

Copyright Royalty Regulation and Competition in the Music Retail Market[†]

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Price control can restore efficiency in some cases, but an uncarefully designed policy fails to restore efficiency, yields side effects, or even exacerbates efficiency losses. This paper shows that the copyright royalty rule, which takes the greater of ad valorem royalties and per-unit royalties, tends to fix the prices of final goods at a specific level. Such a rule weakens competition as it prevents prices from decreasing even when market conditions change, having negative effects on social welfare as well as consumer surplus. Counterfactual analyses using estimation results in the Korean online music service industry show that firms could have profitably reduced prices if the ad valorem rule had been applied instead, although they did not have an incentive to do so under the original combination rule.

Key Word: Price Control, Copyright Royalty, Royalty Regulation,
Ad valorem Rule, Per-unit Rule, Combination Rule,
Online Music Service Industry

JEL Code: D43, L43, L51

I. Introduction

Price control is known to cause deadweight losses in general, as the transaction volume cannot reach the socially optimal level. On the other hand, there are some cases in which price control can restore efficiency, such as under a natural monopoly, for public goods, and/or when externalities exist. For these reasons, the Korean government tries to control price in many industries. However, in some cases, an uncarefully designed policy fails to restore efficiency, yields side effects, or even exacerbates efficiency losses. For instance, Cho (2014) and Cho (2015) show that price control in the book sales industry has a negative impact on social welfare.

This paper investigates the Korean online music service industry, showing that copyright royalty rules used to be designed to fix the price of the final good at a

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specific level, which weakens competition as it prevents prices from decreasing even when market conditions change. Copyright royalties are set by copyright trust management associations, but must be approved by the government. The purpose of the regulation is to keep the royalties from increasing above a reasonable level, as excessively high royalties would suppress the efficient use of creative works. Copyright trust management associations are granted a monopoly power in the copyright market and therefore have an incentive to set monopoly prices if not regulated. An ideal regulation for this purpose would be a price cap so that the royalties cannot exceed a certain level.

In practice, the Ministry of Culture, Sports and Tourism determines copyright royalties by itself, which is the strongest version of royalty regulation. The government claims that it tries to balance between copyright holders and consumers. The government, however, does not have competitiveness in choosing efficient price levels compared to the private sector. Therefore, it needs to refrain from choosing copyright royalties by itself. Instead, it can contribute by not approving anticompetitive copyright royalty rules submitted by copyright trust management associations. In other words, the government needs to compare the submitted rules with the existing rules and reject a submittal if the former are more anticompetitive than the latter. It can advise, but not force, copyright trust management associations to change their rules in a less anticompetitive manner.

The Ministry of Culture, Sports and Tourism used to do the opposite by employing anticompetitive copyright royalty rules by itself. More specifically, the royalties are set proportional to prices of final goods (*ad valorem*), but are guaranteed at a minimum amount (*per-unit*). This paper shows that such a rule yields lower consumer surplus as well as lower overall surplus. As the actual royalties are determined at the maximum of *ad valorem* and *per-unit* royalties (the combination rule, hereafter), firms are inclined to stick to the price level at which the two rules give the same royalties. This occurs because firms must pay more royalties when raising prices but the same royalties when lowering prices, and thus will not change their prices in the event of a marginal shock. Price stickiness yields a less efficient volume of transactions in some cases, which leads to lower consumer surplus. A theoretical analysis in Section 3 shows that the equilibrium price would be lower if the *ad valorem* rule applies instead, so the transaction volume, consumer surplus, and overall surplus are smaller under the combination rule.

Real-world data confirm the above argument. The combination rule was applied to all products in the online music service industry by the end of 2012, and it is currently applied only to streaming services. Prices were mostly set at a level that equates *per-unit* royalties with *ad valorem* royalties in 2012, but differences began to appear in 2013. Counterfactual analyses using estimation results in Section 4 show that firms could have profitably reduced prices if the *ad valorem* rule had been applied, although they did not have an incentive to do so under the combination rule.

This paper is organized as follows. The next section provides an overview of how copyright royalties are determined in the Korean music industry, and discusses anticompetitiveness of the rules related to these processes. Section 3 shows theoretical results that the combination rule causes firms with different cost

structures to choose identical prices and that the combination rule is dominated by the ad valorem rule in terms of social welfare. In Section 4, counterfactual analyses support the theoretical results by showing that the equilibrium price would have been lower under the ad valorem rule. A demand function is estimated using a random utility model for this purpose. Section 5 concludes the paper.

II. Copyright Royalty Rules for Music in Korea

Copyright royalty rules are made by copyright trust management associations. There are four associations who operate copyright trust management businesses in the Korean music industry. The Korea Music Copyright Association (KOMCA) and the Korean Society of Composers, Authors, and Publishers (KOSCAP) manage the copyrights of composers and authors. The Federation of Korean Music Performers (FKMP) manages performers' copyrights, and the Recording Industry Association of Korea (RIAK) manages music record producers' copyrights. There are other institutions who manage copyrights on behalf of copyright holders; these are known as copyright agency and brokerage business operators. A critical difference between copyright trust management businesses and other copyright management businesses is that copyright royalties received by the former must be approved by the Minister of Culture, Sports and Tourism. Article 105, Paragraph (5) of the Copyright Act states that:

“ ... the rate and amount of usage fee ... shall be determined by the copyright management service provider after he/she obtains approval from the Minister of Culture, Sports and Tourism: provided, that the same shall not apply to the person who has reported on the copyright agency and brokerage business.”

The reason why copyright trust management associations must obtain approval from the government is that the associations have market power which allows them to set copyright royalties at an excessively high level. If copyright royalties are too high, fair use of creative works will be hampered, leading to fewer transactions than the socially optimal level. As collective management of copyrights was introduced to foster the efficient use of creative works by reducing transaction costs, it is reasonable to restrain copyright trust management associations from setting copyright royalties too high. One rationale behind such a government intervention would be that the government grants a monopoly right to the associations and therefore has a duty to keep prices at reasonable levels. Although non-governmental agencies can take over such responsibilities, the government determines copyright royalties in many countries, akin to the Copyright Royalty Board in the United States.

