Platforms with Restrictive Licensing

Christiaan Hogendorn*

January 4, 2020

Abstract

Two-sided platforms coordinate two types of users in order to increase the value of the whole system surrounding the platform. Users of a platform have different outside opportunities, and these influence their behavior on the platform. Platforms often limit these outside projects through restrictive licensing agreements. These are often thought to reflect market power and a foreclosure motivation, but we show here that they can be a way of managing the "quality commons" aspect of a platform. This paper analyzes a platform where all component developers produce two kinds of quality – inside quality for their offerings on the platform and outside quality on their outside project. It shows that there are cases where restrictive licensing agreements that shut down the outside projects can increase social welfare, while in other cases they reduce social welfare. The reason is that if consumers and the platform value components inside quality enough, all agents prefer to be protected from low-quality behavior, even at the cost of giving up outside projects.

*Economics Department, Wesleyan University, 238 Church Street, Middletown, CT 06459. Email: chogendorn@wesleyan.edu.

1 Introduction

Two-sided platforms coordinate two types of users in order to increase the value of the whole system surrounding the platform. One side comprises the "components," such as software apps, that offer services on the platform, while the other side is usually end users or sometimes advertisers. Platforms take on complex roles as "facilitators" or "regulators" of their associated component systems. When platforms issue licenses to components, they often impose restrictive clauses that preclude certain activities off of the platform that would otherwise be profitable. A common example is shopping malls that limit the radius in which a tenant can build another store.

The restrictions we study are a subset of *exclusive dealing* where "the distributor agrees not to engage in any other business that competes directly with the manufacturer's activities (or even in any other business)" (Rey and Vergé, 2008) (pg. 355). Our main point is that in the setting where the "manufacturer" is a platform, the various intra-platform externalities tend to make the special case of "even in any other business" more likely.

This paper focuses on an efficiency-based motivation for these restrictive clauses. Some component firms may have outside opportunities that conflict with the inside goals of the platform and the other components on the platform. Specifically, we consider a case where component firms have diseconomies of scope in developing high-quality components. Such diseconomies could arise because of scarce managerial attention, scarce creative talent, or scarce marketing resources. If the quality of platform components has spillovers to the platform as a whole, a situation we term a *quality commons,* then the platform may want to take steps to remove the diseconomies of scope via restrictive clauses.[1] While clearly beneficial to the platform, such clauses may or may not raise social welfare.

[1] One piece of evidence for quality commons in shopping malls is that rental contracts commonly include "cotenancy" clauses that result in reduced rent if other tenants leave the mall. See, e.g., Fung, E. "Sears Closing Stores Is a Blessing for Some Landlords, a Curse for Others." *Wall Street Journal,* October 16, 2018.

There are two other potential motivations for restrictions of the type we study. One is vertical foreclosure, which would typically involve the platform providing an integrated product that competes directly with the component provider (Gilbert and Katz, 2011). The other is demand-side network effect where one platform would attempt to tip the market, or at least dominate the market, by denying components to another platform (Hogendorn and Yuen 2009). We do not suggest that either of these is implausible or even uncommon. Rather, we think that there are many additional cases where restrictive clauses do not appear to serve either of these goals but are present in licensing agreements nonetheless.

The next section reviews some economics literature relevant to this paper. Section 3 presents a simple model of two types of component providers producing both inside projects on a platform and outside projects that may involve diseconomies of scope. In section 4 we analyze equilibrium with and without exclusivity clauses, and compare the social welfare. Section 5 presents some discussion and conclusions.

