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Yukihiro Nishimura

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Graduate School of Economics
The University of Osaka, Toyonaka, Osaka 560-0043, JAPAN

A Novel Argument on Regulating Prices in Two-sided Markets: Finding Win-Win Policy Correctly*

Yukihiro Nishimura†

Abstract

Online markets like app stores are typically characterized by a monopoly who set prices on both sides — the prices of the network good (such as iPhone) and the commission fee to participating firms. There is an ongoing concerns on the welfare consequences of imperfect competition, where the antitrust authorities in the EU are keen about the monopolistic commission fee. With online apps as a representative example, this study investigates the welfare effects of price ceiling policies. The following results are shown. If the network-size externality on apps' price is stronger than the app variety's network externality, then, first, the price ceiling on the network good increases both the producer surplus of the app developers and the consumer surplus of the end-users. Second, in contrast, the price ceiling on the commission fee for the developers reduces the consumer surplus. The reverse proposition holds when the order of the strength of two network externalities is reversed. By the level of the unconstrained equilibrium commission fee, a regulator can identify which policy would make both consumers and developers better off.

Keywords: Digital economy; Platform; Antitrust pricing; Network externality

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†Osaka University and CESifo; E-mail: ynishimu@econ.osaka-u.ac.jp

1 Introduction

The development of technology has enabled firms to conduct business online. In 2022, the total worldwide revenue of the app market was 437 billion U.S. dollars, and the market volume is expected to reach 781 billion U.S. dollars by 2029.[1] Online markets are often characterized by oligopolistic structures, dominated by a few large firms with price-setting power. Consumers access the platform through a network good (such as the iPhone), and a platform operator manages a digital platform (e.g., the App Store) that creates a classic two-sided market structure. The developers in the market place must pay commission fees to the platformer in order to offer their products, which we call *online apps* as an example of the growing market, to consumers through the platform. Such fees play a central role in the platform's pricing strategy, as its monopoly power allows it to both stimulate app developers' entry and the network size — particularly when network externalities are present.

At the same time, they have drawn increasing scrutiny by the antitrust authorities concerned with fair pricing. Notably, in 2024, the European Commission (EC) found that Apple's fees charged to app developers exceeded a reasonable threshold.[2] In response, Apple revised its fee structure, announcing a reduction in charges.[3] The scope of antitrust policy is broad, encompassing measures such as facilitating the entry of alternative firms to handle platform registration — potentially exerting downward pressure on commission fees — and promoting a contestable fee structure. A famous example is Europan Union's the digital market act to reduce commission fee imposed by platfomers.[4]

In this paper, we integrate the frameworks of Hayakawa et al. (2025) and Wu et al. (2023) to construct a two-sided transaction model á la Armstrong (2006), Caillaud and Jullien (2003), Rochet and Tirole (2003), Rochet and Tirole (2006) and Hagiu (2009). Using this model, we examine how price ceiling policies influence total welfare. Rysman (2009) underscores a key challenge for antitrust authorities in regulating two-sided markets: "[a]lthough inefficient pricing is the hallmark of the economic criticism of monopoly power, inefficient pricing is not an antitrust violation by itself. Monopolization ... typically hinge(s) on whether a firm has excluded competitors from the market in a way that did not benefit consumers or reduce costs".

By analyzing the platformer's pricing behavior in a multi-sided market, this paper shows that

[1]See `https://www.statista.com/outlook/amo/app/worldwide`, accessed 2025 February 5th.

[2]See `https://ec.europa.eu/commission/presscorner/detail/en/ip_24_3433`, accessed 2025 February 13th.

[3]See `https://developer.apple.com/jp/support/dma-and-apps-in-the-eu/#app-analytics`, accessed 2025 February 13th.

[4]Due to the act, Apple's commission fee is expected to decline from 30% to 17% on in-app purchase.

the effectiveness of a price ceiling policy critically depends on the relative strengths of two distinct types of network externalities.[5] The attractiveness of a platform is shaped by the number of users on both sides: more consumers enhance the profitability for app developers, while a greater variety of apps increases the consumers' willingness to adopt the platform. If the *network-size externality* — i.e., the externality by which the size of the user base incentivizes app development — is strong, the platformer charges a positive commission fee in the unconstrained (pre-regulation) equilibrium. By contrast, a strong *app variety's externality* — i.e., when the demand for the network good is reinforced by the popularity and richness of its platform — can lead the platformer to subsidize app developers (i.e., negative commission fees, which may take the form of start-up support or technical assistance; footnote 9). In the case where network-size externalities dominate, we find two key results. First, a price ceiling imposed on the network good (e.g., the iPhone) increases both producer surplus for app developers and consumer surplus for end-users. Second, however, a ceiling on the commission fee (the policy which the EC is currently keen about) may *reduce* consumer surplus. This insight introduces a novel policy perspective, as current debates often overlook the indirect effects of pricing across market sides.

