Pricing strategies in two-sided platforms: 
The role of sellers’ competition 
by 
María Fernanda Viecens* 
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Pricing strategies in two-sided platforms: the role of sellers’ competition

María Fernanda Viecens†
FEDEA
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Abstract

This paper offers a model of a two-sided platform to inspect how competition and prices in the seller side affect the platform’s behavior, incentives and profits. When setting prices, sellers may be constrained by one of two margins: the demand margin and the competition margin. According to the competition margin a seller sets its price equal to the marginal contribution to the users utility. However, a seller may set a lower price because it also has to take into account the demand margin: a higher price reduces the overall demand for the platform and the sellers. This central result is used to compare the efficiency of vertical integration and the private incentives to partially integrate. Several interesting insights are obtained; in particular, the model can explain the tendency of firms which operate software platforms to integrate with so-called killer applications. The paper also shows that the platform has an instrument to profitably affect sellers’ prices and to induce the margin that will bind. It is proved that the degree of competition among sellers is a crucial factor determining profitability of the platform.

Keywords: two-sided markets, complements, vertical disintegration, competition policy, technology platforms

JEL Classification: L10, L12, D40

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†Mailing address: Jorge Juan 46, 28001, Madrid, Spain; E-mail: fviecens@fedea.es; tel.: +34 91 435 9020, fax: +34 91 577 9575.
1 Introduction

There are many modern (and non-modern) industries organized around platforms, from shopping malls to stock exchanges to nightclubs. These platforms support different kinds of interaction between two distinct groups of agents: matching users from both groups to enable them to transact (e.g., a job search site), building audiences by assembling content and services to attract viewers or users (e.g., Google search), collectively managing knowledge bases (e.g., Wikipedia) and forms of demand coordination (e.g., credit card network, operating system). In general, the higher the number of agents on one group, the higher the surplus of agents on the other group.

Two-sided market theory tells us about how such platforms work economically. Specifically, it studies the allocation of prices for using platform services between the two sides (groups) of the market, where one side is a ‘seller’ and the other a ‘buyer’. By setting a price on each side, the platform internalizes the externalities that may arise between the groups. The platform typically attracts one side by giving away services below cost or free to attract the less price-sensitive users on the other side.

In some of these markets buyers derive utility from consuming a system consisting of the platform and the sellers’ products that are complementary to the platform. Typical examples are software platforms as operating systems and video game consoles, where applications written by developers are consumed together with the platform. Because of this, buyers are in fact concerned about the system price, i.e., the total amount spent in the platform and the applications. The system price will hence depend on the two-sided pricing strategy of the platform firm, and on the pricing strategy in the developers’ market. Consequently, competition in the market of developers (sellers) will be relevant for users. However, to the best of my knowledge, there are no papers investigating the effect of the market structure of the seller side on platform’s strategies and welfare.

This paper offers a model of a two-sided monopoly platform to inspect how competition and prices in the seller side affect the platform’s behavior, incentives and profits. In analogy to Lerner and Tirole (2004), I distinguish between two constraints, the competition and the demand margin, where either one of them may be binding.\footnote{Lerner and Tirole (2004) introduce the two margins to analyze pricing strategies in patent pools.} According to the competition margin a seller sets its price equal to the marginal contribution to the users’ utility. However, a seller may set a lower price because it also has to take into account the demand margin: a higher price reduces the overall demand for the full system. A novel contribution of the paper is identifying that, when setting the price for the buyer side, the platform has an instrument to profitable affect sellers’ prices and to induce the margin that will bind.

The number of sellers in the market and the level of substitutability (competition) among them will determine the binding margin. In particular, when considering a software platform, the competition margin is more likely to bind
as long as buyers prefer a system with many applications and these are near substitutes. On the other hand, the demand margin will constrain the sellers when they have market power so that they can affect, when setting the price, the demand of the platform. Note that it is possible to establish an analogy between an oligopoly market for sellers and the situation where they are constrained by the demand margin. Similarly, a market where sellers are constrained by the competition margin can be interpreted as a very competitive market.

I then use this central result to compare the efficiency of vertical integration and the private incentives to partially integrate. Several interesting insights are obtained; in particular, the model can explain the tendency of firms which operate the platform to integrate with so-called killer applications.\(^2\) I show that the platform will be partially integrated with the applications for which demand margin will bind and will allow free entry for developers of other applications.