A distinct feature of the Korean system is that the government can change copyright royalty rules even against the intent of copyright trust management associations. Article 105, Paragraphs (6) and (8) of the Copyright Act state:

“(6) As for approval under paragraph (5), the Minister of Culture, Sports and Tourism ... may approve after specifying a period of time or correcting the content in the application if necessary.”

“(8) Where it is necessary ..., the Minister of Culture, Sports and Tourism may change the content of approval pursuant to the provisions of paragraph (5).”

Although it is necessary to control copyright royalties, this does not mean that the government needs to set the royalty level. The only role that the government has to play is to supervise the system and to reject applications which attempt excessive increases in copyright royalties. The government appears to intervene by taking a more regulatory approach in Korea than is required. Such an intervention occasionally has an unintended impact on the market, as noted by Rhee and Yoon (2014).

Another feature of the Korean government intervening too excessively is that the government attempts to control the prices of final goods in the online music service industry. Prices are controlled via the copyright royalty rules approved by the government, which may cause firms to choose the same prices. For example, the current copyright royalty rules of KOMCA for streaming services are as follows:¹

“Article 23. (On-Demand Streaming Services) (1) The copyright royalty for streaming services of music is determined by the following if consumers pay in proportion to the number of streaming times.

1.4 won \times the number of streaming times \times the management ratio²

(2) The copyright royalty for streaming services of music is determined by the greater of the following two if consumers pay a monthly fee regardless of the number of streaming times.

(i) 0.7 won \times the number of streaming times \times the management ratio

(ii) sales volume \times 10% \times the management ratio”

Two ways to calculate copyright royalties are presented in Article 23, Paragraph (2). The first (i) is the per-unit rule: users pay in proportion to the number of transactions. The second (ii) is the ad valorem rule: users pay in proportion to the price of the good. The copyright royalty rules for streaming services combine these two rules, setting copyright royalties at the greater of the two. I call it the combination rule. Using the combination rule causes online service providers (OSPs) to set the price of streaming services at the level which makes the per-unit royalties coincide with the ad valorem royalties. This occurs because OSPs face a different incentive structure when increasing prices from when decreasing prices. At the price where the per-unit rule and the ad valorem rule give identical copyright royalties, OSPs pay more royalties when raising prices, but the same amount of royalties when cutting prices. Thus, OSPs would not deviate from the price level in the event of a small shock. A deeper analysis will be provided in the

¹The copyright royalty rules of FKMP and RIAK are described in a similar way.

²The management ratio is the ratio of music copyrights that KOMCA manages on behalf of composers and authors.

TABLE 1—PRICES OF SELECTED PRODUCTS ACROSS OSPs (SEP 2016)

(UNIT: 1,000 WON)

	Melon	KT music	Genie music	Soribada	Bugs	Mnet
Unlimited streaming	8.4	7.0	6.0	8.4	7.9	7.4
Monthly rent	11.4	9.0	7.0	–	9.9	10.4
Download 30 files	9.5	9.0	6.0	9.4	8.9	9.4
Download 100 files	20.5	18.0	9.0	20.4	19.9	20.4
Download 30 files and unlimited streaming	13.5	11.0	9.0	11.4	10.9	11.4
Download 100 files and unlimited streaming	24.5	20.0	12.0	22.4	21.9	22.4

Source: websites of OSPs.

next section.

In fact, the copyright royalty rules for streaming services had been even worse before they were revised in March of 2013. In the former version, copyright royalties were based on the number of consumers and not on the number of streaming times, and KOMCA set the royalties for streaming services at 400 won or 10% of the price of the good per consumer, whichever was greater. Before the revision, prices showed little dispersion across OSPs, ranging from 5,500 won to 6,000 won, but in September of 2016, prices ranged from 6,000 won to 8,400 won across OSPs, as can be seen in Table 1.

The effect of replacing the combination rule by other rules can be identified by observing changes in the prices of the products other than streaming services. The prices of those products were nearly identical across OSPs when the combination rule was applied to them. Currently there is some variation across OSPs as the per-unit rule is applied. For example, the price for on-demand download services of 40 music files was 5,000 won per month for all the OSPs by the end of 2012, but in September of 2016, download services of 30 music files are sold at 6,000 won to 9,500 won depending on the OSP.³ There are discount offers as well, and consumers can even buy the same services at 3,900 won.⁴ In fact, if consumers download 30 files, the copyright royalties paid to copyright holders exceed the price of the services, as 180 won must be paid per download in total. But OSPs know by experience that consumers typically do not exhaust their download options; thus, they can charge as little as 3,900 won for their services. Changing copyright royalty rules must have affected competition between OSPs.

III. Theoretical Analysis

This section shows that a combination of the ad valorem rule and the per-unit rule causes firms to freeze prices under changing circumstances.

³The download services of 40 music files were sold by only two OSPs as of September of 2016; hence, there is not much variation in the price of this product.

⁴Even less expensive promotion opportunities exist, but with some constraints.

A. Numerical Example

To illustrate, I begin with a toy model of two firms. To focus on pricing, I employ a differentiated product model. Suppose firms 1 and 2 face the following demand functions.

$$q_1 = a_1 - p_1 + bp_2$$

$$q_2 = a_2 - p_2 + bp_1$$

q_i denotes the demand for firm i 's product, and p_i denotes its price. Let r_i denote firm i 's copyright royalties, which are determined by

$$r_i = \max\{\alpha p_i, u\}$$

where $\alpha \in (0, 1)$ is the ad valorem royalty rate and $u \geq 0$ is the per-unit royalty. Assuming that firm i 's marginal cost c_i is constant, firm i 's profit is given by $\pi_i(p) = [p_i - c_i - r_i(p_i)]q_i(p)$. Assume firms optimize à la Bertrand competition, that is, they regard each other's prices as given. Profit maximizing conditions are then given by $d\pi_i / dp_i = 0$, which is

$$p_i = \begin{cases} q_i + \frac{c_i}{1-\alpha} & \text{if } \alpha p_i \geq u \\ q_i + c_i + u & \text{if } \alpha p_i < u \end{cases}$$