To the best of our knowledge, the full welfare implications of price ceiling policies have not been addressed in current policy or public debates. Our novel approach begins with the recognition that each side of the market is affected indirectly by the price faced by the other side — for instance, the commission fee for the network-good (e.g., iPhone) users and the price of the network-good from the perspective of app developers. The profit of app developers through the ceiling of the network-good's price crucially depends on the strength of the two externalities. When the network-size externalities dominate, both app developers and consumers benefit: developers gain from a larger market for their products, and consumers enjoy both increased app variety and a lower price for the network good. However, the alternative policy of imposing a ceiling on commission fees paid by developers — the policy advocated by the EC can be counterproductive. A revenue-maximizing platformer responds by raising the price of the network good. In the presence of strong network-size externalities relative to app variety's externalities, this results in a smaller network size and reduced consumers' welfare. The logic reverses when app variety's externalities are stronger. In such cases, reducing commission fees stimulates app entry and enhances welfare on both sides of the market. In short, policymakers can always identify a price regulation that simultaneously benefits both consumers and developers, provided they account for the prevailing direction and strength of market externalities.

[5] Specifically, we consider types of spillovers known as an indirect network externalities by, e.g., Zodrow (2003).

In a two-sided market model, Etro (2023) showed in a different context than ours that cross-side linkages in two-sided markets can enhance consumer welfare. However, we show that, in our typical Armstrong (2006)-type model, an unconstrained equilibrium failed to maximize total surplus of the platform participants. We further showed that piecemeal price interventions improve both consumers' welfare and app developers' profits. Rey and Tirole (2019) examined price-ceiling policies as solutions to the multiple marginalization problem, which is different from ours. Our contribution thus adds to this literature by addressing the antitrust policies in online platform, where the market power and network effects interact in subtle and policy-relevant ways.

The reminder of the paper is organized as follows. Section 2 introduces the model. Section 3 derives the equilibrium in the absence of price ceiling. Section 4 examines welfare analysis of the two price ceiling policies — on the commission fee and the network-good's price. The last section concludes. The proofs are given in the Appendix.

2 Basic setup

Our model follows Morita and Nishimura (2025). A foreign firm, referred to as the *platformer*, has its own online technology to operate its platform, such as App Store, in the home country. Consumers in the home country have access to the platform through a platform-specific *network good*, such as iPhone, which the platformer sells to the consumers. The platformer then facilitates in transactions in country H involving a relation-specific good which we call, for an illustration, *online apps*.

We consider the following two-stage game. In Stage 1, the platformer sets the price p of the network good and the commission fee R for the entry of the app developers. In Stage 2, consumers, app developers, and the app users make their adoption decision simultaneously. When variables associated with network externalities are simultaneously determined, each party forms rational expectations about the others' behavior.

2.1 Network good's demand

Following Wu et al. (2023), consumers are heterogeneous in their preference over the network good and decide whether to buy one unit of the good or not. The aggregate demand — equivalently, the number of consumers — is determined through a conventional microfounded model by (see Appendix A):

$$q(p) = \nu + \alpha m - p. \tag{1}$$

where ν and p represent, respectively, the maximum willingness to pay for the good and its price, and the second term, αm, captures the network effects from app variety:[6] m represents the total number of apps sold in the platforms and α is the degree of such network externality.

Because more apps provide consumers of the good with a wider variety of app options and allow them to use their favorite apps, they increase the willingness to pay for the network good.[7] Note that such an increase in willingness to pay for the good matters with not only on the number of apps but also on the speed of internet connection. Therefore, consumers receive gains from the network good if they are in a better digitalized environment. The network parameter α reflects the level of digitization and we interpret an exogenous increase of α as digitization as an introduction of 6G, for example, allows high-speed data transfer.[8]

The platformer provides network goods to consumers at the marginal production cost c.

