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Invasion Strategy into Markets with Dominant Platforms

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Abstract

It is well known that there is a high entry barrier for new platforms when they try to enter markets already dominated by powerful incumbent platform(s). The new entrant often cannot solve the chicken-and-egg problem: with no users (e.g., shoppers) on one side of the platform, no users (e.g., vendors) will join the other side of the platform. Currently, many markets are dominated by a small number of platforms. This paper studies an underexplored tactic a dominant platform in one market can use to leverage its user base in that market to facilitate its entry into another market already dominated by another platform: First, it uses its established user base to bring users on one side of the platform in the target market to its home market. After these vendors join, it can launch its own platform in the target market. Users on the other side will join now that there are already large number of users on this side of the platform. We characterize the precise conditions under which this indirect entry tactic is profitable.

Keywords: Platform business model, Cross-border entry, Invasion strategy, Duopoly

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(Signatures of full team below)

Name of team member: Jason Fong

Name of supervising teacher: Tse-Chun Lin

Noted and endorsed by

Name of school principal: Arnett Edwards

Contents

1 Introduction

A platform business model constitutes a setup in which a firm-developed platform facilitates the exchange of goods or services between two or more groups of users. In this paper, we will focus specifically on evaluating platforms featuring two groups of users. Within such a platform, the users present can generally be classified under two categories, producers and consumers. As of June 29, 2022, five of the ten largest companies by market capitalization are platform companies: Apple, Microsoft, Alphabet (Google), Amazon, and Tencent. This figure is a testament to the success of platforms. The reason for the potency of such a model is related to two aspects: the user-generated positive feedback loop and the network effect that accounts for the value of a platform. Together, these two aspects provide the potential for platforms to continuously grow.

Platform firms derive their value from its userbase. Thus, a platform's ability to grow its userbase is tied to the firm's ability to generate increasing revenue. The explanation for why a platforms value is dictated by its userbase is summarized by network effects. In short, a platform's consumers derive value from a platform based on the number/userbase of producers, and vice versa. Generalizing this, we can state that platform users' benefit increases from larger userbases. As such, a platform's value to its users are tied to the size of userbase it can provide. This characteristic is important as it serves as the basis of the positive feedback loop present in platform business models. Any platform with a userbase has value, and thus, the ability to entice potential users outside of the platform to join. In the event that external users join, the userbase of the platform, in turn, grows and with that the platform's value grows with it. From this, the platform with a now larger userbase becomes more enticing for other potential users to join. This summarizes the positive feedback loop. However, the concept of a positive feedback loop also arises the issue of the *chicken-and-egg problem* (Caillaud and Jullien, 2003). The aforementioned positive feedback loop requires a platform with a pre-established userbase to function. However, new platforms without a userbase are inherently unable to entice users to join their platform given that a platform without a userbase provides no value. According to predictions from extant literature, "no one joins until everyone joins." Hagiu and Wright (2021) describe this as an "unfavorable expectations".[1]

Given the necessity for the user-generated positive feedback loop as a means for growth, invading entrant platforms entering into the targeted foreign market with no userbase provide no incentives for

[1] See Andrei Hagiu and Julian Wright's blog "The chicken-and-egg problem of marketplaces," Platform Chronicles, Oct 19, 2021.

users in said foreign market to join the invading entrant's platform. As such, invasion into the foreign market are very challenging. This scenario exemplifies the difficulties digital platforms in two-sided monopolistic markets have faced with firm invasion. Historically, industry giants such as Amazon and eBay have tried to break into the Chinese market, each employing various invasion strategies to navigate the *chicken-and-egg problem* but failing alas.[2] To advise these and similar platform owners on how to enter foreign markets, this paper proposes a theoretical model that allows us to optimize a novel method to break into foreign markets already dominated by incumbent platforms. The posited method involves a strategy in which an invading entrant platform first partners with foreign vendors in the targeted invading market, allowing them to sell to the entrant's home market. The goal is to eventually use these partners as a means to obtain a vendor base, which will function as seed the invading entrant's userbase in the foreign market, to support the invading platform's market entry: thus, solving *chicken-and-egg problem*. To the best of our knowledge, I'm the first to propose and analyze this indirect platform invasion strategy.

This paper extends the classic setting of Armstrong (2006) to build a formal two-period model to study cross-border entry of an e-commerce platform. The model opens with two monopolistic e-commerce platforms in the domestic market and foreign market, respectively. For tractability, we assume that if the two platforms compete in a market where both groups of users (i.e., vendors and buyers) "single home".

According to our hypothesis, to help invading firms successfully invade into the foreign market in the second period, the domestic e-commerce platform can open up its home market for the foreign market's vendors to sell to in the first period. The idea is that the domestic firm (invading entrant) will already have enough buyers on their platform in their home market to entice and assure the foreign vendors that sales can be successfully generated.[3] Once a large enough number of foreign vendors are recruited, the home platform can launch an e-commerce platform in the foreign market using the recruited foreign vendors to compete with the foreign incumbent in the second period. Since the entrant already has foreign vendors that have joined during the first period, it is much easier for the invading entrant to

[2] For more details about how eBay failed in China, the reader is referred to Forbes, "How EBay Failed In China," Sep 12, 2010.

[3] It is important to note that an added transportation cost is likely incurred by the foreign vendors to sell across borders. Thus, the invading entrant in their home market may have to subsidize the foreign vendors (e.g., by charging a reduced or even negative platform access fee) to attract them to sell in the domestic market in the first period.

attract buyers in the foreign market via the built-in positive feedback loop that exists by nature of platforms.

