation for instigating this transition was to stop the low prices set by Amazon on e-books, described as “the \$9.99-problem” by publishers. It cites Steve Jobs (from Isaacson, 2011): “*We’ll go to [an] agency model, where you set the price, and we get our 30%, and yes, the customer pays a little more, but that’s what you want anyway*” as evidence of this.

In our set-up, the introduction of the agency model would be expected to lead to higher retail prices when competitive pressures are lower upstream than they are downstream. This is likely to be the case in the market for e-books because of the relatively small number of upstream firms (see DOJ, 2012) and differentiated content of the books. Moreover, it was widely understood that it was in the interest of the upstream firms to protect the profits they earn from selling printed books, which would make upstream competition on e-books even softer than it might be otherwise.¹⁹ Combined with Amazon’s penchant for setting low ebook prices (perhaps motivated by its desire to increase sales of its ebook reader Kindle), one might reasonably have conjectured that retail prices would be higher in the agency model.²⁰ This seems to be the reason why Jobs expected prices to rise when it was introduced (Isaacson, 2011): “*Amazon screwed it up. It paid the wholesale price for some books, but started selling them below cost at \$9.99. The publishers hated that—they thought it would trash their ability to sell hardcover books at \$28. So before Apple even got on the scene, some booksellers were starting to withhold books from Amazon.*”

It is therefore not surprising that Apple wanted to use the agency model in the market for e-books. The motivation behind transferring control of retail prices to the upstream firms (publishers) was probably not to let a thousand flowers bloom

¹⁸This is the so-called wholesale model. Unit wholesale prices were specified as a percentage rate of the cover price but downstream firms were free to set their retail prices below the cover prices.

¹⁹We do not explicitly incorporate these additional sources of profit into the model. The effects of these sources on the firms’ pricing incentives may, however, be interpreted into β and γ . For example, with publishers wanting to protect the profits they earn from their printed books, this would have the effect of lowering γ . And, with Apple wanting to stimulate sales of complementary products like music players, tablets and smartphones, this would have the effect of increasing β .

²⁰Amazon’s motivation for having low retail prices was allegedly to stimulate sales of its ebook reader, Kindle, similar to what Apple allegedly did with music prices to stimulate its iPod sales.

(stimulate more innovation among publishers) but rather to dampen competition.²¹

3.2.1 The agency model: downstream firms decide revenue shares

We now analyze how downstream firms 1 and 2 might set revenue shares when these are determined prior to the upstream firms' decisions on retail prices. Notice that when both downstream firms sell both goods ($q_i^j > 0$), equilibrium prices in stage 2 are given by (8). It follows that in stage 1, D_i chooses s_i to maximize Π_{D_i} , where

$$\Pi_{D_i} = s_i (P_i^j q_i^j + P_i^{-j} q_i^{-j}).$$

Upstream symmetry implies that the upstream firms set the same prices at any downstream firm ($P_i^j = P_i^{-j} = P_i$), so we can write D_i 's first-order condition as

$$\frac{d\Pi_{D_i}}{ds_i} = 2P_i q_i + 2s_i \left(P_i \frac{dq_i}{ds_i} + q_i \frac{dP_i}{ds_i} \right) = 0. \quad (10)$$

From (10), we have the following candidate for a symmetric equilibrium:

$$s_i = s^* \equiv (1 - \beta^2) \left(1 + \gamma \frac{\beta}{2 - \gamma(1 + \beta)} \right); \quad \frac{ds^*}{d\beta} < 0 \text{ and } \frac{ds^*}{d\gamma} > 0. \quad (11)$$

The intuition for why s^* depends on β and γ in the way that it does follows from Proposition 2, which *de facto* tells us that the opportunity cost to a downstream firm of increasing its revenue share is higher the greater is the substitution downstream (the higher is β) and the weaker is the substitution upstream (the smaller is γ).

With $s_1 = s_2 = s^*$, the downstream firms' equilibrium profits simplify to

$$\Pi_{D_i}^* = \frac{2(1 - \gamma)(1 - \beta)}{[2 - \gamma(1 + \beta)](2 - \gamma)(1 + \gamma)}.$$

It remains to characterize the conditions under which s^* constitutes a Nash equilibrium. To this end, it is useful first to understand why s^* must be less than one. Note that if instead a downstream firm attempted to grab 100% of the revenue, it would be a best response of the rival downstream firm to set s to be slightly less

²¹Indeed, Apple hoped that Amazon might also be persuaded to transfer control of retail prices to the upstream firms so that competition could be more fully dampened. “*To ensure that the iBookstore would be competitive at higher prices, Apple concluded that it needed to eliminate all retail price competition. Thus, the final component of its agency model required the Publishers to move all of their e-tailers to agency.*” (United States v. Apple Inc, 12 Civ. 2826 (DLC), p. 40).

than one. The upstream firms would then choose to sell only to the downstream firm that gave them positive surplus. This would foreclose the downstream firm that was setting $s = 1$, making the firm's rival better off. It follows therefore that competition among the downstream firms will ensure that $s^* < 1$ in any equilibrium.