2 Literature

This paper is part the literature on the *quality* of members of platforms and the policies platforms adopt to enhance that quality. Damiano and Hao (2008) study platform pricing as an aid to platform users' sorting. Hagiu (2009) studies exclusion of some low-quality types in order to increase average quality of one side of the market. Boudreau (2007) challenges the conventional wisdom that more components are always better for a platform, finding that benefits instead follow an inverted U-shape in the number of components. He makes a useful distinction between "platforms," which are surrounded by thousands, even hundred-thousands, of components and "alliances" where the number of components is smaller and the contractual relations can be more individual. While the model of this paper applies to alliance situations in some cases, it is primarily designed for the case of platforms where the sheer number of firms requires a broad-brush approach to contracting. In the closest paper to this one, **?** discusses exclusive contracting in pay-TV as a way to increase the incentives for program providers to invest in quality, but he focuses on asset specificity rather than diseconomies of scope.

Boudreau and Hagiu (2009) introduce the idea that the platform is similar to a regulator, and may try to regulate quality. They discuss the demise of the Atari video game platform of the early 1980s, when a flood of low-quality components was blamed for wrecking the market in a sort of Gresham's Law of video games. Recent, more successful platforms have tried to avoid such problems with tighter management of component quality. Three examples from Boudreau and Hagiu are particularly relevant to the present model. First, the TopCoder platform runs a series of programming contests to match clients with programmers. To maintain the coders' focus on the contests, "TopCoder imposes its control over all interactions with customers; software developers do not interact with final customers." (pg. 176) Thus, TopCoder excludes outside contact which might be in the narrow self-interest of an individual programmer but would reduce the value of the platform as a whole. Second, the Roppongi Hills real estate development in Tokyo adopted an "only one" policy whereby stores that locate there are required to produce unique features *not* available anywhere else. Third, Boudreau and Hagiu note that faculty members of business schools are usually subject to maximal thresholds on the time they may spend on consulting work. Again, the motivation is to maintain the quality of their input into the platform (here, the school).

Other closely related work concerns technology licensing and exclusive territories. Schuett (2008) presents a model of field-of-use restrictions (FOUR) in technology licensing. His review of the empirical literature suggests that 30-50% of all technology licenses include field-of-use restrictions. Like us, he focuses on cost heterogeneity among the licensee firms as an efficiency motivation for restrictive licenses. He analyzes the potential for restrictions to include noncontractible, producer-surplus-reducing overlap, and he shows that licensors can use royalties to mitigate this contracting problem. The literature on exclusive territories (CITE) strikes a similar theme, but there is an essential difference. With exclusive territories, there is another dealer, in a contractual relationship with the producer, who would otherwise be engaged in commerce within the excluded territory. Thus the producer is excluding a firm from producing the *same* product as it is protecting, while our interest is in producers excluding a *different,* noncompeting, product. That said, the end goal is the same: to increase the quality of the protected product.

The timing of this model has the platform first announcing its contractual offerings to component providers and its pricing to consumers. Then the component providers choose whether or not to join the platform, and after observing the number of component providers, consumers decide to join the platform. This is is the sequential game structure pioneered in Katz and Shapiro (1985) and Church and Gandal (1992); both those papers showed that multiple equilibria are possible: there is always a zero equilibrium where the platform receives no components. Hagiu (2006) analyzed this timing in the context of two-sided pricing, paying particular attention to the question of whether the platform precommits to consumer pricing at stage 1 or chooses it *ex post* at stage 3. He finds that precommitment is optimal as long as sellers coordinate on the positive rather than zero equilibrium, an assumption that we follow here. The sequential game structure is contrasted with simultaneous games where buyers and sellers join the platform at the same time. This structure was used in the original two-sided markets literature pioneered by Rochet and Tirole (2003) and Armstrong (2006).

3 Model Setup

We model a single platform that connects consumers with components. Component providers are potentially multi-product firms. For each component provider i, the "inside product," product 1, is specific to the platform and has quality level q_{1i}. The "outside product," product 2, can be sold directly to consumers without use of the platform; its quality is q_{2i}. To isolate the effects that are internal to the platform, we let these products be unrelated in demand (cross elasticity of 0). Thus, we rule out any foreclosure incentive whereby the platform tries to shut down production of product 2 in order to increase its own demand directly.