2.2 App's price and developers' entry

On the online platform, apps are developed by a potentially large pool of app developers M. The apps are demanded by a potentially large pool of app users greater than M. Some network participant may purchase more than one unit of the apps, and others may not buy any app. The app developers are assumed to supply one app each and are heterogeneous in terms of the fixed costs of developing and maintaining apps, denoted by f_S, which is uniformly distributed over $[0, \overline{f}]$.

The apps are demanded by a potentially large pool of app users in the home country. App i generates the marginal utility of consumption as $a_i = \phi q$ to the consumer. Following Rasch and Wenzel (2013), ϕ is regarded as network-size externality. A larger ϕ is interpreted as a different measure of digitization from α. The app's price for product i, p_{ai}, becomes $p_{ai} = \phi q$ (see Online Appendix).

In addition, app developers need to pay commission fee, R, to the platformer to sell their app in the platform. We allow R to be positive or negative and regards a negative R as a subsidy from the platformer to app developers.[9] Notice that R exhibits standard buyer-seller independence: whether

[6] We assume that $\nu > p$ holds in the equilibrium throughout the analysis. This means that some consumers still want to consume the network good even in the absence of additional utility from network effects. This is a realistic assumption, as such indirect externalities arise when a base level of consumers exists and app developers find it profitable to enter the market . Following the literature, including Katz and Shapiro (1985) and Wu et al. (2023), we assume that each consumer makes their decision based on the expected number of the apps in the market. This expectation is in equilibrium, i.e., $m_e = m$ holds.

[7] This is known as an indirect network externalities.

[8] In the last two decades, the percentage of individuals using the internet has grown: It was 7% in 2000 and 67% in 2023. See `https://data.worldbank.org/indicator/IT.NET.USER.ZS`, accessed 2025 February 5th.

[9] A negative R can be interpreted as a non-pecuniary subsidy such as technical supports to app developers by providing constructions kit. For example, Apple allows app developers to apply for an Apple vision pro developer kit (see `https://developer.apple.com/visionos/developer-kit/`, accessed 2025 February 5th). Rysman (2009) gave

the platform charges the fee R to the developer of the relation-specific good or to its consumer is irrelevant for incidence. In the latter case, the developer sets a price of $p_{ai} - R$ for consumer i, who then decides whether to accept the price. The platformer's pricing of R is a policy-relevant matter (as mentioned in Introduction).

Note that q is the number of the network good and equivalently the number of consumers participating in the online platform. So app developer's profit from developing its app is $\pi_S = \phi q - R - f_S$. As for the network-entry fee, R exhibits standard buyer-seller independence: whether the platform charges the fee R to the app developer or to its consumer is irrelevant for incidence. In the latter case, the developer sets a price of $p_{ai} - R$ for consumer i, who then decides whether to accept the price.

With this specification, app developers' entry decision leads to the equilibrium number of app developers:

$$\pi_S \geq 0 \iff \phi q - R \geq f_S \;\Rightarrow\quad m = \frac{M(\phi q - R)}{\overline{f}} \tag{2}$$

The two-stage game is solved backwards. In stage 2, the network users and the app consumption are simultaneously determined by (1) and (2). We derive the induced demand function and the number of app developers as follows:

$$q(p, R) = \frac{\overline{f}(\nu - p) - \alpha M R}{\overline{f} - \alpha\phi M}, \tag{1'}$$

$$m(p, R) = \frac{M\left[\phi(\nu - p) - R\right]}{\overline{f} - \alpha\phi M}, \tag{2'}$$

Electric devices getting access to online platform require are often characterized as a knowledge intensive industry, firms are sometimes criticized of using its high market power and setting their high prices.[10] The online platform runs by its own online technology such as App Store, with zero fixed costs and zero marginal costs of operating the online platform. With the above setup about consumers and app developers, the platformer decides a price of the network good and a

another example of Microsoft, as a supplier of a computer operating systems, making it very easy to become a software developer for the Windows operating system and arguably subsidizes this activity with tutorials and supportive websites.