Some conditions about the relationship between the welfare effects of integration and the degree of substitution of the applications are derived. The analysis implies that the welfare enhancing effect of vertical arrangements between a platform and a set of applications will be determined to a larger extent by the level of importance that users give to this set. The outcomes confirm that all prices fall as a result of a vertical merger, but I show that the gain of merging is decreasing in the substitutability of the applications. In particular, when applications are close substitutes or the number of applications is very high, the effect on final prices of the merger tends to be negligible. While this is close to Lerner and Tirole (2004) it provides some valuable lessons in the context of two-sided markets.

Another contribution of the paper is to show that the degree of competition among sellers is a crucial factor determining profitability of the platform. Given a set of sellers, the more competitive they are, the more profitable is the business for the firm managing the platform.

Finally, I discuss the empirical relevance of the analysis. I make some comparisons between the market of operating systems and the market of video consoles.\(^3\) In a book about empirical business and economics aspects of software based platforms, Evans et al. (2006) document that almost all the successful firms in these industries started being one-sided, producing applications at home, and later they disintegrated becoming in firms producing only the platform and supported by independent developers.\(^4\) I here provide a possible explanation for this observed fact, based again on the margin that binds for

\(^2\) For instance, Microsoft produces operating system Windows and Office package. Nintendo wrote Mario Brothers, its killer game.

\(^3\) Similar analogies have been made before. For instance, Hagiu (2008) analyses the fact that operating systems and video consoles have followed quite different pricing strategies: operating system platforms charge high prices to the buyers and subsidize developers of applications. In contrast, video console firms charge low prices to users and make profits on the developers’ side.

\(^4\) PDA’s were born as "smart agendas" offering a limited number of applications. Then, they evolved to become "small computers". Something similar has occurred in the mobile phone industry: in addition to the traditional communication service, today they allow for hundreds of applications.
developers.

The structure of the paper is as follows. The remainder of this section presents the relationship of the article to the literature. Section 2 presents the model of a monopoly platform and section 3 sets up the optimization problem for the developers. Section 4 analyzes welfare and efficiency issues. Incentives for integration and partial integration of the platform with applications are also considered. The empirical relevance of the study is discussed in section 5. Finally, section 6 concludes.

1.1 Related literature

This article is related to the recent literature on two-sided markets, pioneered by Armstrong (2006), Caillaud and Jullien (2003) and Rochet and Tirole (2003, 2006). These papers emphasize the importance of indirect network effects between the two-sides of the market in determining platform pricing structures but they almost ignore the prices between sellers and users. In this paper I consider the interplay between sellers’ and platform’s strategies. Since the model includes the pricing decision of sellers, it captures the demand effects that arise from the price set by them. In this respect the paper is closely connected to Hagiu (2006, 2008) and Nocke, et. al. (2007). However, in their work assumptions are such that the competition margin always binds and ignore those situations where demand margin binds, which are central to my paper. Consequently, the general contribution of this article is to identify economic environments in which the demand margin binds.

Hagiu (2006) studies pricing and commitment by platforms when sellers arrive before buyers. In his model the platform is allowed to charge variable fees on each buyer-seller transaction, and these fees affect the prices and volumes of trade between sellers and buyers. In the model here, the mechanism by which the platform affects these prices is rather different. In particular, by charging high fixed prices to buyers it induces low sellers’ prices.

Platform ownership is discussed by Nocke, et. al. (2007) in a model where competition between sellers exists. They consider a continuum of them and denote a seller’s (gross) variable profit by

$$\Pi(m_s) = z(m_s)\pi(m_s),$$

where $m_s$ is the measure of entering sellers. The term $\pi(m_s)$ is the seller’s variable profit per unit mass of buyers and $z(m_s)$ is the mass of buyers visiting the market place, which is increasing in $m_s$. They assume that $\pi(m_s)$ will decrease with $m_s$ by two reasons. First, there is a market share effect: for given prices, if the amount of sellers increases buyers buy less from each seller; and second, there is a price effect: as the amount of sellers increases, prices fall as competition increases. In contrast, I find that when the demand margin binds $\pi(m_s)$ may not decrease as more sellers enter. Regarding the impact of $m_s$ on variable profits, it will depend on the interaction between two contrasting effects: on one hand, a positive indirect network effect that makes sellers’ profit
to increase as the number of firms on its own side increases by the impact of \( z(m_s) \) on profits, and, on the other hand, a negative competition effect which makes firm’s profit to decrease as the number of firms on its own side increases via \( \pi(m_s) \). The explicit model here allows me to study in depth the driving forces of these effects.