More generally, suppose $s_1 = s^*$. Inserting (11) into (2) and (8) we can write

$$q_1 = \beta \frac{(1 - \gamma) [2 - (1 + \beta) \gamma] s_2 - (1 - \beta)^2 (2 - \gamma)}{d [2 - \gamma (1 + \beta)] (1 - s^*) (1 + \gamma)}. \quad (12)$$

Thus, if D_1 sets $s_1 = s^*$, it will be foreclosed from the market if $s_2 \leq s_2^f$, where

$$s_2^f \equiv \frac{(1 - \beta)^2 (2 - \gamma)}{(1 - \gamma) [2 - \gamma (1 + \beta)]} > 0; \quad \frac{ds^f}{d\beta} < 0 \text{ and } \frac{ds^f}{d\gamma} > 0.$$

Intuitively, $\text{sign} \frac{ds^f}{d\beta} = \text{sign} \frac{ds^*}{d\beta} < 0$ because $s_1 = s^*$ is decreasing in β and a smaller s_1 requires a smaller s_2 to foreclose D_1 from the market. Analogously, $\text{sign} \frac{ds^f}{d\gamma} = \text{sign} \frac{ds^*}{d\gamma} > 0$. It follows that a symmetric equilibrium in pure strategies in which downstream firms set revenue shares is more likely to exist the more intense is downstream competition and the weaker is upstream competition.

It remains to check the conditions under which at $s_1 = s^*$ it will not be profitable for D_2 to foreclose D_1 from the market. Setting $s_1 = s^*$ and $s_2 = s_2^f$, we find that

$$\Pi_{D_2}^f = 2 \frac{(1 - \beta)^2}{[2 - \gamma (1 + \beta)] (2 - \gamma) (1 + \gamma)},$$

and therefore foreclosure will not be profitable if

$$\Pi_{D_i}^* - \Pi_{D_2}^f = \frac{2(1 - \beta)}{(2 - \gamma (1 + \beta)) (2 - \gamma) (1 + \gamma)} (\beta - \gamma) > 0.$$

Since the numerator and denominator are strictly positive, it follows that foreclosure will not be profitable if $\beta > \gamma$. Setting $\beta > \gamma$ into (11) shows that $s^* < 1$ in the relevant area. Remarkably, we thus have a Nash equilibrium in pure strategies if and only if the imposition of RPM increases joint profits (see Appendix for proofs):

Proposition 4: *Suppose competitive pressures downstream are greater than competitive pressures upstream ($\beta > \gamma$). Then, in the modified game in which revenue shares are endogenous and chosen prior to the firms' decisions on retail prices,*

there exists a symmetric equilibrium in which the non-cooperative revenue-share is $s^* \in (0, 1)$. The share is decreasing in β and increasing in γ ; $s'(\beta) < 0$ and $s'(\gamma) > 0$.

This suggests that the result that retail prices and industry profits may be higher with RPM than without RPM is robust, even when revenue shares are endogenous.

3.2.2 Some more implications

In any equilibrium in which $s_i = s_{-i}$, we have seen that the equilibrium price under RPM is given by $P^{RPM} = (1 - \gamma) / (2 - \gamma)$. This implies that greater substitutability (less differentiation) between the upstream goods will unambiguously reduce equilibrium prices and, since the size of the market will be smaller, also industry profits. However, surprisingly, this does not necessarily mean that downstream profits will be lower. The reason is that a higher γ increases the downstream firms' revenue shares; $ds^*/d\gamma > 0$. From the downstream firms' perspective we thus have a trade-off with respect to the degree of differentiation among the upstream firms:

$$\frac{d\Pi_{Di}}{d\gamma} = 2 \left\{ \underbrace{s[P'(\gamma)q + Pq'(\gamma)]}_{-} + \underbrace{s'(\gamma)Pq}_{+} \right\} \underset{\geq}{\leq} 0.$$

This yields the following result:

Proposition 5: *Even though more upstream competition leads to lower equilibrium retail prices and industry profits in the agency model, downstream profits might nevertheless increase when revenue shares are endogenous and can adjust accordingly.*

Proposition 5 points to a novel feature of the analysis. The lower is the degree of upstream competition (the smaller is γ), the higher is the share of revenues that downstream firms have to offer upstream firms. Innovation into more unique content (leading to a smaller γ) at the upstream level might therefore harm downstream firms, even if it would increase both the size of the market and equilibrium prices.