[10]For example, the U.S. department of Justice accused Apple of monopolizing Smartphone market. See https://www.reuters.com/legal/us-takes-apple-antitrust-lawsuit-2024-03-21/, accessed 2025 February 5th. European Union has the digital market act in 2023 to ensure for all businesses, contestable and fair markets in the digital sector. Inspired by the digital market act, Japan also enacted so called the Smartphone act to stop large companies such as Google and Apple from taking advantage of their position to give their own products "a competitive advantage" and from "imposing disadvantages on business users". See https://eu-renew.eu/is-the-eus-digital-markets-act-going-global-how-japan-is-crafting-its-own-version-of-digital-regulation-with-the-smartphone-act/, accessed 2025 February 5th.

commission fee. Thus, the profit of the platformer is

$$\pi_P = (p-c)q + Rm. \tag{3}$$

3 Unconstrained equilibrium

3.1 Price and commission fee

By differentiating (3) with respect to p and R, and taking into account (1′) and (2′), the first-order condition (FOC) $\frac{\partial \pi_P}{\partial p} = 0$ yields the following. From (1′), we have $\frac{\partial q}{\partial p} = \frac{-\overline{f}}{\overline{f}-\alpha\phi M} \equiv -\frac{1}{\gamma} < 0$, $q = \frac{1}{\gamma}\left(\nu - p - \frac{\alpha RM}{\overline{f}}\right)$ and from (2), we have $\frac{\partial m}{\partial p} = \phi\frac{-1}{\gamma}\frac{M}{\overline{f}}$. Therefore, the FOC for p in the platformer's problem is written as:

$$\frac{\partial\Big((p-c)q + Rm\Big)}{\partial p}\gamma = -(p-c) + \left(\nu - p - \frac{\alpha RM}{\overline{f}}\right) - R\frac{\phi M}{\overline{f}} = 0, \tag{4A}$$

which derives

$$p^* = c + \frac{\nu - c}{2} - \frac{\{\alpha + \phi\}MR^*}{2\overline{f}} \tag{4}$$

In the above formula, the price is composed of two key components : market power and network externality. Without network externality, the platformer sets the price above marginal cost by a monopoly markup, reflected in the second term on the right-hand side. With network externalities, if the commission fee R is positive, the last term on p^* lowers the equilibrium price, as the commission fee revenue can be used for increasing the network size. It should be noted that the price in (4) is below the standard monopoly markup $p^* - c = \dfrac{\nu - c}{2}$. As Rysman (2009) suggested, monopoly power does not necessarily imply inefficiently high price. On the other hand, if $R^* < 0$, then the increase of p^* occurs since entries of more developers would scale up the second term of the right-hand side, αm^*, in (1). See footnote 12 below.

In general, (i) m's sensitivity to q in (2), $\frac{\partial m}{\partial q} = \frac{M}{\overline{f}}\phi$, which is increasing in responsiveness of the app developers from the number of users and decreasing in firm heterogeneity $\overline{f}$, matters for production side, and (ii) the number of app developers ($\alpha\frac{M}{\overline{f}}$ increasing in M) matters for consumption side. From this perspective, hereafter we call the corresponding parameter $\frac{M}{\overline{f}}$ as *entry responsiveness*.

Turning to the first-order condition for the commission fee R, we have $m \propto \phi(\nu - p) - R$, $R\frac{\partial m}{\partial R} =$

$-R\frac{M}{\overline{f}}\frac{1}{\gamma}$ and $(p-c)\frac{\partial q}{\partial R}=(p-c)\alpha\frac{M}{\overline{f}}\frac{-1}{\gamma}$, so that:

$$\frac{\partial\Big((p-c)q+Rm\Big)}{\partial R}\gamma\frac{\overline{f}}{M}=\phi(\nu-p)-2R-\alpha(p-c)=0,\Rightarrow \tag{5A}$$

$$R^{*}=\frac{\overline{f}(\nu-c)(\phi-\alpha)}{4\overline{f}-M(\alpha+\phi)^{2}}\gtreqless 0 \;\;\Leftrightarrow\;\; \phi\gtreqless\alpha \tag{5}$$

The denominator of R^* is positive due to the second-order condition.[11] This assumption warrants that the induced demand function (1′) is downward-sloping in p.