3.1 Timing

The game is in three stages. First, the platform chooses a fixed access price P_1 that consumers will pay, and it also chooses whether components will be restricted from working on the outside project if they join the platform.

In the second stage, a population of n component providers choose whether or not to accept the contract. Component providers have cost function

$$C(q_{1i}, q_{2i}) = q_{1i}^2 + \gamma q_{1i} q_{2i} + q_{2i}^2$$

where the term γ determines the component's type, namely whether it is a substitute type or not. Let γ=0 with probability ρ and γ=1 with probability $(1-\rho)$, these are the neutral and substitute types respectively. Let $n_1 \leq n$ denote the number of component providers who actually join the platform.

Component providers receive revenue

$$R(q_{1i}, q_{2i}) = \beta D + p_2 q_{2i}$$

where β is a parameter, D is the number of consumers who end up signing up for the platform, and p_2 is the price per unit of quality of the outside product. Note that a component provider's revenue from its inside product does not depend directly on q_{1i}, but only indirectly through the number of consumers who sign up for the platform. We can think of the component providers being engaged in pure team production with their inside products.

In the third stage, consumers choose whether or not to subscribe to the platform, and they also buy the outside product in a separate decision. For goods on the platform, consumers only care about *average* quality,

$$\overline{q}_1 = \sum_{i=1}^{n_1} q_{1i}$$

A consumer of type θ who pays to access the platform receives utility

$$U_1 = v n_1 \overline{q}_1 - P_1 - \theta$$

Note that consumers care about both the number of components and the average quality of components on the platform. Parameter v indexes the value of quality to the consumer, while consumer type parameter θ is distributed uniformly on [0,1].

Consumers also may purchase the outside products of the components. Denote the number of components that offer outside projects by $n_2 \leq n$. The utility a consumer receives from these projects is

$$U_2 = (w - p_2) n_2 \overline{q}_2$$

where w is a parameter indexing reservation utility for quality of the outside projects and $\overline{q}_2$ is the average quality of the outside projects. Here the motivation for using the average is purely for easy comparability with U_1.

Note that the two utilities are additively separable, so they do not interact in the consumer's decision of whether or not to buy the platform. We will only need the utility U_2 for welfare analysis, not for finding the equilibrium of the game. For simplicity, we assume that p_2 is fixed.

From here on, we will drop the i subscript from the quality choices because it is the average quality that matters, so every component will behave identically.

3.2 Third Stage: Consumers

We now solve backward to find a subgame-perfect equilibrium. Given $\overline{q}_1$, and n_1, all consumers with $U_1 > 0$ will subscribe to the platform, so

$$D(P_1, n_1, \overline{q}_1) = v n_1 \overline{q}_1 - P_1$$

provided that $D \leq 1$.

3.3 Second Stage: Components

In Stage 2, the exclusivity provision has already been set. The components must decide whether or not to enter, and if so what quality to choose.

One possible case is that a component (of either type) chooses not to join the platform and to specialize on the outside product. In this case, $q_1 = 0$, and the cost functions of the neutral and substitute types are identical. An outside-specialized component solves

$$\max_{q_2} \Pi_2 = p_2 q_2 - q_2^2$$

This yields an optimal $q_2 = \frac{1}{2} p_2$ and outside payoff

$$\Pi_2^* = \frac{1}{2} p_2^2 - \left(\frac{1}{2} p_2\right)^2 = \left(\frac{1}{2} p_2\right)^2$$

The opposite case is that a component specializes on the inside product only. Either type might be required to do this by contractual obligation, and a substitute type might do it voluntarily to avoid diseconomies of scope. An inside-specialized component sets $q_2 = 0$, which again makes the cost functions of the two types identical. The component then solves

$$\max_{q_1} \Pi_1 = \beta D(P_1, n_1, \overline{q}_1) - q_1^2$$

Denote the value of this problem by Π_1^*.