Timing of the game

It seems reasonable to assume that terms of trade are decided prior to decisions on retail prices (with and without RPM). Without RPM, we often observe that the

terms of trade consist of a unit wholesale price. One example is the conventional business format for books in the US (the wholesale model), where publishers determine a unit wholesale price prior to the bookstores' decisions on retail prices. In contrast, in several European book markets, RPM is used. There, the terms of trade involve revenue sharing instead of unit wholesale prices. Thus, the business format in European countries where RPM is used resembles the agency model. This raises the question, why switch from a unit wholesale price to revenue sharing when control of the retail prices is transferred from downstream firms to upstream firms?

We now show the following:

Proposition 6: *Suppose unit wholesale prices are used instead of revenue sharing in the agency model. Then, even if the downstream firms are in a position to make take-it-or-leave-it contract offers, all profits will be captured by the upstream firms.*

The proof of this is straightforward. For a fixed unit wholesale price w_i from downstream firm i , upstream profit maximization is equivalent to maximizing sales. It follows immediately that each upstream firm j will choose $P_i^j = w_i$. Setting a higher retail price than this would cause its own sales to decrease, reducing profits. Setting a lower retail price than this would violate downstream firm i 's participation constraint and cause it to exit the market before any sales are made to consumers.

This result contrasts sharply with the case we have been considering, where the downstream firms use revenue sharing in stage 1 to earn positive profits unless there is perfect competition downstream. It follows therefore that from the downstream firms' perspective, revenue sharing dominates unit wholesale prices under RPM.²²

3.3 Only one downstream firm uses the agency model

We now consider asymmetric business formats. Specifically, we analyze the case in which D_1 uses RPM (the agency model) but D_2 does not. This means that D_2

²²It is interesting to note that in their seminal work on industry-wide RPM, Dobson and Waterson (2007) do not allow firms to engage in revenue sharing. They only allow unit wholesale prices. Presumably to get around the problem we identify, they assume that in the absence of RPM, retail prices are determined after wholesale prices, whereas with RPM, retail prices are determined (by the upstream firms) before wholesale prices. Hence, there is a switch in timing with respect to the terms of trade in their model when control of the retail prices is transferred to the upstream firms.

decides P_2^1 and P_2^2 while upstream firm j decides P_1^j ($j = 1, 2$). We assume that retail prices are chosen simultaneously. We also assume that downstream firms' revenue shares are the same ($s_1 = s_2 = s$). The maximization problems are thus given by

$$\max_{P_1^1} \Pi^{U1} = \sum_{i=1}^2 (1-s) P_i^1 q_i^1, \quad \max_{P_1^2} \Pi^{U2} = \sum_{i=1}^2 (1-s) P_i^2 q_i^2, \quad (13)$$

and

$$\max_{P_2^1, P_2^2} \Pi_{D2} = s \sum_{j=1}^2 P_2^j q_2^j. \quad (14)$$

From (13) and (14), we obtain four FOCs. Because the FOCs for U_1 and U_2 are symmetric, and the two FOCs for D_2 are symmetric, it follows that $P_1^1 = P_1^2 = P_1$ and $P_2^1 = P_2^2 = P_2$. Using this, we obtain the following two "reaction functions":²³

$$P_1 = \frac{1-\beta}{2} \left(1 - \frac{\gamma}{2-\gamma} \right) + \beta P_2 \quad (15)$$

and

$$P_2 = \frac{1-\beta}{2} + \frac{\beta P_1}{2}. \quad (16)$$

Notice that (16) does not depend on the degree of substitution upstream. This is because D_2 cares only about how fiercely it competes with its downstream rival when it chooses its retail prices. If its rival were also setting retail prices, then $P_1 = P_2$ and the solution to (16) would be the same as in the symmetric no RPM case: $P_1 = P_2 = \frac{1-\beta}{2-\beta}$. In contrast, (15) does depend on the degree of substitution upstream. In this case, it is the upstream firms who are setting prices at D_1 . If they were also setting prices at D_2 (i.e., if D_2 were also using RPM), then $P_1 = P_2$ and the solution to (15) would be the same as in the symmetric RPM case: $P_1 = P_2 = \frac{1-\gamma}{2-\gamma}$.

It follows that because (15) intersects the line $P_1 = P_2$ at $\frac{1-\gamma}{2-\gamma}$ and (16) intersects the line $P_1 = P_2$ at $\frac{1-\beta}{2-\beta}$, the unique intersection of the reaction functions will occur somewhere between these endpoints. It remains to see, however, whether the RPM price, given by P_1 , will be higher or lower than the no RPM price, given by P_2 .