2 A monopoly platform model

Assume that there is a monopoly platform and preferences of users are defined over the platform, its applications and an outside good. There is a measure one of users with a preference for software variety and whose tastes for the platform are uniformly distributed along the unit interval. The gross utility of a user located at distance \( t \) from the platform is

\[
U = V(M) + x - kt,
\]

where \( M \) is the number of software varieties or applications purchased by the user, \( x \) is the numeraire good and \( k \) measures the degree of platform differentiation. Unless otherwise specified, applications are considered symmetric in importance. The component \( V(M) \) is assumed increasing in \( M \) and concave.\(^5\)

Every user who purchases the platform consumes at most one unit of each application and maximizes her utility by choosing applications and consumption of the outside good subject to the constraint

\[
\sum_{j=1}^{M} p_j + x + P^U = y,
\]

where \( p_j \) is the price of a unit of application variety \( j \), \( P^U \) is the charge that platform sets to the users and \( y \) is their income. A user’s decision can be decomposed into two decision problems. First, the user sets her optimal basket of applications among the total number in the market,

\[
G(M, \sum_{j=1}^{M} p_j, P^U) = \max_{M \leq N} \{V(M) - \left( \sum_{j=1}^{M} p_j \right) \} - P^U, \tag{1}
\]

where \( N \) is the number of applications in the market.\(^6\)

Then, the user buys the platform if and only if

\[
G(M, \sum_{j=1}^{M} p_j, P^U) - kt \geq 0.
\]

The users demand for the system (size of the network) is hence determined by

\[
t^d = \frac{G(M, \sum_{j=1}^{M} p_j, P^U)}{k} \epsilon [0, 1].
\]

Note that demand depends on the price that platform sets for the users, but also on the number and prices of applications.

\(^5\)Similar utility functions are used by Church and Gandal, (1992, 1993, 2000) and Church et.al. (2008).

\(^6\)It is implicitly assumed that products are sorted by increasing price.
On the other side of the market there are \( N \) developers of applications, each of them providing a single different application. Profits of developer of application \( i \) are given by

\[
\pi_i = p_i t^d - F - P^D,
\]

where \( F \) is a fixed cost of production, and \( P^D \) is the price that platform charges to developers to allow them to write applications for the platform.\(^7\)

Costs of the platform are assumed zero, so that platform profits are given by,

\[
\Pi = P^U t^d + P^D N.
\]

In this set-up I study the pricing strategies of the platform and developers. To do so I consider a game whose timing is as follows. In the first stage, the platform sets the charge to developers. In the second stage, the platform sets the price to the buyers. In the third stage, developers compete and set the prices for their applications to the buyers, then finally buyers decide if they buy the platform and the number of applications. Timing above takes into account that developers of applications join platforms before buyers do, a common feature in the software and video-game markets. Since the development of application is a costly activity, platform firms often deal with developers before selling their product in order to ensure that enough applications will be available to be used with the platform.\(^8\) An alternative timing is the one in Hagiu (2008) in which users decide about the developers products once they have purchased the platform. This alternative timing can be embedded in my model as equivalent to assume that developers can not affect the overall demand of the system when setting prices, i.e., the competition margin always binds as explained below.

3 Application prices and users payments

When a user considers buying the platform, her decision will depend upon the prices set by developers. No user will purchase a video console without buying some video games, nor an operating system without buying the application software. Because of this I first study how developers set prices which will be a key point in the analysis. I then solve the second stage of the game at which developers compete and set the prices for their applications to the buyers, then finally buyers decide if they buy the platform. Before that let me define an elasticity that will be used throughout the paper.

Ignoring the integer problem I define the elasticity of \( V(N) \), a measure of the degree of substitution of applications for the users, as follows,\(^9\)

\[
e_v(N) = \frac{V'(N)N}{V(N)}.
\]

\(^7\) The platform charges membership fees on both sides. As remarked by Hagiu (2008), nothing would change if the platform could also charge usage fees.

\(^8\) See Hagiu (2006) for more details about the reasonability of this timing.

\(^9\) It has also been interpreted as a measure of "degree of preference for variety" (see Kühn and Vives (1999) and Hagiu (2008)).
Since $V(N)$ is increasing and concave, it lies in the interval $(0, 1)$. Keeping $N$ and $V(N)$ fixed, I consider applications to be more substitutable when $e_v(N)$ decreases.\(^{10}\) Therefore, a higher $e_v(N)$ means that applications are less substitutable and competition among developers is less intense.