Whether the commission fee is positive or negative depends on the sizes of network externalities. If the network-size externality is strong such that $\phi>\alpha$, the motive to charge app developers dominates in determining R^*, resulting in a positive equilibrium commission fee $R^*>0$. Conversely, if app-variety externality is strong and $\alpha>\phi$ holds, the platformer subsidizes app developers to expand the demand for the network good through increased variety and to increase demand for the network good. The decision in (5) then feeds back into the pricing channel in (4). When the network-size externality is strong ($\phi>\alpha$), the platformer decreases the equilibrium price to stimulate consumption. Otherwise, the equilibrium price for the good exceeds the standard markup but the entry of app developers and the consumption externality still allow the expansion of the network.

Proposition 1. The monopoly platformer sets the commission fee R^* to be positive if production externality ϕ (the extent that the iPhone induces developers' entry in (2′)) is greater than consumption externality α (the extent that R discourages iPhone's demand in (1′)), and sets R^* negative otherwise.

Substituting (4) and (5) into the induced demand (1′), we have:

$$q^{*}=\frac{2\overline{f}(\nu-c)}{4\overline{f}-M(\alpha+\phi)^{2}}\quad\text{and}\quad m^{*}=\frac{M(\nu-c)(\alpha+\phi)}{4\overline{f}-M(\alpha+\phi)^{2}} \tag{6}$$

q^* is increasing in both α and ϕ, so regardless of the sign of $\alpha\gtrless\phi$, we see that the role of the commission fee is to raise the number of the network users and participating firms.[12]

[11]For the second-order condition, we have $\frac{\partial^2\pi_P}{\partial p\partial p}\gamma^{-1}=-2$, $\frac{\partial^2\pi_P}{\partial R\partial R}\gamma^{-1}=-2\frac{M}{\overline{f}}$, $\frac{\partial^2\pi_P}{\partial p\partial R}\gamma^{-1}=-\frac{\alpha M}{\overline{f}}-\frac{\phi M}{\overline{f}}$. Therefore,

$$4\overline{f}-M(\alpha+\phi)^2>0.$$

[12]The collected fee R^*m^* per se will offset with the externality part of the network-good's price, and there is no excess profit from commission fee revenue: $p^*-c=\frac{\nu-c}{2}-\frac{(\alpha+\phi)MR^*}{2\overline{f}}$ and the second term offsets with $R^*\frac{m^*}{q^*}=R^*\frac{M}{2\overline{f}}(\phi+\alpha)$. Surrounding the benchmark gains-of-trade value of $\frac{\nu-c}{2}=\nu-p^*|_{R=0}$ in (4), meaning also that $\phi=\alpha$, one can equate

3.2 Consumer surplus and producer surplus

Turning to the welfare effects, our specification yields the following consumer surplus and producer surplus, which are increasing in the number of network users q^* and the number of app developers m^* respectively (for CS, see Appendix A):

$$CS = \frac{q^{*2}}{2}, \quad PS = \int_0^{\overline{f}_S} \{\phi q - R - f_S\} \frac{M}{\overline{f}} df_S = \frac{m^{*2}\overline{f}}{2M} \tag{7}$$

4 Price ceiling: to app store or to iPhone?

In the present model, consumers receive direct benefits from the network good, while apps provide indirect benefits. Producers receive indirect benefits from consumers and pay R to the platformer. In this main section of the analysis, we discuss the following novel feature: the ceiling policy that benefits a party *in*directly (R for the consumer and p for the developer) will make "Pareto improvement":[13] consumer surplus and producer surplus all rise (Proposition 2). As briefly mentioned in Appendix A, the price ceiling on the price of apps does not seem a good idea.[14] Hence, the following analysis focuses on the regulation on commission fee instead of the price of apps.

We first consider the ceiling policy $\hat{R}$ in the neighborhood of R^*,

$$\hat{R} = R^* - \epsilon$$

with $\epsilon > 0$, and the platformer's commission fee is constrained by $R \leq \hat{R}$. In the following, we deal with the case of $\phi > \alpha$ (so that the unregulated commission fee is $R^* > 0$) since the analysis is completely symmetric in the reverse case.

4.1 Commission-fee Ceiling

The first key point to understand is that the platformer re-optimizes against the commission-fee ceiling. Denoting all variables with the reaction of the ceiling policy by "hat", and in this section

q^* in (6) with the function before platformer's optimization (1′) as: $q^* = \frac{\overline{f}(\nu-c)/2}{\overline{f}-M\frac{\{\alpha+\phi\}^2}{4}} = \frac{\overline{f}(\nu-p)-\alpha MR}{\overline{f}-\alpha M\phi}$. Intuitively, utilizing externalities for pricing, the multiplier (self-enforcing) effect of the product's demand with respect to the retained benefit $\nu - p$ or $\frac{\nu-c}{2}$ is stronger in the optimized demand function than the effect in the price-taker's induced demand. $\frac{\{\alpha+\phi\}^2}{4} > \alpha\phi$ when $R^* \neq 0$.