Consequently, there are four possible candidates of equilibria. One is

$$p_1 = \frac{1}{2+b} \left(a_1 + \frac{c_1}{1-\alpha} \right) + \frac{b}{4-b^2} \left(a_1 + a_2 + \frac{c_1 + c_2}{1-\alpha} \right) \quad (1)$$

$$p_2 = \frac{1}{2+b} \left(a_2 + \frac{c_2}{1-\alpha} \right) + \frac{b}{4-b^2} \left(a_1 + a_2 + \frac{c_1 + c_2}{1-\alpha} \right)$$

when $\alpha p_1 \geq u$ and $\alpha p_2 \geq u$, and another is

$$p_1 = \frac{1}{2+b} (a_1 + c_1 + u) + \frac{b}{4-b^2} (a_1 + a_2 + c_1 + c_2 + 2u) \quad (2)$$

$$p_2 = \frac{1}{2+b} (a_2 + c_2 + u) + \frac{b}{4-b^2} (a_1 + a_2 + c_1 + c_2 + 2u)$$

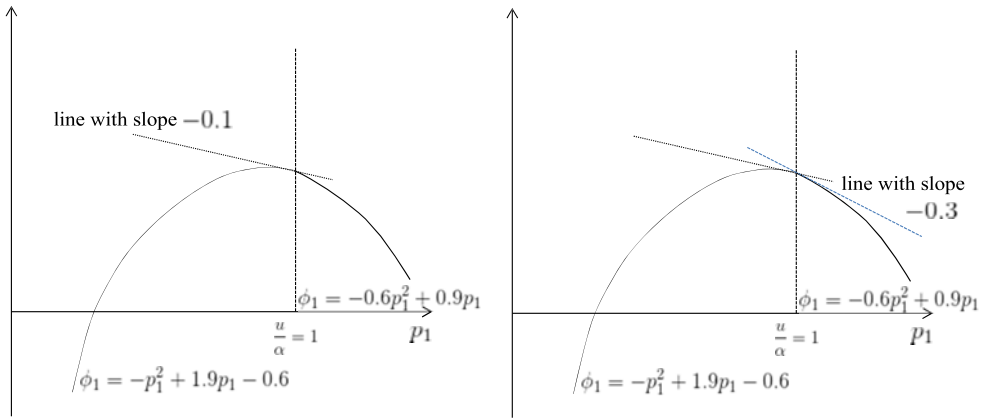


FIGURE 1. BEST RESPONSE OF FIRM 1 UNDER DIFFERENT LEVELS OF c_1 WHEN $p_2 = 1$

when $\alpha p_1 \leq u$ and $\alpha p_2 \leq u$. The other two cases are omitted as I focus on a symmetric example below, but in fact there is only one equilibrium for a reason I explain later.

To see that firms may retain a specific price even when market conditions change, suppose $a_1 = a_2 = 1$, $b = 0.5$, $\alpha = 0.4$, and $u = 0.4$. When $c_1 = c_2 = 0.3$, the equilibrium is characterized by (1), yielding $p_1 = p_2 = 1$, in which case $\alpha p_1 = \alpha p_2 = u$. When $c_1 = c_2 = 0.1$, the equilibrium is characterized by (2), yielding $p_1 = p_2 = 1$, in which case $\alpha p_1 = \alpha p_2 = u$. As costs are in between, that is $c_1, c_2 \in (0.1, 0.3)$, (1) yields $p_1 < 1$ and $p_2 < 1$, but this violates the conditions $\alpha p_1 \geq u$ and $\alpha p_2 \geq u$ and therefore cannot be an equilibrium. Meanwhile, (2) yields $p_1 > 1$ and $p_2 > 1$, but this violates the conditions $\alpha p_1 \leq u$ and $\alpha p_2 \leq u$. Therefore, when $c_1, c_2 \in [0.1, 0.3]$, the only equilibrium is always $p_1 = p_2 = 1$.

To understand why this happens, fix $p_2 = 1$ and write π_1 in terms of p_1 and c_1 as

$$\pi_1(p_1, 1) = \begin{cases} -p_1^2 + (1.9 + c_1)p_1 - 0.6 - 1.5c_1 & \text{if } p_1 < 1 \\ -0.6p_1^2 + (0.9 + c_1)p_1 - 1.5c_1 & \text{if } p_1 \geq 1 \end{cases}$$

It is easy to see that $\pi_1(p_1, 1)$ is concave in p_1 , implying that there is a unique p_1 that maximizes $\pi_1(p_1, 1)$. There is a kink in $\pi_1(p_1, 1)$ at $p_1 = 1$, and $c_1 \in [0.1, 0.3]$ makes $p_1 = 1$ maximize $\pi_1(p_1, 1)$. To see this in a graph, define $\phi_1(p_1) = [p_1 - r_1(p_1)]q_1(p_1, 1)$, then $\pi_1(p_1, 1) = \phi_1(p_1) - c_1q_1(p_1, 1)$ is maximized

when, to roughly say, $\phi_1(p_1)$ has a slope identical to that of $c_1 q_1(p_1, 1)$. Note that $\phi_1(p_1) = -p_1^2 + 1.9p_1 - 0.6$ if $p_1 < 1$, and $-0.6p_1^2 + 0.9p_1$ if $p_1 \geq 1$, and $c_1 q_1 = c_1(1.5 - p_1)$ is a linear function of p_1 with a slope $-c_1$. As shown in Figure 1, $\pi(p_1, 1)$ is maximized at $p_1 = 1$ when $c_1 \in [0.1, 0.3]$.

Let us now see how the result changes when the ad valorem rule or the per-unit rule is employed. If royalties are determined by rates only, as c_1 and c_2 decrease from 0.3 to 0.1, the equilibrium price decreases from 1 to $7/9$. The current copyright royalty rules prevent firms from lowering prices when marginal costs decrease. To see the deadweight loss, the price is higher by $2/9$, and the quantities sold by two firms are lower by $2/9$, indicating that the overall surplus is lower by $2/81$ under the combination rule than under the ad valorem rule. The consumer surplus is lower by $20/81$ under the combination rule as $q_1 + q_2 = 1$ consumers suffer from high prices and the deadweight loss is solely a loss for consumers who give up purchasing.