### 3.1 Equilibrium application prices

The problem faced by developers is similar to the problem faced by a licensor in a patent pool. In the context of patents, the licensor problem has been studied by Lerner and Tirole (2004). They show that, when setting a licensing fee, an individual licensor may be constrained by either of two margins that they call the \textit{competition margin} and the \textit{demand margin}. In the context here, developers are constrained in a similar way. If the developer can not increase her price without being excluded from the set of applications selected by the users, (in user’s problem (1)) then the competition margin binds. In contrast, demand margin is said to bind for developer $i$, if she can individually raise her price without being excluded but leading to a reduction in the overall demand for the system (effect on $t^d$). In particular, if the demand margin binds, a developer chooses a price $p_i = \hat{p}$ such that

$$\hat{p} = \arg \max \left\{ p_i \frac{V(N) - P^U - (N - 1)\hat{p} - p_i}{k} \right\}.$$  \hspace{1cm} (2)

Consequently,

$$\hat{p} = \frac{V(N) - P^U}{(N + 1)}.$$  

Note that this price depends on the level of $P^U$. In contrast, if the competition margin binds, the price that a developer sets is its marginal contribution to the users utility, i.e.,

$$\tilde{p} = V(N) - V(N - 1),$$

a price that depends on $V(N)$ and the substitutability among applications but not on $P^U$.\(^{11}\)

Next lemma, that follows immediately from propositions 1 and 4 in Lerner and Tirole (2004), shows the equilibrium outcome at this stage of the game.

\textbf{Lemma 1} There exists a unique and symmetric equilibrium such that, if $\tilde{p} < \hat{p}$, developers are constrained by the competition margin and charge equilibrium price $\tilde{p}$, whereas if $\tilde{p} > \hat{p}$, developers are constrained by the demand margin and charge equilibrium price $\hat{p}$.

As long as demand margin binds, developers set the price that maximizes their profits as defined in (2), and this price is lower than their marginal con-

\(^{10}\)Our interpretation here is similar to the one in Lerner and Tirole (2004): given $N$ applications and two surplus functions $V_1(\cdot)$ and $V_2(\cdot)$, such that $V_1(N) = V_2(N)$, applications are more substitutable for surplus function $V_1(\cdot)$ than for $V_2(\cdot)$ if $V_1'(\cdot) < V_2'(\cdot)$.

\(^{11}\)If we ignore the integer problem we have $\tilde{p} = V'(N)$. 

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tribution to the users’ utility. In contrast, if the competition margin binds, the developers are forced to set a price that is equal to this contribution.

The consideration of both scenarios allows me to include in the analysis situations where the developers consider the reduction in the overall demand for the system when contemplating an application price increase (i.e. when demand margin is binding). As said, other papers in the literature, such as Hagiu (2008) and Church et. al. (2008), implicitly restrict their analyses to a scenario where the competition margin is always binding. In particular, Hagiu (2008) assumes that developers set prices for applications once users have bought the platform. Similarly, Church et. al. (2008) derive the equilibrium prices set by developers under the proviso that platform sales are invariant to application pricing. The contribution here will not only be to study the case in which the demand margin binds, but also the comparisons that will follow.

3.2 What is the binding margin?

By using lemma 1 and the equilibrium values of prices \( \hat{p} \) and \( \tilde{p} \) the next lemma follows:

**Lemma 2** Developers are constrained by the competition margin if the platform sets a price to the buyers such that

\[
P_U < V(N) - \tilde{p}(N+1).
\]

(3)

If the opposite inequality holds, developers are constrained by the demand margin.

The main implication of condition (3) is that when setting the price for users, the platform may affect the price set by developers and may induce the margin that will bind for them. In particular, the higher \( P_U \), the lower \( \hat{p} \), and the higher the probability for the developers of being restricted by the demand margin. In this sense, \( P_U \) is an instrument that the platform has to modify the developers’ prices. In particular, the platform would like the developers to reduce their prices in order to boost the demand of the system. Consequently, when \( V'(N) \) is high, the platform firm will set a large \( P_U \) such that the developers’ price will be given by \( \hat{p} < V'(N) \). In contrast, if \( V'(N) \) is low, the platform will choose a low price for users. In other words, whenever the market of developers is not very competitive, because applications are not close substitutes, the platform is able to engage in a price squeeze whereby developers are forced to set a low price. The lemma below shows the equilibrium price that the platform will choose for users.

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12 In Church et. al. (2003), \( V(N) = N^\beta \). For this utility function they show that the Nash equilibrium in developers’ prices is given by \( p(N) = V'(N) \) when \( N > 1 \) and \( \beta \leq \frac{1}{2} \), so that, in our terminology, the competition margin binds.

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Lemma 3 In the second stage of the game the price that the platform will optimally set to users is given by

\[ p^U (N, e_v (N)) = \begin{cases} \frac{V(N)}{2} (1 - e_v (N)) & \text{if} \quad e_v (N) < \left[ 1 - \frac{1}{\sqrt{N+1}} \right] \\ \frac{V(N)}{2} & \text{otherwise}. \end{cases} \]

Proof: See the appendix.