[13]Conceivably, the government does not take into account the profit of the platformer (π_P) for the domestic welfare: the platformer is typically a foreign multinational firm which does not bring benefits apart from the platform services.

[14]First, the price of apps below $p_{ai} = \phi q$ causes exits of app developers, with total surplus getting lower than the unconstrained equilibrium. Second, with R^* being controlled by the platformer as the "upstream" firm, the departure from the apps' fee below the competitive price is a form of multiple marginalization problem.

we use superscript $*$ only to represent the benchmark (unregulated) values, the new price $\hat{p}$ has its feature for $d\hat{p} = \hat{p} - p^*$ from (4A):

$$\hat{p} = c + \frac{\nu - c}{2} - \frac{\{\alpha + \phi\}M(R^* - \epsilon)}{2\overline{f}} \quad \Rightarrow \quad d\hat{p} = \epsilon(\alpha + \phi)\frac{M}{2\overline{f}}$$

With $\hat{R} < R^*$, the platformer re-optimizes with the increase of the product's price. The second key point is that the following cross-market effect occurs: substituting these values into the numerator of $q(\hat{p}, \hat{R}) = \frac{\nu - \hat{p} - \alpha \hat{R} M/\overline{f}}{1 - \alpha\phi M/\overline{f}}$ in (1′) and subtracting it from the unconstrained equilibrium $q = q^*$:

$$dq(\hat{p}, \hat{R}) \propto -d\hat{p} - \alpha d\hat{R}\frac{M}{\overline{f}} < 0 \quad \text{if} \quad \{-\alpha + \phi\}(-\epsilon)\frac{M}{2\overline{f}} < 0 \quad (\ R^* > 0\ ) \tag{8.1}$$

Quite surprisingly, when the unconstrained commission-fee R^* is positive, the commission-fee ceiling decreases the consumption of the network good and the consumer surplus. This result is because, in the induced demand $q(p, R)$, the commission-fee's reduction counts by the order of $\alpha\frac{M}{\overline{f}}$, whereas this policy raises p by the order of $(\alpha + \phi)\frac{M}{2\overline{f}}$ and lowers the number of network users.

As to the developers, substitute these values to the numerator of the expression of $m = \frac{M}{\overline{f}}\frac{[\phi(\nu - \hat{p}) - \hat{R}]}{1 - \alpha M\phi/\overline{f}}$,

$$dm(\hat{p}, \hat{R}) \quad \propto \quad \big(-\phi\{\alpha + \phi\}\frac{M}{2\overline{f}} + 1\big)\epsilon \tag{8.2}$$

The developers' net benefit is decreasing in the entry responsiveness, and we show below that another factor that newly matters for its sign is $\frac{\phi}{\alpha}$. Assumption 1 does not warrant its sign. We will come back to an implication of this formula later.

4.2 Indirect and direct benefits of policies

The fact that the commission-fee ceiling may not work for the consumers' welfare motivates us to examine another policy, which is *a price cap on p*.

If a price cap on p, denoted by "bar", is imposed as $\bar{p} = p^* - \delta$ ($\delta > 0$), the platformer re-optimizes the commission fee through the first-order condition on R: Again, another variable is raised. Substituting $\bar{p} = p^* - \delta$ and the platformer's revised commission fee in (5A), $\phi(-d\bar{p}) - 2d\bar{R} - \alpha d\bar{p} = 0$ so that $d\bar{R} = \{0.5\phi + 0.5\alpha\}d\bar{p}$ into the numerator of $m = \frac{M}{\overline{f}}\frac{[\phi(\nu - \bar{p}) - \bar{R}]}{1 - \alpha M\phi/\overline{f}}$, in (2′), we see for the increase or decrease of m by the price ceiling as:

$$dm(\bar{p}, \bar{R}) \propto \phi(-d\bar{p}) - d\bar{R} > 0 \quad \text{if} \qquad \phi - 0.5\phi - 0.5\alpha > 0 \tag{8.3}$$

Interestingly and quite symmetrically with the case of the consumer surplus, the total number of apps and *the producer surplus* are increased by the price ceiling when $\phi - \alpha > 0$. This in turn provides that *the increase of* m from the price ceiling warrants the increase of the consumption by $q = v + \alpha m - p$ in the demand function (1).