Combining (15) and (16), and solving for the Nash equilibrium prices, we have

$$P_1^{RPM} = (1-\beta) \frac{2 - \beta\gamma + 2(\beta - \gamma)}{(2 - \beta^2)(2 - \gamma)}, \quad (17)$$

²³All SOCs and stability conditions are satisfied for $\gamma < 1$ and $\beta < 1$. See Appendix.

and

$$P_2^{NO\ RPM} = (1 - \beta) \frac{2 - \beta\gamma + (\beta - \gamma)}{(2 - \beta^2)(2 - \gamma)}. \quad (18)$$

The difference in the RPM prices at D_1 and the no RPM prices at D_2 is thus

$$P_1^{RPM} - P_2^{NO\ RPM} = (\beta - \gamma) \frac{1 - \beta}{(2 - \beta^2)(2 - \gamma)}. \quad (19)$$

Because (19) is positive if and only if $\beta > \gamma$, it follows that the retail prices of the firm that uses the agency model will be higher than the retail prices of the rival firm if and only if competitive pressures are greater downstream than they are upstream.

We illustrate reaction functions (15) and (16) in Figure 1 below. There we fix β at some $\beta = \hat{\beta}$. The reaction function (15) is given by $P_2(P_1)|_{\beta=\hat{\beta}}$. If $\beta = \hat{\beta} < \gamma$, the reaction function (16) is given by $P_1(P_2)|_{\beta=\hat{\beta}<\gamma}$. In this case, retail prices at D_1 are lower than at D_2 . In contrast, if $\beta = \hat{\beta} > \gamma$, the reaction function (16) is given by $P_1(P_2)|_{\beta=\hat{\beta}>\gamma}$. In this case, retail prices at D_1 are higher than at D_2 . We can also see from Figure 1 that the retail prices that arise in equilibrium when only one firm uses the agency model are bounded by the retail prices that arise in the symmetric RPM equilibrium (when both firms use the agency model) and the retail prices that arise in the symmetric no RPM equilibrium (when neither uses the agency model).

We thus have the following result:

Proposition 7: *Assume that only D_1 uses the agency model (adopts RPM). Then*

- (i) *retail prices at D_1 will be higher than retail prices at D_2 if and only if $\beta > \gamma$;*
- (ii) *retail prices will be lower than they are in a symmetric RPM equilibrium, and higher than they are in a symmetric no RPM equilibrium, if and only if $\beta > \gamma$;*
- (iii) *retail prices will be higher than they are in a symmetric RPM equilibrium, and lower than they are in a symmetric no RPM equilibrium, if and only if $\beta < \gamma$.*

See the appendix for proofs.

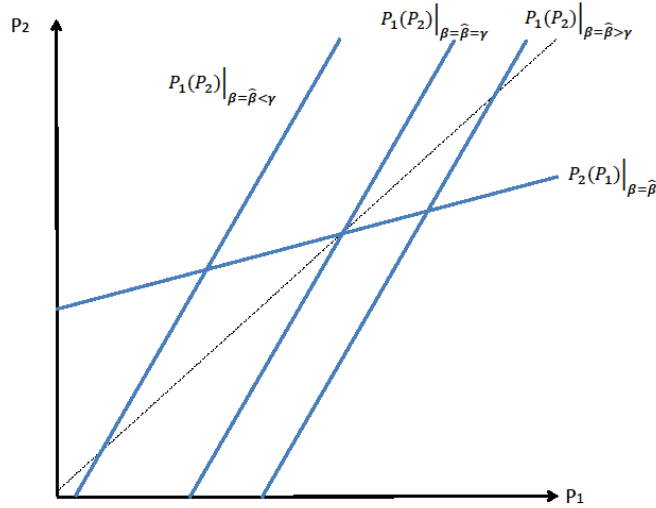


Figure 1: Reaction functions for U^j and D_2

To understand why D_1 does not always have higher prices, suppose first that $\beta = 0$. Since we then have no downstream competition, D_2 will simply set monopoly prices; $P_2^{NO\ RPM}(\beta = 0) = 1/2$. Retail prices at D_1 , on the other hand, will reflect the competitive pressure between the upstream firms, so that $P_1^{RPM}(\beta = 0) = \frac{1-\gamma}{2-\gamma}$ (i.e., the same price as would result from an industry-wide adoption of RPM). This means that $P_2^{NO\ RPM}(\beta = 0) > P_1^{RPM}(\beta = 0)$. More generally, prices at D_1 will be closely related to upstream competition, and prices at D_2 will be closely related to downstream competition. D_2 thus has more incentives to undercut D_1 's retail prices the stronger is downstream competition compared to upstream competition, and for $\beta > \gamma$ we have $P_2^{NO\ RPM} < P_1^{RPM}$. Note, however, that both retail prices are driven to marginal cost if $\beta \rightarrow 1$. This means that even if retail prices at D_1 are determined by the upstream firms, the Bertrand paradox cannot be avoided if the downstream firms are undifferentiated. A downstream firm which is more expensive than its rival in this case would lose all its sales, regardless of who has set the prices.