Along the range of \( e_v (N) \), \( p^U (N, e_v (N)) \) is initially decreasing in it. However, when \( V' (N) \) starts to be sufficiently high, it is profitable for the platform setting a larger \( p^U (N, e_v (N)) \) that is constant in \( e_v (N) \). From the proof of this lemma immediately follows what are the conditions that lead the margin that will bind. Thus, the binding margin can be determined as a function of the primitives in the model.

Proposition 1 If

\[ e_v (N) < \left[ 1 - \frac{1}{\sqrt{N+1}} \right], \]

the competition margin will bind. If the opposite inequality holds, the demand margin will bind.

Proposition 1 above shows that the degree of substitution among applications and the number of developers determine the binding margin. The intuition of this result is the following: the competition margin will bind for the developers in a competitive environment, where substitutability is high or the number of developers is large. In contrast, if they have some market power, because \( N \) is low or applications are poor substitutes, the demand margin will bind.

Corollary 1 If \( e_v (N) \) is non-increasing there exists \( N^* \) such that if \( N < N^* \) the demand margin binds and if \( N > N^* \) the competition margin binds. However, if \( e_v (N) \) is strictly increasing, \( N^* \) may fail to exist, so that the demand margin always binds.\(^{13}\)

Proof See the appendix

4 Profits, welfare and efficiency

The aim of this section is providing two results. First, I demonstrate that it is profitable for the platform firm having competitive developers. Second, I show that the higher the developers’ market power, the stronger the incentives of the platform to integrate with applications. I stress that in the first stage, because developers are identical and the platform can make a take-it-or-leave-it offer, it can capture their entire gross surplus by setting \( p^d (N) = p (N) t^d (N) - F \).

Consequently, the results do not hinge in the ability of the platform to extract this surplus. The driving forces of these results are in the spirit of the standard

\(^{13}\)This is the case for instance for \( V(N) = N + \sqrt{N} \) for which demand margin always binds. Note that if \( N^* \) exists, it is defined by \( N^* = \left( \frac{1}{1-e_v(N^*)} \right)^2 - 1 \).
analysis of double marginalization or pricing of complementary goods as better explained below.\textsuperscript{14} The next proposition shows the first result.

**Proposition 2** *Platform profits are decreasing (or constant) in $e_v(N)$.\textsuperscript{14}*

**Proof:** See the appendix

Now, as a benchmark, consider a firm that produces the platform and the $N$ applications. The profits of this integrated firm are given by

$$\Pi^I = \frac{1}{4} V(N)^2 \frac{1}{k} - FN$$

and are always higher than those that the firm gets when the platform is disintegrated.\textsuperscript{15} Moreover, the price that an integrated firm would set for the system, $P^I = \frac{V(N)}{2}$, is always lower than the price of the system when integration is absent. In particular, if demand margin binds the resulting system price is $\frac{V(N)}{2} \left(1 + \frac{N}{N+1}\right)$, and if competition margin binds the resulting system price is $\frac{V(N)}{2} \left(1 + e_v(N)\right)$. In both cases the system price is larger than $P^I$.

The rational behind these results is clear: first, under separation the developers do not take into account the reduction of sales of the platform and the other developers when raising the price. In other words, developers do not internalize the effect in the other agents’ profits. Second, when setting the price for users the platform imposes a double marginalization to the final price of the system, so that an inefficiently large price arises.\textsuperscript{16} Consequently, disintegration yields two sources of inefficiencies compared with integration. However, note that these inefficiencies are higher whenever demand margin binds. It explains the result in proposition 2: the profits of the platform are decreasing in these two inefficiencies, and the inefficiencies are increasing in $e_v(N)$. In other words, as the next proposition shows, the inefficiencies get lower and tend to disappear when substitutability among the applications is very high.

**Proposition 3** *Inefficiencies of disintegration are lower when competition margin binds and tend to disappear as long as applications are near substitutes.*

**Proof:** See the appendix

The proposition follows from the fact that the difference between the profits of the integrated and the disintegrated firm is increasing in $e_v(N)$. In the same vein, it is easy to see that the difference between the price that users pay for the total system with no integration and the price of the integrated system is decreasing in $e_v(N)$. Figure 1 summarizes the discussion. Part (a) in the figure considers the platform profits as a function of $e_v(N)$, where zero denotes applications that are perfect substitutes (and perfectly competitive), and the

\textsuperscript{14}See Tirole (1988).

\textsuperscript{15}Compare with (5) in the proof of proposition 2.