Finally, there is the case of a component that pursues both projects at the same time. An unspecialized neutral component solves

$$\max_{q_1, q_2} \Pi_{12}^N = \beta D(P_1, n_1, \overline{q}_1) + p_2 q_2 - q_1^2 - q_2^2$$

Denote the maximum by Π_{12}^{N*}.

If the substitute type pursues both projects, it solves

$$\max_{q_1, q_2} \Pi_{12}^S = \beta D(P_1, n_1, \overline{q}_1) + p_2 q_2 - q_1^2 - q_1 q_2 - q_2^2$$

Denote this maximum by Π_{12}^{S*}.

Each type of component will select between the above three candidate optima, selecting the one with the highest payoff.

3.4 First Stage: Platform

In stage 1, the platform maximizes its own revenue, $P_1 D(P_1, n_1, \overline{q}_1)$. The demand function takes the form $D(P_1, n_1, \overline{q}_1) = v n_1 \overline{q}_1 - P_1$, so the first order condition for access price P_1 is

$$\frac{\partial P_1 D(P_1, n_1, \overline{q}_1)}{\partial P_1} = (v n_1 \overline{q}_1 - P_1) - P_1 = 0$$

For now, we leave aside participation constraints for the components, but we will return to them in the next section. Assuming participation is not an issue, the platform optimally sets

$$P_1 = \frac{v n_1 \overline{q}_1}{2}$$

That is, the platform sets the consumer access price at one-half the demand intercept, i.e. the point where price elasticity of demand is unitary. This is the standard result for any monopolist with zero marginal cost and a linear demand curve.

4 Equilibrium

We analyze the platform's maximization problem for two different types of contracts: (i) an unmanaged platform which restricts neither q_1 nor q_2, and (ii) a restrictive contract that specifies $q_2 = 0$ but leaves q_1 unmanaged.

In all of what follows, we focus on the cases where both component types join the platform ($n_1 = n$) and check that the relevant participation constraints are met. Clearly it would not be in the platform's interest to promote the case where zero components join the platform. The case of only neutral components joining is somewhat more interesting, but the platform would only prefer this case if the indirect network effect v and/or the proportion of substitute types $(1-\rho)$ were low. If these were low enough, there would be little opportunity cost of excluding substitute types. However, the point of this paper is to study platform strategies with respect to substitute types, so we are most interested in the case where the substitute types are too numerous and/or too valuable to ignore.

4.1 An Unmanaged Platform.

If the platform does not place any constraints on the behavior of the firms, then the neutral types will never specialize. Their profit maximization problems are:

$$\max_{q_1,q_2} \Pi_{12}^N = \beta D(P_1, n, \overline{q}_1) + p_2 q_2 - q_1^2 - q_2^2$$

Since this function is additively separable in q_1 and q_2, the optima are determined independently of one another. Note that any one component's inside quality decision affects the average only a little: $\frac{\partial \overline{q}_1}{\partial q_1} = \frac{1}{n}$. This means the first order condition for a neutral type's inside quality optimum is:

$$\frac{\partial \Pi_{12}^N}{\partial q_1} = \frac{\beta n v}{n} - 2q_1 = 0 \Rightarrow q_1 = \frac{\beta v}{2}$$

Since this does not take account of the spillover to the other $n-1$ components, there is a quality commons problem.

The first order condition for a neutral type's outside quality is

$$\frac{\partial \Pi_{12}^N}{\partial q_2} = p_2 - 2q_2 = 0 \Rightarrow q_2 = \frac{p_2}{2}$$

Substituting the optimal solutions into the objective function gives the optimal profits:

$$\Pi_{12}^{N*} = \beta(v n \overline{q}_1 - P_1) + \frac{1}{4} p_2^2 - \frac{1}{4}(\beta v)^2$$

The problem of a substitute type is more complicated because its cost function includes diseconomies of scope between the two quality levels. If it chooses to pursue both projects, it solves

$$\max_{q_1,q_2} \Pi_{12}^S = \beta D(P_1, n, \overline{q}_1) + p_2 q_2 - q_1^2 - q_1 q_2 - q_2^2$$