4 Choice of business format

We have considered the case of (i) no firm using RPM, (ii) both firms using RPM, and (iii) only one firm using RPM. In this section, we introduce an initial stage of the game in which the firms non-cooperatively decide whether to use RPM. This allows us to endogenize these choices. We will continue to assume that $s_1 = s_2 = s$.

Consider first whether both firms using RPM can be supported in equilibrium. This is an important question in light of the DOJ trial involving Apple and various book publishers regarding whether they “pressured” Amazon into adopting the agency model after it was introduced. If industry-wide adoption arises naturally in equilibrium, then our model would predict that no pressure was needed. But, if industry-wide adoption does not arise naturally, then our model would predict that something more (e.g., “pressure” or “threats”) would indeed have been needed.

As we will now show, whether both firms using RPM can arise in our game depends on (i) exogenous parameter conditions and (ii) the use or non-use of ancillary provisions such as retail MFN clauses (which Apple allegedly had in its contracts).

An equilibrium in which both firms use RPM can arise only if it is immune to profitable unilateral deviations. As above, let Π^{RPM} denote the profit of each downstream firm if both use RPM, and $\Pi_i^{only -i RPM}$ denote the profit of downstream firm i if only its rival uses RPM. A deviation from RPM is profitable for firm i if $d_i^{RPM} \equiv \Pi_i^{only -i RPM} - \Pi^{RPM} > 0$. Inserting from (9), (17) and (18) into (3) yields

$$\text{sign } d_i^{RPM} = \text{sign}(\beta - \gamma) \left((\beta - \gamma) - \frac{\beta^2(2 - \beta^2)}{(1 - \beta)(\beta + 1)^2} \right), \quad (20)$$

which implies that a deviation from RPM is profitable ($d_i^{RPM} > 0$) if and only if

$$\begin{aligned} \text{(i) } & \gamma > \beta \text{ or} \\ \text{(ii) } & \beta > \gamma \text{ and } \gamma < \gamma^* \equiv \max \left\{ \beta \frac{1 - \beta - \beta^2}{(1 - \beta)(1 + \beta)^2}, 0 \right\}. \end{aligned} \quad (21)$$

This is surprising. Although one might expect deviations from RPM to be profitable when competitive pressures are greater upstream than downstream, the second condition suggests that they can be profitable for low enough values of γ even when $\beta > \gamma$ (in particular, we find that $\gamma^* > 0$ for all $\beta \in (0, \beta^*)$, where

$\beta^* \equiv (\sqrt{5} - 1) / 2 \approx 0.618$). This is surprising because when γ is small, the competitive pressure between upstream firms is weak, in which case they should be able to charge prices which yield high channel profits. However, this is a case of a downstream firm deviating so as to capture a larger share of profits for itself; the $\gamma < \gamma^*$ inequality reflects the fact that if γ is small, downstream competition is especially important, and upstream firms do not take downstream profits into account per se.

Next, we consider whether firm D_{-i} would want to deviate if it is the only one using RPM. This depends on $d_{both}^{RPM} \equiv \Pi^{NO\ RPM} - \Pi_i^{only\ -i\ RPM}$, which simplifies to

$$\text{sign } d_{both}^{RPM} = \text{sign } (\beta - \gamma) \left((\beta - \gamma) - \beta^2 \frac{\beta - 2}{\beta^2 - 2} \right). \quad (22)$$

This implies that if D_i deviates from RPM then D_{-i} will also deviate from RPM if

$$\begin{aligned} \text{(i) } & \gamma > \beta \text{ or} \\ \text{(ii) } & \beta > \gamma \text{ and } \gamma < \gamma^{**} \equiv 2\beta \frac{1 - \beta}{2 - \beta^2}. \end{aligned} \quad (23)$$

Since $\gamma^{**} - \gamma^* = \beta^2 \frac{2 - \beta - \beta^2 + \beta^3}{(1 - \beta)(2 - \beta^2)(1 + \beta)^2} > 0$, we have that if condition (21) is satisfied, then condition (23) will also be satisfied (i.e., if D_i deviates from RPM, then it will also be in the interest of its rival to do so as well). The constraint $\gamma < \gamma^{**}$ is consequently not binding. Deviation from RPM is profitable if and only if $\gamma < \gamma^*$.

Lastly, we consider when firms might find it profitable to deviate when neither firm is using RPM. In this case, if firm i deviates and unilaterally adopts the agency model, its gain in profit will be equal to $d_i^{NO\ RPM} \equiv \Pi_i^{only\ i\ RPM} - \Pi^{NO\ RPM} = -d_{both}^{RPM}$. It follows that its gain will be positive only if $\gamma > \gamma^{**}$, and therefore, it follows that if $\beta > \gamma$ and $\gamma^* < \gamma < \gamma^{**}$ then we have an area with multiple equilibria.