If royalties are determined by per-unit only, as c_1 and c_2 increase from 0.1 to 0.3, the equilibrium price increases from 1 to $17/15$. The overall surplus is higher under the combination rule than under the per-unit rule in this case, but the situation is opposite as costs rise. For example, suppose $c_1 = c_2 = 0.7$. The equilibrium price is $p_1 = p_2 = 7/5$ under the per-unit rule, but it is $p_1 = p_2 = 13/9$ under the combination rule. Thus, the overall surplus is higher under the per-unit rule when costs are high.

The above illustration shows that using the combination rule makes firms reluctant to change their prices. There is a range of marginal costs in which firms stick to the same price, which equates ad valorem royalties with per-unit royalties. When costs are low, the ad valorem rule yields higher consumer surplus and higher overall surplus than the combination rule. When costs are high enough, the per-unit rule yields higher consumer surplus and higher overall surplus than the combination rule.

To summarize, the combination rule makes the price of the final good rigid, thus lessening competition, and gives lower consumer surplus than the ad valorem rule and the per-unit rule under some circumstances. This can be shown in a more general context. The following subsection deals with a generalized model.

B. Generalization

Suppose n firms are competing in a differentiated product model. Each firm optimizes à la Bertrand competition, that is, each firm regards others' prices as given. Copyright royalties are determined by $r_i = \max\{\alpha p_i, u\}$, and each firm's profit function is given by $\pi_i(p) = [p_i - c_i - r_i(p_i)]q_i(p)$. Suppose the market is in the equilibrium with p^* satisfying $\alpha p_i^* = u$ for all i . If firm i is raising its price p_i , its marginal profit would be

$$(3) \quad \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = (1 - \alpha)q_i(p^*) + (p_i^* - c) \frac{\partial q_i(p^*)}{\partial p_i} - \alpha p_i^* \frac{\partial q_i(p^*)}{\partial p_i}$$

If firm i is reducing its price, its marginal profit would be

$$(4) \quad \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = q_i(p^*) + (p_i^* - c) \frac{\partial q_i(p^*)}{\partial p_i} - u \frac{\partial q_i(p^*)}{\partial p_i}$$

Note that $\alpha p_i^* = u$; accordingly, it is clear that⁵

$$\lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} < \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*}$$

This implies that firms may not want to change their prices even when a demand shift or a supply shock arises. In particular, firms would not change their prices in the event of a marginal shock if and only if

$$(5) \quad \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} < 0 < \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*}$$

The above can be summarized by the following proposition.⁶

Proposition 1: *Suppose the demand $q(p)$ is given, satisfying $2\partial q_i / \partial p_i + \sum_{j \neq i} \partial q_j / \partial p_j < 0$.*

If copyright royalties are determined by $r_i = \max\{\alpha p_i, u\}$, there exists a non-singleton set of cost profiles c under which all firms choose p^ such that $\alpha p_i^* = u$.*

The above proposition implies that firms with different production costs may choose the same price. This can be verified from the actual data. Figure 2 shows the price dispersion of six products across five online service providers (OSPs) from January of 2012 to June of 2014. The six products were sold during the overall data period. The price dispersion is measured by the standard deviation of the price divided by the mean of the price. Five out of the six products show no price dispersion in 2012, in which year the combination rule was applied to all products. Those products were priced exactly at the level which equates ad valorem royalties with per-unit royalties. For example, the price of streaming services was

⁵This shows why there exists a unique equilibrium. Given p_{-i} , π_i is concave in p_i in the region of $p_i < p_i^*$ as well as in the region $p_i > p_i^*$. At the kink, the right derivative of the profit function is less than its left derivative, so π_i is universally concave in p_i . This implies that firm i 's best response is uniquely defined by a function of p_{-i} .

⁶Equivalently, the proposition can be rewritten that given costs, there exists a non-singleton set of demand functions under which firms choose p^* , or even that there exists a non-singleton set of cost profiles and demand functions.

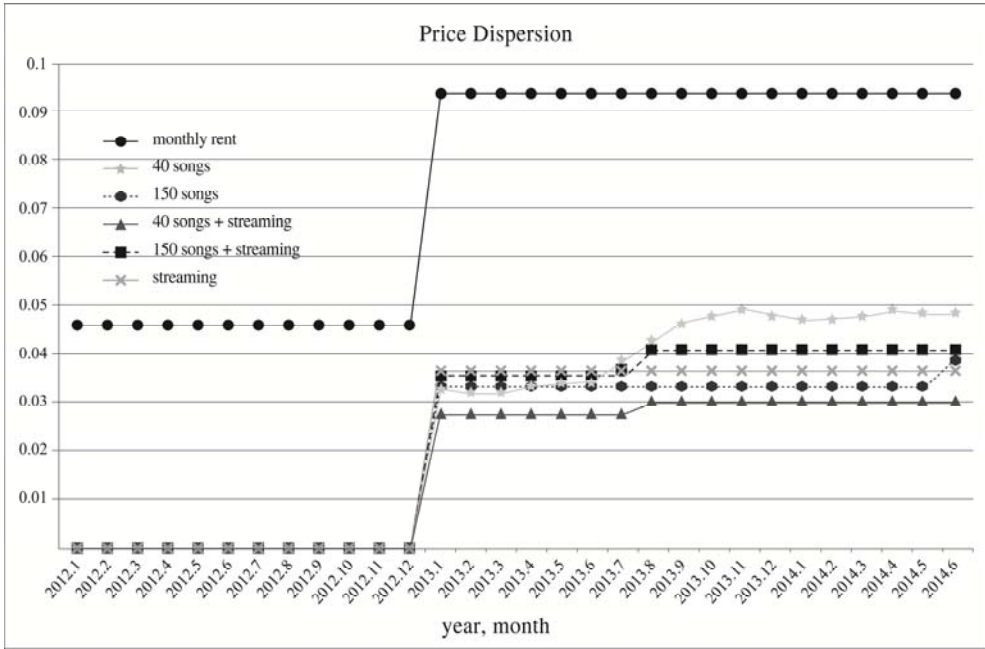


FIGURE 2. PRICE DISPERSION OF SIX PRODUCTS FROM FIVE OSPs

3,000 won in 2012, and royalties were the greater of 150 won and 5% of the price to composers and authors, the greater of 75 won and 2.5% of the price to performers, and the greater of 1,050 won and 35% of the price to music record producers. Download services of 40 songs were priced at 5,000 won in 2012, and royalties were the greater of 410 won and 8.2% of the price to composers and authors, and similarly determined to other copyright holders.