Proposition 2. Suppose that the unregulated commission fee satisfies $R^* > 0$.

(i) The price ceiling on the network product brings the following welfare consequences. First, the policy increases the producer surplus. Second, $dm > 0$ and $-d\bar{p} > 0$ imply the increase of the consumer surplus.

(ii) The price ceiling of the commission fee on the app developers reduces the consumer surplus.

(iii) If the entry responsiveness $\frac{M}{f}$ or $\frac{\phi}{\alpha}$ is sufficiently small, developers prefer R–ceiling that brings direct benefit to p–ceiling.

Part (iii) will be explained later. Parts (i) and (ii) are contrary to the initial impression. We show that, in our typical Armstrong (2006)-type model, an unconstrained equilibrium failed to maximize total surplus of the platform participants so that *either* the regulation on R *or* p benefits total surplus. However, the commission-fee ceiling does not work for the consumers' welfare when $R^* > 0$ (in general, when the unconstrained commission fee is high reflecting the platformer's charging motive).

To the best of our knowledge, the full welfare implications of price ceiling policies have not been addressed in current policy or public debates. Our novel approach starts from the variable that affects each party indirectly — R for consumers and p for developers. The relationship between these variables and consumption (or app production, in the case of developers) influences the consumer and producer surplus under different policy. The profit of app developers determined by the price ceiling of p in (8.3) crucially depends on the strength of two externalities. In the reverse case of the current scenario — namely, when $\alpha > \phi$ — we refer to (8.1) to find that $-d\hat{R} > 0$ leads to an increase in both $\hat{q}$ and $m(\hat{q}, \hat{R})$. This implies that, once policymakers identify the underlying parameters that determine the sign of unregulated commission fee R^* , they can always identify a Pareto-improving policy.

However, the party who receives direct benefit (R for developers) may prefer the policy that gives them direct benefit. We prove in Appendix B that the increase of the profit is higher with

$\phi > \alpha$	CS	PS
$\hat{R} < R^*$	Eq.(8.1); $(-)$ by the order of $\alpha - \phi$	Eq.(8.2); possibly larger than eq.(8.3)
$\bar{p} < p^*$	increase (by $p \downarrow$ and $m \uparrow$)	Eq.(8.3); $(+)$ by the order of $\phi - \alpha$

Table 1: Welfare effects of price ceiling

a suitable commission-fee ceiling policy when $\max\{\frac{\phi}{\alpha}, \frac{\alpha}{\phi}\}$ is not much larger than 1, or when the entry responsiveness is small. In such cases, the app developers and consumers face a conflict of interest between a policy that makes both parties better-off (price ceiling in Table 1) and the one which gives a bigger benefit to one party (commission-fee ceiling in Table 1).

5 Conclusion

The world has been globalized but a big share of the total consumption, such as a multi-sided market on digital contents in the present study, is characterized by an oligopoly with a few gigantic firms. Rysman (2009) raised a crucial issue on antitrust policies in two-sided markets. The intervention by the antitrust authorities (where, as we noted in the text, we exclude the MNE's profit from the total surplus) looks appearing in its first sight. However, the discussion needs some caution since our model provides clear-cut real-world explanations of the monopolist's attempt for reduction of the product's price or for stimulating the supply and the demand of multi-sided markets, and as well, its profit-maximizing no-excess-profit policy from commission fee revenue in footnote 12 below. They are what Rysman (2009) indicated: the monoplolistic situation (in one of the multi-market) is not an antitrust violation by itself. Indeed, price ceiling may hurt developers or consumers unless the correct policy was adopted. Nevertheless, we proved that the Pareto-improving policy always exists and it can be found by the sign of the unconstrained equilibrium's commission fee.

Practically, estimating the sizes of network externalities is essential to identify the correct policies. As Birke (2009) listed empirical papers estimated network effects, empirical analysis on α and ϕ remains an important future research not only for academics but also for policy-makers.