Figure 2 sums up the discussion. Above the 45 degree line we have $\gamma > \beta$, and neither firm will use RPM. Below this line channel profits are maximized if both firms use RPM, but they will fail to do so if $\gamma < \gamma^*$. For $\gamma^* < \gamma < \gamma^{**}$ we have one equilibrium where they both choose RPM and one where neither one chooses RPM.

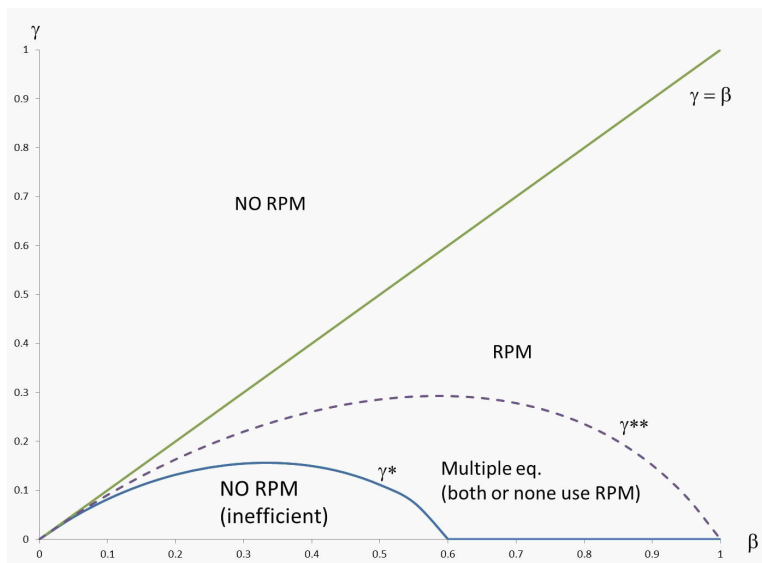


Figure 2: The choice of business format

Suppose $\beta > \gamma$ so that retail prices and industry profits are higher with RPM than without RPM. Then our main results in this section can be stated as follows:

Proposition 8: *Assume that $\beta > \gamma$. Then (i) if $\gamma < \gamma^*$, no firm uses RPM; (ii) if $\gamma^* < \gamma < \gamma^{**}$, there are multiple equilibria (either both downstream firms use RPM or neither downstream firm uses RPM), and (iii) if $\gamma > \gamma^{**}$, both firms use RPM.*

Returning to the question of whether firms would need to be “pressured” into adopting RPM — our results suggest that there would be no need to pressure firms into adopting RPM when retail prices and industry profits would be higher with RPM than without RPM and competitive pressures upstream are strong enough ($\gamma > \gamma^{**}$). However, “pressure” would be needed to induce industry-wide adoption of RPM when competition upstream is sufficiently weak ($\gamma < \gamma^*$). This in turn suggests that it may indeed be possible that no firm will adopt RPM even though industry-wide adoption of RPM might increase retail prices and industry profits.

4.1 Retail MFN as an ancillary restraint

We now consider whether a “most-favored-nation clause”, which was adopted by Apple in the market for e-books, may help to avoid such a prisoner’s dilemma. According to the facts in DoJ (2012), Apple’s contracts with ebook publishers contained

a “Most-Favored-Nation clause” (MFN). This clause prevented any publisher from selling its books at higher retail prices through Apple’s iBookstore than the books were sold for elsewhere, independent of whether Apple’s rivals also used RPM.²⁴

To investigate the effects of an MFN clause in our model, let us hold on to the assumption that only D_1 uses RPM. Then, from equation (19), it follows that D_1 will have lower prices than D_2 if $\gamma \geq \beta$, in which case an MFN would not be binding (see also Figure 1). In contrast, when $\beta > \gamma$, an MFN clause would be binding.

With a binding MFN clause, D_2 would be unable to undercut the prices set by the upstream firms through D_1 . Any attempt to do so would only force the upstream firms to follow suit with their own price cuts. Such a price-reducing strategy would therefore be profitable for D_2 only for prices above the cartel price. However, the cartel price cannot be an equilibrium. This is clear from the analysis above, which shows that the upstream firms will undercut each other if and only if $P > (1 - \gamma)/(2 - \gamma)$. It follows that $P = (1 - \gamma)/(2 - \gamma)$ is an equilibrium price.

Not surprisingly, there are a multiplicity of equilibrium prices. This is because the MFN creates a kink point in the reaction functions of the upstream firms. The next proposition characterizes the set of equilibria. The proof is in the appendix.