It seems, however, that OSPs had different cost structures in that the price dispersion increases in January of 2013, i.e., as soon as the revised copyright royalty rules became effective. The combination rule was substituted by the per-unit rule for all the products except for streaming services, after which OSPs began to set different prices for the same product, implying differences in profit maximization conditions. Therefore it is suspected that OSPs chose the same price in 2012 even though their marginal costs were different.⁷

Interestingly, the price dispersion of streaming services also increased though the combination rule was maintained for streaming services. In fact, the prices of streaming services increased far beyond the level where ad valorem royalties meet per-unit royalties. As the prices of other products rose due to increases in copyright royalties for them, OSPs increased the prices of streaming services as well. The price of streaming services was set around 6,000 won and not at 4,000 won which makes ad valorem royalties and per-unit royalties identical.⁸ Consequently, only

⁷Alternatively, OSPs may have faced different demand functions, which also leads them to choose different prices under the per-unit rule.

⁸Copyright royalties for streaming services were 400 won to composers and authors, or 10% of the price if greater than 400 won, and they were similarly determined to other copyright holders in 2013.

the ad valorem rule was applied to determine copyright royalties, so it seems that prices were set differently across OSPs, reflecting differences in cost structures.

One may wonder about the welfare effect when the combination rule is replaced by the per-unit rule, or by the ad valorem rule. As the actual data indicate that prices of all products increased as soon as the per-unit rule went into effect in 2013, it is reasonable to ask whether increases in prices resulted from the adoption of the per-unit rule. If the combination rule causes firms to choose identical prices but at a lower level than the per-unit rule, or the ad valorem rule, consumers may prefer the combination rule to the per-unit rule and the ad valorem rule. The answer is that prices went up due to increased royalties rather than the adoption of the per-unit rule. For example, the price for download services of 40 songs increased from 5,000 won in 2012 to approximately 6,900 won in 2013, and royalties for it increased from 2,635 won to 4,558 won. It is necessary to see how prices would have changed if royalties had not increased.

The numerical example discussed in the previous subsection provides a clue. When the combination rule is replaced by the per-unit rule, prices may increase or decrease. Hence, the welfare effect is ambiguous in this case. When the ad valorem rule replaces the combination rule, prices decrease and consumers are better off in the previous numerical example. I show that this is always the case below. I begin with the case where all the firms choose p^* satisfying $\alpha p_i^* = u$ under the combination rule. To see that consumer surplus is lower under the combination rule than under the ad valorem rule, note that the condition under which firms choose p^* such that $\alpha p_i^* = u$ implies

$$0 > \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = \frac{\partial [p_i - c_i - \alpha p_i] q_i(p)}{\partial p_i} \Big|_{p=p^*}$$

As the marginal profit is negative at p_i^* under the ad valorem rule, firms would choose a lower price at equilibrium. As the price is lower, the equilibrium quantity is greater, so consumer surplus will be higher under the ad valorem rule.

A similar argument can be made with regard to the case where firms do not choose p^* . When firms' costs are high, the combination rule yields the same equilibrium with the ad valorem rule, and thus prices and consumer surplus are the same under both rules as well. When costs are low, prices will be low so that firms need to pay per-unit royalties under the combination rule, greater than ad valorem royalties, and thus prices are higher under the combination rule. Consumer surplus is weakly lower under the combination rule, as prices are always weakly higher. The following proposition describes this result.

Proposition 2: *The equilibrium price cannot be lower under the combination rule than under the ad valorem rule. Hence, consumer surplus cannot be higher under the combination rule than under the ad valorem rule.*

Proof Let π_i^c and π_i^a denote firm i 's profit function under the combination rule and under the ad valorem rule, respectively. Also let p^c and p^a denote the equilibrium price under the combination rule and under the ad valorem rule, respectively. When $\alpha p^c > u$, it is clear that $p^c = p^a$. When $\alpha p^c \geq u$ with equality holding for some i , those firms with $\alpha p_i^c = u$ have

$$0 > \lim_{p_i \rightarrow +p_i^c} \frac{\pi_i(p_i, p_i^c) - \pi_i(p^c)}{p_i - p_i^c} = \frac{\partial [p_i - c_i - \alpha p_i] q_i(p)}{\partial p_i} \Bigg|_{p=p^c},$$

so $p_i^c \geq p_i^a$ for those firms. The other firms will also set no lower price as competing firms set higher prices, which implies $p^c \geq p^a$. When $\alpha p^c \leq u$ with equality holding for some i , those firms with $\alpha p_i^c = u$ have

$$0 > \lim_{p_i \rightarrow +p_i^c} \frac{\pi_i(p_i, p_i^c) - \pi_i(p^c)}{p_i - p_i^c} = \frac{\partial [p_i - c_i - \alpha p_i] q_i(p)}{\partial p_i} \Bigg|_{p=p^c},$$

so $p_i^c \geq p_i^a$ for those firms. The other firms with $\alpha p_j^c < u$ have

$$0 = \frac{\partial [p_j - c_j - u] q_j(p)}{\partial p_j} \Bigg|_{p=p^c} > \frac{\partial [p_j - c_j - \alpha p_j] q_j(p)}{\partial p_j} \Bigg|_{p=p^c},$$

where the last inequality holds given that (3) is less than (4), even when $\alpha p_j^c < u$. Accordingly, $p_j^c \geq p_j^a$ as well. When $\alpha p_i^c > u$ for some i and $\alpha p_j^c < u$ for some j , the above argument applies as well, and thus $p^c \geq p^a$. ■

Between the ad valorem rule and the per-unit rule, one does not dominate the other. When costs are high, the ad valorem rule yields the same equilibrium with the combination rule, and thus higher prices than the per-unit rule in some cases. When costs are low, the ad valorem rule yields lower prices than the combination rule which yields lower prices than the per-unit rule.