\textsuperscript{16}Note that the second fact is crucial to conclude that the price of the system under integration is always higher than under separation. In contrast, if for instance the price set by the platform were zero, i.e., as an open platform, the price of the system when competition margin binds would be $V(N) e_v(N)$. For values such that $e_v(N) < \frac{1}{k}$ separation would be more efficient than integration.
substitutability among applications decreases along the axis. The thin line corresponds to the profits of the integrated platform, whereas the thick one corresponds to those of the disintegrated platform. Part (b) is the analogous figure for the price of the system ($PS$).

As noted above, when applications are complementary, the demand margin will bind instead of the competition margin. It is shown that competitive developers are more profitable for the platform than developers constrained by the demand margin. The result also confirms that prices fall as a result of a vertical merger, but it also shows that the gain of merging, for the platform and for consumers, is decreasing in the substitutability of the applications.

4.1 Partial Integration

A widely observed fact in software industries is that some computer software are clearly more useful or more commonly used than others, Office software and Messenger are illustrative examples. At the same time, some video games are the most popular (killer games) in the market, so that applications’ contributions to total surplus may be different. To incorporate this feature into the model, in what follows I allow applications to be heterogeneous.

Assume that each application $i$ has a contribution $N_i \in [0, N]$, with the normalization

$$\sum_{i=1}^{N} N_i = N.$$ 

Note that $N_i = 1$ will bring back the homogeneity I have considered so far. Assume that $\frac{\partial N_i}{\partial x} > 0$ and define $V(\cdot)$ by $V \left( \sum_{i=1}^{N} x_i N_i \right)$, where $x_i = 1$ if user buys application $i$ and $x_i = 0$ otherwise. The next lemma is inspired in proposition 6 in Lerner and Tirole (2004).

**Lemma 4** Assume that surplus of users by applications is $V(\sum_{i=1}^{N} x_i N_i)$, where $x_i = 1$ if users buy application $i$ and $x_i = 0$ otherwise, with $\frac{\partial N_i}{\partial x} > 0$. Then, there is a mass $0 \leq n \leq N$ of developers that are constrained by the competition margin and charge a price $\tilde{p}_i = V'_i$, their marginal contribution.
to the total surplus. The rest of the developers are constrained by the demand margin and all of them set the same price $\hat{p} = \frac{V(N)-P_U-\int_0^n \tilde{p}_i d_i}{N-n+1}$. Finally, the platform sets $P_U = \frac{V(N)-\int_0^n \tilde{p}_i d_i}{2}$.

When the platform decides $P_U$, it defines the value $n$, i.e., the mass of developers that will be constrained by the competition margin. For every $i \in [0, n]$ it must hold that $\tilde{p}_i = V'_i < \hat{p}$ and that $V'_i$ is increasing in $i$. If $n = 0$, I have that every developer is constrained by the demand margin. Analogously, if $n = N$ every developer is constrained by the competition margin. I have already explained that inefficiencies of disintegration are lower when competition margin binds than when demand margin does. Consequently, the next result follows,

**Proposition 4** The platform will be partially integrated with the killer applications for which demand margin will bind, and will allow free entry for developers of other applications.

The proposition also may help to explain why platforms are often partially integrated, most of them with the core application. Microsoft produces operating systems and some of the applications (i.e. Office package). Nintendo wrote Mario Brothers, the killer game of one of its consoles. In the US the proportion of games developed in house is about 10% for GambeCube and 8% for PlayStation and Xbox.

### 5 Empirical relevance

This section proceeds as follows: first, I show that the preceding insights permit to establish some comparison between two well known and widely used software platforms, the video consoles and computer operating systems. Then, I extend the analysis above allowing for a comparative static analysis with respect to $N$. By making it I provide an explanation for an observed and documented phenomena: most of successful firms in the industry started as vertically integrated platforms and later disintegrate.\(^\text{17}\)

#### 5.1 Operating systems vs. video consoles

The analysis here is motivated by some observations made in the video game console market and the market for PC operating system. First, look at some facts in the video game industry,

1) 76% of gamers state that price is very/somewhat important in deciding what game to buy,
2) From a survey of over 1000 game consumers it is known that around 19.10% of them purchase 1 or 2 games per month, 26.50% purchase 1 every two month and 6.90% 3 or more per month,
3) Some players report having more than 50 games,

\(^{17}\text{See Evans et al. (2006).}\)
4) Among the ten top rated PlayStation 2 games, 3 of them belong to the adventure genre and 3 to the role-playing genre. Among the ten top rated Xbox 360 games, 2 of them belong to the Ice Hockey genre.\textsuperscript{18} 

Facts 1 and 4 suggest that there exists a near substitution between the games. Facts 2 and 3 show that consumers usually own a system of console and video games composed of many applications. By comparing these facts with those observed for operating systems (i.e. Windows) I observe that it is not easy to find a consumer using a huge number of applications.\textsuperscript{19} Moreover, applications are far substitutes (and sometimes complements). A user may need a text processor and a spreadsheet and also a browser.