Assuming the interior solution exists, the first order conditions are:

$$\frac{\partial \Pi_{12}^S}{\partial q_1} = \frac{\beta n v}{n} - 2q_1 - q_2 = 0$$

$$\frac{\partial \Pi_{12}^S}{\partial q_2} = p_2 - q_1 - 2q_2 = 0$$

Solving simultaneously gives:

$$q_1 = \frac{2}{3}\beta v - \frac{1}{3}p_2 \qquad q_2 = \frac{2}{3}p_2 - \frac{\beta v}{3}$$

Substituting the optimal solutions into the objective function and simplifying gives the optimal profits:

$$\Pi_{12}^{S*} = \beta(vn\overline{q}_1 - P_1) + \frac{1}{3}p_2^2 - \frac{1}{3}(\beta v)^2$$

This leads immediately to a result:

Lemma 1: Non-specialized substitute types have higher payoffs than neutral types due to free-riding: $\Pi_{12}^{S*} > \Pi_{12}^{N*}$

The result in Lemma 1 is typical of the payoffs to free-riders (or really "reduced-effort riders") in pure team production settings. The result would not be so stark if we further supposed that neutral types tend to be larger firms, with a higher multiple β in their revenue functions and no corresponding multiple in their cost functions due to economies of scale in *quantity* as opposed to the constant returns to scale in *quality* that we have focused on here. Since this paper focuses on managing free-riding behavior, it makes sense to emphasize that behavior. Even if we added a size multiple, it would still be true that substitute types have higher revenue per unit of quality that they contribute to the platform, which is the essence of the problem from the platform's point of view.

Alternatively, the substitute type could specialize in the inside project only. In that case, it would solve:

$$\max_{q_1} \Pi_1 = \beta D(P_1, n, \overline{q}_1) - q_1^2$$

The solution is $q_1 = \frac{\beta v}{2}$ and the payoff is

$$\Pi_1^* = \beta(vn\overline{q}_1 - P_1) - \left(\frac{\beta v}{2}\right)^2$$

Based on the above, we can see that if substitute types specialize, they behave like neutral types, and the average quality level is $\overline{q}_1^H = \frac{\beta v}{2}$. If substitute types pursue both projects, the average quality level is

$$\overline{q}_1^L = \rho \frac{\beta v}{2} + (1-\rho)\left(\frac{2\beta v}{3} - \frac{1}{3}p_2\right)$$

which is lower than $\overline{q}_1^H$. This lower quality $\overline{q}_1^L$ is decreasing in the price of the outside project p_2.

Lemma 2: Average component quality is inefficiently low in an unmanaged equilibrium.

Proof: This follows from the quality commons formulation where average quality enters the payoff function. If substitute components specialized and all components colluded on quality, they would maximize $\beta(vn\overline{q}_1) - \overline{q}_1^2$ by choosing $\overline{q}_1$ and set $\overline{q}_1 = \frac{1}{2}\beta vn$. If the substitute types remained unspecialized, the collusive quality would maximize, by choice of $\overline{q}_1$, a weighted average of Π_{12}^N and Π_{12}^S.

From here on, we will assume that on an unmanaged platform, the substitute type prefers to pursue both projects rather than specializing:

Outside Project Value (OPV) Assumption: The price of the outside project, w, is neither too low nor too high, so that a substitute-type component chooses an interior solution pursuing both projects whenever it chooses to participate in the platform:

$$\frac{\beta v}{2} \leq p_2 \leq 2\beta v \qquad \text{(OPV)}$$

Our justification is simple: the point of this paper is to discuss components that might problematically pursue outside projects. If such components independently give up on such projects in order to specialize on the platform, or if they find such projects so valuable that they do not join the platform, they are not of interest here.