The above discussion implies that the combination rule tends to maintain prices at a higher level. This would benefit producers to the detriment of consumers. Copyright holders may benefit by earning more royalties but by sacrificing consumer surplus. There exists a deadweight loss as the transaction volume is lower than the socially optimal level. Therefore, employing the combination rule to determine copyright royalties should be avoided. I suggest the use of the ad valorem rule, as it is always better in terms of overall surplus.

IV. Empirical Tests

In this section, I empirically test the hypothesis that the combination rule prevents online service providers (OSPs) from changing prices. A straightforward way to prove it would be to see whether the cost structures of OSPs fall into the range in which price stickiness arises. More specifically, it suffices to see whether the cost structures satisfy (5). Unfortunately, I could not obtain supply side data, meaning that cost structures cannot be estimated. As an alternative method, I calculate changes in the profits of OSPs upon a marginal change in the price. (5) is satisfied if OSPs' profits decrease both when the price increases and when it decreases. To do this, I first estimate a demand function using the actual data. Then I predict market shares as if OSPs change the prices of their products, and calculate changes in profits to see that price is indeed sticky. Moreover, by comparing changes in profits to those under the counterfactual situation where only the ad valorem rule applies, I show that the combination rule restrained OSPs, which would have lowered prices under the ad valorem rule, from doing so.

A. Data

Data are monthly, spanning from January of 2012 to June of 2014, and contain sales data from five OSPs (Melon, KT music, Soribada, Bugs, and CJ E&M). Data are obtained from several sources. Listed prices, the average discount rate, and the number of consumers of each product were obtained for Melon and KT Music with the help of the Ministry of Culture, Sports and Tourism. The actual usage data (downloads, streaming) of each product were obtained from KOMCA, FKMP, and RIAK for the five OSPs for the entire period. The number of consumers of each product was obtained from FKMP and RIAK for the five OSPs for a subset of the data period. The characteristics of each product were obtained at the website of each OSP.

To estimate a demand function, the number of consumers or the market share of each product is necessary. I do not have this information for the entire period and therefore extrapolated the variable to the former and the later period. Specifically, as I have the number of consumers for all the products from June of 2012 to April of 2013, I calculated the average number of streaming times per consumer for streaming services from June of 2012 to October of 2012 and divided the number of streaming times by the average number of streaming times per consumer to obtain the extrapolated number of consumers for streaming services from January of 2012 to May of 2012. To obtain the number for May of 2013 to June of 2014, I used the average number of streaming times from December of 2012 to April of 2013. Here, I implicitly assumed that the average number of streaming times remained stable during the data period. There is some variation in the average number of streaming times, but the volatility is not high since the maximum to minimum ratio is less than 1.3. For download-only products, the number of download times was used. The data from FKMP and that from KOMCA do not coincide exactly, but the difference was only within 1% of the magnitude of the variables. I used data from FKMP mostly, as it includes the number of consumers.

B. Demand Estimation

A random utility model with a logit error is used to estimate the demand function. I adopt the estimation methodology of Berry (1994), which begins with an indirect utility function

$$u_{ij} = x'_j \beta_x - \beta_p p_j + \xi_j + \varepsilon_{ij},$$

which is the utility that consumer i obtains from purchasing product j with observable characteristics x_j , price p_j , and unobserved quality $\xi_j \in \mathbb{R}$. ε_{ij} is an idiosyncratic utility term that i has for j in addition to x_j, p_j , and ξ_j . ε_{ij} follows a type-I extreme value distribution. There are products from the five OSPs and an outside option. An outside option is denoted by product 0, and its utility is normalized to $u_{i0} = \varepsilon_{i0}$; that is $\xi_0 = 0$. The market share of product $j = 0, \dots, n$ is calculated by

$$s_j = \frac{\exp(x'_j \beta_x - \beta_p p_j + \xi_j)}{1 + \sum_{m=1}^n \exp(x'_m \beta_x - \beta_p p_m + \xi_m)}$$

and especially

$$s_0 = \frac{1}{1 + \sum_{m=1}^n \exp(x'_m \beta_x - \beta_p p_m + \xi_m)}.$$

Therefore,

$$\frac{s_j}{s_0} = \exp(x'_j \beta_x - \beta_p p_j + \xi_j)$$

and taking the log gives

$$\log s_j - \log s_0 = x'_j \beta_x - \beta_p p_j + \xi_j$$

This equation is used for the estimation. It is assumed that $E[\xi_j | x_j] = 0$, but $E[p_j \xi_j] \neq 0$. Consequently, a two-stage least squares (2SLS) estimation is conducted using instrumental variables. Following Berry *et al.* (1995), the average characteristics of the other products of the same OSP, and the average characteristics of the products of the competing OSPs were used as instrumental variables for the price. These variables are closely related to prices, as prices are determined through competition among products but would not be correlated with

TABLE 2—ESTIMATION RESULTS

Variables	OLS	2SLS	OLS	2SLS
	w/o trend	w/o trend	w/ trend	w/ trend
Price (1,000 won)	-0.2902***	-0.3355***	-0.3436***	-0.5384***
(SE)	(0.025)	(0.0317)	(0.0313)	(0.0497)
download	0.002801	0.005313**	0.005913**	0.01692***
(SE)	(0.001599)	(0.001930)	(0.001938)	(0.002922)
Monthly rent dummy	1.5738***	1.7160***	1.7811***	2.4456***
(SE)	(0.1636)	(0.1743)	(0.1788)	(0.2231)
Streaming dummy	1.2229***	1.3317***	1.3648***	1.8510***
(SE)	(0.1057)	(0.1155)	(0.1167)	(0.1520)
trend			0.01751**	0.04077***
(SE)			(0.006188)	(0.007751)
OSP dummies	included	included	included	included
adjusted R ²	0.5091	0.5108	0.5115	0.5014

Note: *** indicates significant at the 0.1% level, ** at the 1% level, and * at the 5% level.

unobserved quality.