These observations notice that developers writing for the video console may be constrained by the competition margin and developers writing for an operating system may be constrained by the demand margin. Although the statement would deserve a more rigorous study, I believe that it is a highlight to be taken into account when considering policy implications and merger analysis in high technology markets. For instance, the model predicts that it would be particularly harmful to impose separation in the operating system market, as it was sometime proposed by the Justice Department for Microsoft.\textsuperscript{20} In contrast, in markets where competition margin binds as presumed for developers writing for video consoles, potential competitive gains of separation may compensate the inefficiencies that would arise.

5.2 Vertical disintegration

Throughout the paper the comparative static analysis has been focused on changes of $e_v(N)$ for a given fixed number of applications. Consider now how changes in $N$ may alter the profits of the platform firm. Corollary 1 shows that, as long as $e_v(N)$ is non-increasing, there exists $N^*$ which determines the margin that is going to be binding. It also shows that it is more likely that the competition margin will bind when $N$ is large.

Figure 2 illustrates the fact that the platform profits and the price of the system will get close to the profits and the system price of an integrated firm as $N$ increases. Consumers are also better off with a larger number of applications.


\textsuperscript{19}Evans et.al. (2006) point out that, as opposed to the case of video consoles, "there’s probably not much correlation between the number of applications that someone uses on a computer and the value that person places on that computer".

\textsuperscript{20}On April 28, 2000, the Justice Department proposed that Microsoft be broken into two companies. One would have hold the Windows operating system, the other everything else, including the Office suite of application programs like Word and Excel. The proposal did not prosper.
They enjoy more variety and pay a lower price for the system.

These results are consistent with the observed phenomena that many successful firms started as vertically integrated platforms that later disintegrate. Consequently, the model suggests a novel explanation for this pattern observed in practice: when the industry is less developed (initial steps of the industry with low $N$) the platform strictly prefers being integrated. As the industry evolves and the number of developers available in the market increases, the competition margin is likely to bind, and at this stage of the industry, the platform will be more willing to disintegrate because the losses due to disintegration tend to disappear. As the market of developers matures and becomes more competitive, the firm can concentrate on producing only the platform.

6 Concluding remarks

This paper is a contribution to the literature of two-sided markets which borrows from Lerner and Tirole (2004) and obtains related insights in a different context. In particular, the model provides some elements for a better understanding of two-sided pricing strategies. I look at the case of a platform that sells a good that is complementary to the product sold in a market of sellers (developers). Then, I examine the interplay between developers’ and platform’s strategies.

Throughout the article I have insisted on the importance of considering competition on seller side to analyze platforms’ pricing strategies. I note that, when setting prices, developers are constrained by two margins: the demand margin and the competition margin. What margin is binding depends on the number of developers in the market and substitutability among their product. In this sense, it is possible to establish an analogy between an oligopoly market for developers and the situation where developers are constrained by the demand margin. Similarly, a market where developers are constrained by the competition margin can be interpreted as a very competitive market.

I remark that the price charged by the platform to users is an instrument to have effect on the prices charged by developers. By this way the platform may also influence the margin that will bind.
I show that not only the number of sellers is important for the platform, but also the level of competition among them. In particular, it is profitable for the platform having competitive sellers. Moreover, if they have market power, the platform has strong incentives to integrate with them. Results are mainly explained by the fact that the inefficiencies due to double marginalization when demand margin binds are much higher than when competition margin does.

I have considered the case where applications are asymmetric in the users’ surplus and I find that in the long run the platform will remain integrated with the applications for which demand margin binds and will leave for third-party developers the production of applications for which competition margin binds. This is consistent with observed patterns in reality.