Proposition 9: *Assume D_1 has an MFN clause and that it is the only retailer that uses RPM. Then, if $\beta > \gamma$, any retail price in the interval $[P^{NO\ RPM}, P^{RPM}]$ can arise in any equilibrium in which both retailers sell both goods. More formally, if P^{MFN} denotes the equilibrium retail price under an MFN, then $P^{MFN} \in \left[\frac{1-\beta}{2-\beta}, \frac{1-\gamma}{2-\gamma}\right]$.*

Using equations (17) and (18) it can be seen that an MFN reduces retail prices at both outlets if $P^{MFN} = \frac{1-\beta}{2-\beta}$ and increases all retail prices if $P^{MFN} = \frac{1-\gamma}{2-\gamma}$. Thus, in principle, an MFN might increase consumer surplus and reduce channel profits or vice versa. However, even though there exists a continuum of equilibrium prices in the interval $\left[\frac{1-\beta}{2-\beta}, \frac{1-\gamma}{2-\gamma}\right]$, the maximum price in this set is arguably the most likely to

²⁴According to DOJ (2012): “[T]he MFN here required each publisher to guarantee that it would lower the retail price of each e-book in Apple’s iBookstore to match the lowest price offered by any other retailer, even if the Publisher Defendant did not control that other retailer’s ultimate consumer price.” A key aspect of the clause, which we emphasize, is that the MFN was expected to apply even if the ebook publisher did not control the rival retailer’s ultimate price to consumers.

arise. This is because any other price an upstream firm may set is weakly dominated (there is no gain — only potential costs — associated with setting a price below $\frac{1-\gamma}{2-\gamma}$).

Johnson (2013b) argues that MFNs have no impact on downstream prices under an industry-wide adoption of the agency model, and thus have no value. However our analysis suggests that an MFN might increase prices under an asymmetric structure when $\beta > \gamma$. Moreover, if firms expect $P = \frac{1-\gamma}{2-\gamma}$ when an MFN is imposed, the possibility that RPM might not be used when $\beta > \gamma$ (c.f. Proposition 8) is avoided.

One would therefore expect the MFN to be a binding constraint. If so, then this sheds additional light on why Apple may have insisted on having an MFN clause, given its history of preferring to stay in control of its retail prices. When the iPad was launched (January 2010), and Steve Jobs was asked why someone should buy a book from Apple for \$14.99 if the same book was offered for \$9.99 from Amazon, he responded (Isaacson, 2011): *That won't be the case The price will be the same.*

5 Conclusion

We set up a model with competition among upstream firms (content providers like publishers and developers of apps) and downstream firms (platform providers like Apple, Google and Amazon). In contrast to much of the literature, we assume that each downstream firm may sell each upstream firm's product (e-books, apps, etc.).

We focus on supply contracts that consist of revenue sharing. We first treat the revenue shares as exogenous and show that retail prices would be expected to be higher with the agency model than without the agency model if and only if the competitive pressure upstream is lower than the competitive pressure downstream. We next assume that downstream firms (such as Apple, Google and Amazon) are in position to offer revenue shares as take-it-or-leave-it contracts prior to the upstream firms' determination of retail prices. This is consistent with the widespread presumption that Apple, Amazon, and Google have significant bargaining power over the upstream firms. We find that despite the fact that the downstream firms can make take-it-or-leave-it offers, a key outcome of the model is that the upstream firms' participation constraints will in general not be binding. Thus, the upstream firms can

expect to earn positive profits in our model. We further show that the equilibrium revenue shares depend on competition at both levels. The greater the competition at the upstream level, the higher the revenue shares will be. The greater the competition at the downstream level, the lower the revenue shares will be. Lastly, we show that under asymmetric adoption of business formats (when not all firms use the agency model), retail MFN clauses may lead to higher equilibrium retail prices.

An interesting implication of how revenue shares are determined is that it creates an ambiguous relationship between product variety and downstream profits. On the one hand, we show that greater product variety (less substitution between goods) implies that retail prices with RPM will be higher. By itself, this is good for the downstream firms. On the other hand, we show that greater product variety reduces upstream competition, which may force downstream firms to increase the share of the revenues they offer to upstream firms. This is bad for the downstream firms. Put differently, we show that greater product variety might increase equilibrium prices and even the size of the market, but could nonetheless reduce downstream profits. As a result, product development that has the effect of increasing product variety and consumers' willingness to pay need not be profitable for the downstream firms.

6 Appendix

SOCs and stability conditions, Section 3.3

The second-order conditions for D_2 are fulfilled; $\frac{d^2_2 \Pi_{D_2}}{d(P_2^1)^2} = \frac{d^2_2 \Pi_{D_2}}{d(P_2^2)^2} = -\frac{2s}{(1-\beta^2)(1-\gamma^2)} < 0$; $\frac{d^2 \Pi_{D_2}}{d(P_2^1)^2} \frac{d^2 \Pi_{D_2}}{d(P_2^2)^2} - \left(\frac{d^2 \Pi_{D_2}}{dP_2^1 dP_2^2} \right)^2 = \frac{4s^2}{(1-\beta^2)^2 (1-\gamma^2)} > 0$ for $\beta, \gamma < 1$. For the upstream firms we likewise have $\frac{d^2 \Pi^{U_i}}{dP_{i1}^2} = -\frac{2(1-s)}{(1-\beta^2)(1-\gamma^2)} < 0$ for $\beta, \gamma < 1$ and $s < 1$.