Estimation results are given in Table 2. The price coefficient is negatively significant in all the settings, but the 2SLS method gives bias-corrected estimates. The results are consistent with the theory that the coefficient estimate may be positively biased under OLS when the variable is positively correlated with error terms. The coefficients of the observed characteristics are positively significant in the two 2SLS estimation results. The model is estimated with a trend variable excluded and included. Given the increase in the total number of consumers over the data period, it can be regarded as reasonable to include a trend variable. Indeed, the coefficient of the trend variable is estimated to be significant and positive. On the other hand, it is also reasonable to let the unobserved quality ξ_j capture the increase in the attractiveness of products over time, as a trend variable is not a characteristic of products and does not precisely capture an increase in attractiveness although they are correlated. The adjusted R^2 is greater for the second column without a trend variable as compared to that in the fourth column. For this reason, I perform a counterfactual analysis using both results: one from the second column, and the other from the fourth column.

C. Counterfactual Analysis

A counterfactual analysis is carried out as follows. I first change the price of streaming services, to see if such a deviation is profitable to OSPs. If it is not for both an increase and a decrease in the price, price is proven to be sticky. I then apply a different copyright royalty rule to see if such a deviation would have been profitable. If this is the case, it proves that the combination rule prevented OSPs from changing prices, which would have occurred under a different rule.

December of 2013 is chosen as the base period, as most products are sold around that month. The number of products doubled in January of 2013 when the new copyright royalty rule became effective, and KT Music stopped selling two products in August of 2013 and one product in June of 2014. When new products are introduced or when certain products exit a market, the demand for those

TABLE 3—CHANGES IN PROFITS WHEN
THE PRICE OF STREAMING SERVICES DECREASES BY 1%

OSP	Δ profit under the combination rule		Δ profit under the ad valorem rule	
	streaming services	all products	streaming services	all products
CJ E&M	-0.17%	-0.18%	1.77%	1.04%
Melon	-0.91%	-1.70%	1.37%	0.56%
KT music	0.58%	0.46%	2.13%	1.73%
Bugs	0.55%	0.07%	2.17%	0.34%
Soribada	0.69%	0.18%	2.24%	0.59%

Note: The estimation result with a trend variable was used for a counterfactual analysis.

products may not be stable. Hence, I use the data from December of 2013 for a counterfactual analysis to see the price effect when the market condition is relatively stable.

I focus on streaming services because the combination rule was applied only to streaming services in December of 2013. Other products were charged royalties by the per-unit rule, which does not dominate, nor is dominated by, the combination rule as discussed in the previous section. Copyright royalties for streaming services were the greater of 3.6 won per streaming and 60% of the price in total in December of 2013, effective from May of 2013. Although this type of combination rule does not limit setting prices of final goods as much as the combination rule discussed above, the government revised the copyright royalty rule considering that the price of streaming services was mostly 6,000 won in 2013, and that the average number of streaming times per consumer is 1,000 times.⁹ Therefore, those OSPs which set the prices of streaming services at 6,000 won paid 3,600 won for copyright royalties in either case and therefore were effectively restrained by the combination rule.

Table 3 summarizes the results of a counterfactual analysis using the estimation result with a trend variable. The cases of CJ E&M and Melon prove that they would have profitably lowered prices under the ad valorem rule. If CJ E&M cut the price of its streaming services by 1%, its profit from streaming services decreases by 0.17%, but if the ad valorem rule had been applied, the profit would have increased by 1.77%. As prices drop, demand for this product increases by 2.80%, and revenue from it increases by 1.77%, but copyright royalties increase by 2.80%, a growth rate identical to that of demand, under the combination rule.¹⁰ However, if the ad valorem rule had been applied, copyright royalties would have increased only by 1.77%, a growth rate identical to that of revenue. Therefore, cutting prices would have led to greater profits for CJ E&M. While reducing the price of streaming services leads to decreases in sales of other products and thus decreases in profits from those products as well, the total profit would have increased by 1.04% under the ad valorem rule. A similar argument applies to Melon's case as well.

When KT music reduces the price of streaming services, however, its profit turns out to increase under the combination rule. A decrease in the price of streaming

⁹See the press release by the Ministry of Culture, Sports and Tourism on March 18th, 2013.

¹⁰Here, I implicitly assume that OSPs do not incur more costs when they serve an additional 3% of consumers. If they do incur more costs, the decrease in price would reduce the profit under the combination rule by a greater amount.

TABLE 4—CHANGES IN PROFITS WHEN
THE PRICE OF STREAMING SERVICES INCREASES BY 1%

OSP	Δ profit under the combination rule		Δ profit under the ad valorem rule	
	streaming services	all products	streaming services	all products
CJ E&M	0.09%	0.13%	-1.76%	-1.03%
Melon	0.80%	1.61%	-1.37%	-0.57%
KT music	-2.10%	-1.70%	-2.10%	-1.70%
Bugs	-0.62%	-0.08%	-2.13%	-0.34%
Soribada	-2.20%	-0.58%	-2.20%	-0.58%

Note: The estimation result with a trend variable was used for a counterfactual analysis.

TABLE 5—CHANGES IN THE TOTAL PROFIT WHEN
THE PRICE OF STREAMING SERVICES CHANGES BY 1%

OSP	Δ profit when price decreases		Δ profit when price increases	
	Combination	Ad valorem	Combination	Ad valorem
CJ E&M	-0.77%	0.41%	0.72%	-0.41%
Melon	-2.04%	0.09%	1.98%	-0.10%
KT Music	-0.50%	0.76%	-0.76%	-0.76%
Bugs	-0.12%	0.15%	0.11%	-0.15%
Soribada	-0.14%	0.26%	-0.26%	-0.26%

Note: The estimation result without a trend variable was used for a counterfactual analysis.

services by 1% leads to an increase in its profit from streaming services by 0.58%, and an increase in the total profit by 0.46%.¹¹ One possibility is that OSPs colluded to earn more profit.¹² OSPs may earn more profit by cutting prices alone but earn less profit by reducing prices together. Indeed, when all of the OSPs cut the prices of streaming services by 1%, all of them lose profits. Under the ad valorem rule, however, some OSPs would have earned more profit even if all of the OSPs reduced the prices of their streaming services by 1%. Such a deviation would have increased Melon's profit by 0.21%, KT Music's by 1.05%, and CJ E&M's by 0.45%. Therefore, these OSPs have an incentive to deviate from collusion.