I have also provided some arguments that support the hypothesis that developers writing for video consoles are constrained by the competition margin, whereas those writing for operating systems are constrained by the demand margin. Finally, the model can explain observed instances of the practice of vertical disintegration in successful firms.
References


Appendix

Proof of lemma 3

From lemma 2 it follows that when setting the price the platform decides the margin that will bind. To show the result in lemma 3, I compute the profits that each margin generates for the platform, then I compare them and deduce its optimal strategy. If the platform sets a price that satisfies \( P_U < V(N) - \tilde{p}(N + 1) \), then the competition margin will bind for the developers and platform profits will be

\[
\tilde{\Pi}_P^U = P_U \left[ V(N) - \tilde{p}N - P_U \right].
\]

The price that maximizes profits, given \( P_U < V(N) - \tilde{p}(N + 1) \), is

\[
P_U = \begin{cases} \frac{V(N) - \tilde{p}N}{2} & \text{if } \tilde{p} < \frac{V(N)}{N + 2} \\ V(N) - \tilde{p}(N + 1) & \text{if } \tilde{p} > \frac{V(N)}{N + 2}. \end{cases}
\]

If the platform sets a price such that \( P_U > V(N) - \tilde{p}(N + 1) \), so that demand margin will bind for the developers, platform profits will be

\[
\tilde{\Pi}_P^U = P_U \left[ V(N) - P_U \right].
\]

The price that maximizes profits, given \( P_U > V(N) - \tilde{p}(N + 1) \), is

\[
P_U = \begin{cases} \frac{V(N)}{2} & \text{if } \tilde{p} > \frac{V(N)}{2(N + 1)} \\ \frac{V(N) - \tilde{p}N}{k(N + 1)} & \text{if } \tilde{p} < \frac{V(N)}{2(N + 1)}. \end{cases}
\]

Comparing above the profits I observe that if \( \tilde{p} < \frac{V(N)}{2(N + 1)} \), the price that generates highest profits for the platform is \( P_U = \frac{V(N) - \tilde{p}N}{2} \). If \( \tilde{p} > \frac{V(N)}{2(N + 1)} \), the platform will optimally choose \( P_U = \frac{V(N) - \tilde{p}N}{2(N + 1)} \). Finally, whenever the relevant interval is \( \frac{V(N)}{2(N + 1)} < \tilde{p} < \frac{V(N)}{N + 2} \), the platform will set \( P_U = \frac{V(N) - \tilde{p}N}{k(N + 1)} \) and will set \( P_U = \frac{V(N)}{2} \) otherwise. Note that \( \tilde{p} < \frac{V(N)}{N + 1} \left[ 1 - \frac{1}{\sqrt{N + 1}} \right] \) occurs whenever \( e_v(N) < \left[ 1 - \frac{1}{\sqrt{N + 1}} \right] \), and the statement follows.

Proof of proposition 1

It follows directly from the proof of lemma 3. In particular, if \( e_v(N) < \left[ 1 - \frac{1}{\sqrt{N + 1}} \right] \) is satisfied, the platform will optimally choose \( P_U = \frac{V(N) - \tilde{p}N}{2} \) and the competition margin will bind. In contrast, whenever \( e_v(N) > \left[ 1 - \frac{1}{\sqrt{N + 1}} \right] \) is the case, the platform will set \( P_U = \frac{V(N)}{2} \) and then the demand margin will bind as stated by the proposition.

Proof of corollary 1
Note that the function \(1 - \frac{1}{\sqrt{N} + 1}\) is increasing in \(N\), equals zero at \(N = 0\), and goes to one as \(N\) goes to infinity. Since \(e_v(N) \in (0,1)\), if \(e_v(N)\) is a non-increasing function, it will necessarily cross \(1 - \frac{1}{\sqrt{N} + 1}\). However, if \(e_v(N)\) is an increasing function, a crossing point may not exist.

**Proof of proposition 2**

Straightforward computations show that profits of the platform are given by

\[
\Pi(N, e_v(N)) = \begin{cases} 
\frac{1}{4}V(N)^2 \left(1 - e_v(N)^2\right) \frac{1}{k} - FN & \text{if competition margin binds} \\
\frac{1}{4}V(N)^2 \left(\frac{2N+1}{N+N+1}\right) \frac{1}{k} - FN & \text{otherwise.}
\end{cases}
\]

(5)

Note that the expression \(\frac{1}{4}V(N)^2 \left(1 - e_v(N)^2\right) \frac{1}{k}\) is decreasing in \(e_v(N)\), and evaluated at \(e_v(N) = \left[1 - \frac{1}{\sqrt{N} + 1}\right]\) is larger than \(\frac{1}{4}V(N)^2 \left(\frac{2N+1}{N+N+1}\right) \frac{1}{k}\). Consequently, the lower \(e_v(N)\), the higher the profits of the platform and the statement of the proposition follows.
ÚLTIMOS DOCUMENTOS DE TRABAJO

2008-29: “Aggregation and Dissemination of Information in Experimental Asset Markets in the Presence of a Manipulator”, Helena Veiga y Marc Vorsatz.