Appendix

A. Derivation of (1) , consumer surplus and apps' equilibrium price

Consumers of the network good are heterogeneous in their preference over the network good. Specifically, consumer k has the following net utility from purchasing the good,

$$u_k = b_k + \alpha m - p,$$

where b_k is fundamental willingness to pay for the good and is assumed to be uniformly distributed, $b_k \in (-\infty, \nu]$ whereas the last term p is the price for the good. We assume that consumers decide to buy one unit of the good or not. This means that consumer k buys the good if $u_k \geq 0$ or equivalently $b_k \geq p - \alpha m \equiv \underline{\nu}$ holds, which implies that consumers having higher fundamental willingness to pay than $\underline{\nu}$ buy the good, leading to (1),

$$q(p) = \int_{\underline{\nu}}^{\nu} 1 db_k = \nu - \underline{\nu} = \nu + \alpha m - p.$$

With the above features, we have the following formulation about the consumer surplus:

$$CS = \int_{\underline{\nu}}^{\nu} (b_k + \alpha m - p)\, db_k = \frac{1}{2}(\nu^2 - \underline{\nu}^2) - \underline{\nu}(\nu - \underline{\nu}) = \frac{1}{2}(\nu - \underline{\nu})^2 = \frac{q^2}{2}.$$

In the platform, app user i is matched with an app developer who has a relation-specific technology that activates consumer's gross benefit a_i through computer algorithms or technologies. Following Rasch and Wenzel (2013) and Wu et al. (2023), this gross benefit is $a_i = \phi q$ as in the text,[15] and in Online Appendix we show that:

$$p_{ai} = \phi q \quad \text{for all } i.$$

The price ceiling on $\bar{p}_{ai} = p_{ai} - \delta_a$ is a downward marginalization against a competitive price. It merely distorts the entry of app developers in (2) downwards to $\bar{m} = \frac{M(\phi q^* - \delta_a - R^*)}{\bar{f}}$ which decreases the total surplus in the app market and the network users (1) to $q(p) = \nu + \alpha \bar{m} - p$.

[15] Strictly speaking, as other externalities appeared in the text, the right-hand side is the rational expectation value $\phi q_e = \phi q$ which each market participant regards to be given.

B. Proof of Proposition 2.(iii)

By taking the ratio between the positive term and the negative term of (8.3) and (8.2), we conclude the following: for any $d\bar{p}$ chosen in (8.3), the policymaker can choose a commission-fee ceiling policy with $dm(\hat{p}, \hat{R}) > dm(\bar{p}, \bar{R})$ if:

$$\frac{\phi}{\alpha}\phi\{\alpha+\phi\} < \frac{\overline{f}}{M}$$

holds. In words, $dm(\hat{p}, \hat{R}) > dm(\bar{p}, \bar{R})$ occurs if $\frac{\phi}{\alpha}$ is not much larger than 1 or the entry responsiveness is small. This is because the above condition is satisfied by the second-order condition. *Q.E.D.*

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Online Appendix for
"A Novel Argument on Regulating Prices in Two-sided Markets: Finding Win-Win Policy Correctly "

Yukihiro Nishimura

The following derivation of $p_{ai} = \phi q$ follows Nishimura (2025). The app's user has the net utility from app i by $v_i = \{a_i - p_{ai}\}A_i$ with p_{ai} being the relation-specific price of the app that a developer sets for app i, and $A_i = 0$ or 1, indicating whether the consumer buys the app. Following Rasch and Wenzel (2013) and Wu et al. (2023), network externality by the users with size q gives the user the expected gain by $a_i = \phi q$. Developers have relation-specific technology that activates consumer's gross benefit a_i through, for example, a better online algorithms or technology to match consumers and apps well based on individuals' consumption or search histories which are beneficial to predict their preference on apps. In the platform, a potential user is matched with an app developer. Since the potential users' population is greater than the number of app developers, there are people who cannot obtain the app. Note that the app user's benefit is realized only upon the developer's technology so that $a_i = 0$ when developers do not give an app to the consumer. With the fallback-option's utility being 0, the buyer of the apps has no other choice but to accept the maximal acceptable price:

$$p_{ai} = \phi q \quad \text{for all } i.$$

Additional Reference

Nishimura, Y., 2025. Tax incidence of VAT enforcement for foreign services and small businesses in two-sided markets. Presented at Center for Operations Research and Econometrics (CORE, Belgium) and Osaka University.