The reaction function for U_i equals $P_1^i = \frac{(1-\beta)(1-\gamma) + \beta P_2^i + \gamma P_1^{-i} - \beta \gamma P_2^{-i}}{2}$, so that we have $\frac{dP_1^i}{dP_2^i} = \beta < 1$, $\frac{dP_1^i}{dP_1^{-i}} = \gamma < 1$ and $\left| \frac{dP_1^i}{dP_2^{-i}} \right| = \beta \gamma < 1$. For D_2 we find $P_2^i = \frac{s(1-\beta)(1-\gamma) + s\beta P_1^i + 2s\gamma P_2^{-i} - s\beta\gamma P_1^{-i}}{2}$, where again all price derivatives are smaller than one in absolute value. All stability conditions are thus satisfied.

Proof of Proposition 7

Proof: (i): follows from (19). (ii) Using (18) and (6) we find:

$$P_2 - P^{NO\ RPM} = (\beta - \gamma) \frac{\beta(1 - \beta)}{(2 - \beta)(2 - \beta^2)(2 - \gamma)} > 0 \text{ if } \beta > \gamma,$$

while (17) and (9) give us

$$P_1^{RPM} - P^{RPM} = -(\beta - \gamma) \frac{\beta}{(2 - \beta^2)(2 - \gamma)} < 0 \text{ if } \beta > \gamma.$$

(iii) then follows straightforward from (ii). ■

Proof of Proposition 8

Inserting for (17) and (18) into the profit functions we find

$$\begin{aligned} \Pi_{1D}^{RPM} &= \frac{2s(1 - \beta)(2 - \beta\gamma + 2(\beta - \gamma))(2 - \beta^2)}{D_1}, \quad \Pi_{2D} = \frac{2s(1 - \beta)(2 - \beta\gamma + (\beta - \gamma))^2}{D_1} \\ \Pi^{Ui} &= (1 - s)(1 - \beta) \frac{(8(1 - \gamma)(1 + \beta) - (\beta^2 - (\gamma + \beta\gamma)^2) - \beta^3(2 - \gamma))}{D_1}, \end{aligned}$$

where $D_1 = (1 + \beta)(1 + \gamma)(2 - \beta^2)^2(2 - \gamma)^2$. This implies that

$$\Pi_{1D}^{RPM} - \Pi_{2D} = \frac{2s(1 - \beta^2) \left(\frac{\sqrt{9 - 4\gamma + 3 - 2\gamma}}{2(2 - \gamma)} + \beta \right)}{(1 + \gamma)(2 - \beta^2)^2(2 - \gamma)(1 + \beta)^2} (\beta - \gamma)(\beta_0 - \beta),$$

where $\beta_0 = \frac{\sqrt{9 - 4\gamma - (3 - 2\gamma)}}{2(2 - \gamma)}$. We thus have $\Pi_{1D}^{RPM} - \Pi_{2D}$ for $\beta_0 < \beta < \gamma$. *Q.E.D.*

Proof of Proposition 9

To see that $P = (1 - \gamma)/(2 - \gamma)$ is not a unique equilibrium, suppose that all firms charge some arbitrary price $Q < \frac{1 - \gamma}{2 - \gamma}$. The MFN clause prevents the upstream firms from charging higher prices than D_2 does, and as just noted, they have no incentives to charge a lower price than $\frac{1 - \gamma}{2 - \gamma}$. The upstream will consequently not deviate from Q . Neither will D_2 have any incentives to price below Q ; that would only provoke correspondingly lower prices at D_1 , and unambiguously lower profit. So the question is whether D_2 have incentives to deviate upwards from Q . From the analysis of the NO-RPM equilibrium, we might expect that D_2 can profitably charge higher prices than its rival if and only if $Q < \frac{1 - \beta}{2 - \beta}$. To verify this conjecture, suppose that the

prices at D_1 equal $P_{11} = P_{21} = Q$, while D_2 charges $P_{12} = P_{22} = P_2$, which possibly is different from Q . We then find that

$$\left. \frac{d\Pi_{D_2}}{dP_{12}} \right|_{Q, P_2} = s \frac{(Q\beta - \beta + 1) - 2P_2}{(1 - \beta^2)(1 + \gamma)}.$$

If there were no constraints, D_2 would thus charge $P_2 = (Q\beta - \beta + 1)/2$. Using this, we find

$$P_2 - Q = \frac{2 - \beta}{2} \left(\frac{1 - \beta}{2 - \beta} - Q \right).$$

Since the MFN constraint implies that we must have $P_2 \geq Q$, it follows that D_2 can profitably deviate from Q (and charge a higher price) if and only if $Q < \frac{1-\beta}{2-\beta}$.

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