Table 4 shows whether OSPs have an incentive to increase their prices of streaming services. Under the combination rule, some OSPs have an incentive to increase prices, but no OSP does under the ad valorem rule. Comparing Table 3 with Table 4, it is interesting to note that under the combination rule, the magnitude of the price effect is different when prices decrease from when prices increase, especially in the cases of KT Music and Soribada. This proves that the combination rule presents OSPs with a different incentive structure when raising prices as opposed to when lowering price. This is not the case under the ad valorem rule, as the effect of a price decrease is nearly identical in terms of magnitude but only opposite in direction relative to that of a price increase for all the OSPs.

Table 5 summarizes the results of a counterfactual analysis using the estimation result without a trend variable. Reducing the price is not profitable for any OSP under the combination rule, but is profitable for all the OSPs under the ad valorem rule. Therefore, this result reinforces the claim that the combination rule prevented

¹¹If the ad valorem rule had been applied, the increase in the total profit would have been 1.73%, so it can be claimed that the ad valorem rule pushes KT Music harder to reduce prices than the combination rule.

¹²Another possibility is that the assumption of no additional cost fails, so KT Music indeed earns less considering an increase in costs.

OSPs from reducing prices, which would have occurred if the ad valorem rule had been in force. For KT Music and Soribada, raising prices as well as reducing prices is unprofitable under the combination rule, which satisfies (5). This proves again that the combination rule causes some OSPs to keep their price level at 6,000 won, which equates ad valorem royalties with per-unit royalties. On the other hand, CJ E&M, Melon and Bugs set their prices of streaming services at less than 6,000 won, which is why (5) is not satisfied in those cases. In fact, they are tempted to raise prices under the combination rule, which implies that the combination rule causes OSPs to choose identical prices, i.e., those which make ad valorem royalties and per-unit royalties equal.

V. Concluding Remarks

Price control may have side effects that firms retain the current price level even when market conditions change. A combination of the ad valorem and the per-unit copyright royalty rules is a weak version of price control. This paper shows that the combination rule makes firms inclined to choose a specific price level, which equates ad valorem royalties with per-unit royalties. It is also shown that the equilibrium price is no lower and overall surplus (as well as consumer surplus) is no larger under the combination rule than under the ad valorem rule. A counterfactual analysis implies that some online service providers (OSPs) in the online music service industry would have reduced price if the ad valorem rule had been applied, which is consistent with a theoretical prediction. Thus, employing the combination rule weakens competition.

The combination rule may also be exploited for tacit collusion. Firms may implicitly agree not to deviate from a specific price level in order to earn more profits together, even when a unilateral deviation would be profitable. One of the counterfactual analyses shows that some OSPs could have profitably deviated to a lower price level, given that the indirect utility function is correctly specified. One possible reason why they did not do so is that they had an incentive to hold prices steady, as they would have earned less if all the OSPs had lowered prices. The problem is that such tacit collusion is difficult to detect, as choosing such a price is in the competition equilibrium in many cases under the combination rule. Obtaining data would be the most challenging part with regard to detection, but even if the data are available, it would be difficult to prove that firms implicitly colluded in all the possible scenarios. Indeed, using a different specification for the indirect utility function in the above counterfactual analysis justifies the pricing behavior of OSPs as competitive, as the price is in the Bertrand competition equilibrium.

To summarize, the combination rule by itself causes firms to set prices at higher levels, thus reducing consumer surplus, and this may be exploited by way of tacit collusion in some cases. Therefore, replacing the combination rule with the ad valorem rule is strongly recommended. In the online music service industry, the combination rule is currently not applied to most products, but only a weak version of the combination rule is applied to streaming services. I have two remarks for the copyright royalty rule policy in this matter.

First, it would promote competition to switch to the ad valorem rule for streaming services. Copyright holders and their associations have an objection to switching to the ad valorem rule, as they are worried about the possibility that some OSPs such as Apple music may cut prices aggressively to attract more consumers. The government should not consider their concerns too much, keeping in mind that using the combination rule may harm consumers. If minimum per-unit royalties need to be specified in order to avoid abuse by OSPs, they must be determined at a low level that is not binding in most cases.

Second, bringing the combination rule back to other products must be avoided. The per-unit rule is mostly applied to other products according to the current copyright royalty rules. Copyright holders want to apply the combination rule that would give more royalties when prices increase. For instance, they argued that the minimum rate provision must be restored when it was removed in June of 2012. Although the combination rule is not worse than the per-unit rule in terms of overall surplus, as proven above, bringing the combination rule back would clearly be worse than switching to the ad valorem rule. Thus, the government can retain the current per-unit rule or alternatively switch to the ad valorem rule, but should not restore the combination rule.

A remark pertaining to the welfare of copyright holders is in order. As claimed in the introduction, the government should make a decision in terms of anticompetitiveness rather than balance between copyright holders and consumers. In evaluating anticompetitiveness, however, it is necessary to consider the dynamic effects of copyright royalties that stimulate the production of creative works. When copyright holders are able to earn more royalties, they would create more art products, which in turn increases consumer welfare. Therefore, if the combination rule gives copyright holders more royalties, there can be a positive dynamic effect that might be considered. Incorporating the dynamic effect into the model would not only complicate the analysis much but also make the result sensitive to assumptions, so I leave it to a future research topic.

One thing to note, however, is that copyright holders may not be better off under the combination rule than under the ad valorem rule. Royalties per transaction are higher, but the transaction volume is lower under the combination rule, so the effect on the total amount of royalties earned by copyright holders is ambiguous. More assumptions are necessary for an accurate analysis of how much each stakeholder, including copyright holders, will be affected by changes in copyright royalty rules. Measurement of the effect on each stakeholder would help the government make policy decisions. This is left as a future research topic.

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