4.2 A Platform with Restrictive Licenses

We have seen that the inside quality level is too low due to the commons problem when the platform is unmanaged. Suppose that the only tool available to the platform to manage this problem is to ban outside projects, thus forcing $q_2 = 0$. Clearly such exclusivity will have a high cost, since neither type of component will receive the profits from the outside proуct. But there is also a benefit, because the inside quality produced by the substitute components will rise. Our question in this section is whether the quality increase can be enough to outweigh the cost and still meet the participation constraints.

From the previous section, it is clear that with the outside product removed, both types behave like the inside-specialized substitute type. We have seen that this leads to an optimal quality choice

$$q_1 = \frac{\beta v}{2}$$

and inside-specialized payoff

$$\Pi_1^* = \beta\left(vn\frac{\beta v}{2} - P_1\right) - \left(\frac{\beta v}{2}\right)^2$$

The first question is whether components would participate in a platform offering such a contract (and no other alternative). This depends on whether the profits from the inside product exceed the value of the outside product, namely whether

$$\Pi_1^* \geq \Pi_2^* \Rightarrow \beta\left(vn\frac{\beta v}{2} - P_1\right) - \left(\frac{\beta v}{2}\right)^2 \geq \frac{1}{4}p_2^2 \qquad \text{(PC)}$$

Predictably, the participation constraint is met as long as the price the components receive for outside quality is not too high.

The next question is whether the platform actually gains from such a contract, and the answer here is clear:

Lemma 3: As long as the participation constraint is met, the platform gains from restricting outside projects. The amount of this gain is

$$v^2 n^2 \frac{\left(\overline{q}_1^H\right)^2 - \left(\overline{q}_1^L\right)^2}{4}$$

Proof: The platform's payoff is simply $P_1 D(P_1, n, \overline{q}_1)$. This is always increasing in $\overline{q}_1$, so any policy that increases average quality will increase the platform's payoff. As discussed above, the optimal interior value is $P_1 = \frac{vn\overline{q}_1}{2}$. Thus, the platform's gain is $\frac{(vn\overline{q}_1^H)^2}{4} - \frac{(vn\overline{q}_1^L)^2}{4}$ which simplifies as above. ■

Now let us turn to welfare analysis. This comes in four parts: the change in platform producer surplus, the change in neutral-type producer surplus, the change in substitute-type producer surplus, and the change in consumer surplus. Lemma 3 already showed the gain in platform producer surplus.

Lemma 4: A neutral type's payoff is higher on an exclusive versus unmanaged platform if

$$\frac{\beta v n}{2}\left(\overline{q}_1^H - \overline{q}_1^L\right) - \frac{1}{4} p_2^2 > 0$$

Proof: We are looking for the payoff difference

$$\Pi_1^*\left(\overline{q}_1^H\right) - \Pi_{12}^{*N}\left(\overline{q}_1^L\right)$$

This can be written out

$$\beta\left(vn\overline{q}_1^H - P_1\right) - \left(\frac{\beta v}{2}\right)^2 - \beta\left(vn\overline{q}_1^L - P_1\right) - \frac{p_2^2}{2} + \left(\frac{\beta v}{2}\right)^2 + \left(\frac{p_2}{2}\right)^2$$

If in both cases the platform sets P_1 equal to its optimal interior value, this can be simplified to the above. ■

This lemma is easily interpreted; the neutral types sees a gain in producer surplus due to the higher quality of the platform but a loss equal to its profits from the outside project.

Under OPV, a similar producer surplus comparison applies to a substitute type. It will gain less because it loses the advantage of free-riding on the neutral types' quality, but it does receive some benefit from avoiding diseconomies of scope.

Lemma 5: A substitute type's payoff is higher on a restrictive versus unmanaged platform if

$$\frac{\beta v n}{2}\left(\overline{q}_1^H - \overline{q}_1^L\right) + \frac{1}{12}(\beta v)^2 - \frac{1}{3}p_2^2 > 0$$

Proof: We are looking for the payoff difference

$$\Pi_1^*\left(\overline{q}_1^H\right) - \Pi_{12}^{*S}\left(\overline{q}_1^L\right)$$

This can be written out

$$\beta(vn\overline{q}_1^H - P_1) - \frac{1}{4}(\beta v)^2 - \beta(vn\overline{q}_1^L - P_1) - \frac{1}{3}p_2^2 + \frac{1}{3}(\beta v)^2$$

Again assuming an interior optimum for P_1, we have the expression in the lemma. ■

An interesting implication here is that depending on the parameters, either the neutral type *or* the substitute type may gain more (or lose less) from the imposition of the restriction. By comparing the expressions in Lemmas 4 and 5, one can see that a neutral type's payoff increases by more than a substitute type's payoff if $\beta v < p_2$. This condition may or may not hold under OPV, so either situation is possible. Interestingly, when it does not hold, the substitute types, which are the source of the problem for the platform, are nonetheless more willing to accept the solution.

Finally we turn to the change in consumer surplus. This has two components, the loss of utility from the outside projects and the change in utility due to the increased quality of the inside projects.

Lemma 6: Consumers' payoffs are higher under an exclusive platform than an unmanaged one if

$$v^2 n^2 \frac{\left(\overline{q}_1^H\right)^2 - \left(\overline{q}_1^L\right)^2}{4} - (w - p_2)\overline{q}_2 nM > 0$$

Proof: Each of the M consumers loses utility $U_2 = (w - p_2)\overline{q}_2 n$ from the outside products. Under OPV, the average quality of the outside products is

$$\overline{q}_2 = \rho \frac{p_2}{2} + (1-\rho)\left(\frac{2}{3}p_2 - \frac{\beta v}{3}\right)$$

Consumer surplus from the platform is the net utility squared, since we have assumed a demand curve with slope -1. Thus, the change in consumer surplus from the platform is

$$\left(\frac{vn\overline{q}_1^H}{2}\right)^2 - \left(\frac{vn\overline{q}_1^L}{2}\right)^2 = v^2 n^2 \frac{\left(\overline{q}_1^H\right)^2 - \left(\overline{q}_1^L\right)^2}{4}$$

This is the same as the platform's profit gain, since the platform's optimal price takes one-half the surplus from the consumers. ■

Combining the above Lemmas, we can see several main results.

Most obvious, if the consumer valuation of the outside projects, w, is high, then there can be a social welfare loss from exclusivity despite its efficiency advantages.

Second, the difference between $\overline{q}_1^H$ and $\overline{q}_1^L$ is key to any gains from exclusivity. This difference, in turn, is increasing in the percentage of substitute types and the price of the outside project.

Finally, the price of the outside project enters directly since it reflects lost producer surplus from moving to a restrictive regime. However, it also negatively affects consumer surplus from these outside projects.

5 Extensions and Conclusion

In the above, we assumed that both types of components are willing to participate in the restrictive regime. And we showed that it is possible that one or both types actually gain from the restriction. Even if they do not gain, they may still be willing to participate as long as the platform can make a take-it-or-leave-it offer. But considering the obvious loss from abandoning the outside project, one might expect that in many cases at least one component type would *not* be willing to participate under the restriction. Since the platform always gains from the restriction, we now ask whether there are other ways to ensure participation even when the participation constraints of the model above are not satisfied.

Menu of Contracts. We have considered a single contract offered to two different types of agents. It seems natural in this situation for the platform to offer a menu of two contracts. Properly designed, these contracts would separate the two types, allowing the neutral types to pursue their "harmless" outside projects and giving the substitute types incentives to accept an exclusive contract which would improve everyone's welfare.

In actual fact, we rarely see such a menu offered. Several reasons are possible, but the one that seems most likely is that the incentive compatibility constraint would require that the neutral type pay a substantial fee for the privilege of an unrestricted contract. This would violate principles of fairness and put the platform in the position of expropriating considerable surplus from its most valuable components.

Relaxed Restriction. Another way to meet the neutral types' participation conditions would be to relax the restriction that $q_2 = 0$. Instead, a restriction that q_2 must be less than or equal to some positive amount could be stipulated. This would increase the profits of the neutral type, and to a lesser degree the substitute type, and make their participation more likely. It has two disadvantages, however. First, it would reduce the substitute types' optimal q_1, partially negating the value of the restrictive regime. Second, it is less easy to monitor than the simple prohibition on outside projects.

Decrease Consumer Price. A final, and intriguing, solution to a binding participation constraint is for the platform to lower its price to consumers below the level $P_1 = \frac{vn\overline{q}_1}{2}$ analyzed above. By doing so, the platform gives up some profit (at least relative to what it would receive if the participation constraint could be ignored) but it also expands the size of its customer base. This does not change the optimal choice of q_1, but it does change the level of the profit of a component firm

$$\beta(v n \overline{q}_1 - P_1) - \left(\frac{\beta v}{2}\right)^2$$

raising it by β for every dollar of price reduction. An interesting implication is that such a move would also improve social welfare, since the platform behaves as a monopolist with the usual associated dead-weight loss. Thus, even in the case where the restrictive regime would otherwise be socially costly, it might become socially beneficial if coupled with a reduced P_1 to ensure participation.

Other Extensions. The model could be elaborated with respect to platform ownership and decision-making. We can expect a platform to make different decisions regarding restrictions if it is owned privately, owned by some mixture of the component types, or owned by the consumers. Another extension is that the outside projects, rather than being independent, might be collected on a platform of their own. Then outside project restrictions would serve two goals – the efficiency goal we have described here and a demand-side goal of reducing the number of components on the competing platform.

This paper presents a model for thinking about the quality of components on a platform when those components produce both indirect network effects and a quality commons whereby average quality matters. The model includes some firms whose incentives are less aligned with those of the platform due to outside opportunities that are privately valuable but negatively impact the quality commons due to diseconomies of scope. Restricting outside projects can increase average platform quality. This causes both gains and losses from a social welfare perspective, so it may or may not be a desirable behavior from a regulatory policy-maker's point of view. Still, it is important for policy-makers to consider these cost-side objectives and not jump to the conclusion of market power.

References

Armstrong, M. (2006). "Competition in two-sided markets." *RAND Journal of Economics*.

Boudreau, K., and Hagiu, A. (2009). "Platform rules: Regulating the ecosystem around a multi-sided platform." *Platforms, Markets and Innovation*.

Church, J., and Gandal, N. (1992). "Network effects, software provision, and standardization." *The Journal of Industrial Economics*.

Damiano, E., and Hao, L. (2008). "Competing matchmaking." *Journal of the European Economic Association*.

Gilbert, R. J., and Katz, M. L. (2011). "Efficient division of profits from complementary innovations." *International Journal of Industrial Organization*, *29*(4), 443–454.

Hagiu, A. (2006). "Pricing and commitment by two-sided platforms." *RAND Journal of Economics*.

Hagiu, A. (2009). "Quantity vs. quality and exclusion by two-sided platforms." *papers.ssrn.com*.

Hogendorn, C., and Yuen, S. (2009). "Platform competition with 'must-have' components." *Journal of Industrial Economics*, *57*(2), 294–318.

Katz, M., and Shapiro, C. (1985). "Network externalities, competition, and compatibility." *The American Economic Review*, *75*(3), 424–440.

Rey, P., and Vergé, T. (2008). "Economics of vertical restraints." *Handbook of antitrust economics*, *353*, 390.

Rochet, J., and Tirole, J. (2003). "Platform competition in two-sided markets." *Journal of the European Economic Association*.

Schuett, F. (2008). "Field-of-use restrictions in licensing agreements." *mpra.ub.uni-muenchen.de*.