In the second period, firm invasion occurs. The domestic firm (invading entrant) will enter the foreign market in this second period. The incumbent in the foreign market, in response, will want to deter the invading entrant. This is assumed to be done through a strategy in which the incumbent offers their own users' high enough value (through low enough fees) to deny the entrant from entering profitably. To account for the incumbent's first-mover advantage derived from their pre-existence as a monopolist in the foreign market (the incumbents home market), we assume that when the incumbent attempts to deter the invading entrant, the incumbent's users (vendors and buyers) will hold a conservative view of the entrant, switching to the entrant only when it is beneficial for them to switch based on the userbase/value of the entrant platform prior to entry. Assuming an entrant utilizes no invasion strategy, the entrant platform has zero vendors or buyers during entry to the foreign market (i.e., *chicken-and-egg problem*). Given the users' conservative beliefs, the entrant must attract users to switch only by paying them to account for the lack of platform value. Such a strategy cannot be profitable for the invading entrant. Under this unprofitable scenario, entry will not be considered successful.

However, under the hypothesized invasion strategy, entry into the foreign market incurs no further costs to the invading entrant and the previous issue of unprofitability is circumnavigated. Thus, invasion will be successful and the two intermediaries (invading entrant and foreign incumbent) play the Nash equilibrium ala Armstrong (2006) and earn their respective duopoly profits in the newly invaded foreign market.

2 Literature Review

We are not the first to study the entry strategy of a platform into a market with existing one(s). Zhu and Iansiti (2012) examines the relative importance of platform quality, indirect network effects, and consumer expectations on the success of entrants in platform-based markets. Their main finding is that an entrant's success depends on the strength of indirect network effects and on the consumers' discount factor for future applications. Wen and Zhu (2019) also study empirically the competitive response from threatened complementors when a platform owner enters their market. They find that Google's entry threat caused developers to reduce innovation and raise the prices for the affected apps. They also shift innovation to unaffected and new apps. They argue that Google's entry threat may reduce wasteful innovation.

Other literature that relates to platform economics and/or platform competition include Basu et al. 2019 study the interplay between search and authentication services provided by platforms for online matching. Caillaud and Julien (2003) predicts a “winner-take-all” outcome. Other studies, however, show that multiple platforms could coexist when platforms are asymmetric and local network effects are strong (e.g., Lee et al. 2006), costs of adopting multiple platforms is high (e.g., Eisenmann 2006), and consumers have heterogeneous preferences (e.g., Armstrong and Wright 2007).

Levin and Skrzypacz (2016) show that competition can lead to inefficiency, with prices falling below the socially optimal level; and Nikzad (2017) compares monopoly and duopoly equilibria. A few studies examine the impact of multi-homing on ride sharing platforms on the wait time and social welfare (Liu et al. 2017, Bryan and Gans 2019). Also studying ride sharing, Bernstein et al. (2021) analyze the congestion between demand and supply in ride-sharing markets and Wu et al. (2020) study how the sequence of moves by riders and drivers affect the market outcomes.

3 Basic Model

To model the posited invasion strategy, we propose a two-period game for analyzing cross-boarder entry of an invading entrant platform. The setting involves two incumbent monopolist platforms in two different countries: A and B. For ease of notation, we will also call the respective incumbent platforms from Country A and B platforms A and B. For our analysis, suppose Platform A is a *potential entrant* considering entering Country B.

The entry tactic I will consider is the prior posited entry strategy in which the *potential entrant* and invading monopolist, Platform A, brings vendors from Country B to sell across borders into Country A. Platform A is able to entice Country B vendors by using its pre-established domestic platform (userbase featuring the entirety of Country A's market given Platform A's monopolistic nature). In the modeled game, this “bringing over” of Country B vendors occurs in period 1. In period 2, Platform A can request the newly brought over Country B vendors to assist in the invasion into Country B. This strategic partnership as an invasion strategy solves the *chicken-and-egg problem* given that the brought over Country B vendors serve as seed userbase to catalyze the positive feedback loop to occur in Country B.

By contrast, if platform A enters Country B to compete with platform B with no preexisting userbase, it is likely unprofitable given that it either cannot overcome the *chicken-and-egg problem* or has to give users large subsidies so that they would join the platform despite the lack of users on the other side. However, given that the main purpose of this paper is to study the condition under which a more plausible tactic of entry is profitable, I have not modeled this scenario in this current paper. I instead simply assume by the general intuition above that direct entry is not profitable.

Before we conduct the formal analysis, I will mathematically describe the two scenarios involved in our model: (1) The Monopoly Setting in which the two are monopolists in their respective domestic markets (again, this corresponds to the first period where Platform A is bringing on Country B vendors) and one in which the two firms compete (this corresponds to the second period after platform A enters Country B). I will first describe the monopoly setting.

3.1 Monopoly Setting

In this subsection, I model the status quo in which there is a monopolist platform in each country. I assume that both monopolists are located in location zero of the $[0, 1]$ Hotelling line with users on both sides uniformly distributed on it.

The platforms featured in this paper will be exclusively two-sided platforms. The individual sides are referred to as groups, with each platform consisting of Group 1 and 2 agents. Groups 1 and 2 obtain the respective utilities $\{u_1^i, u_2^i\}$ if they join platform $i \in \{A, B\}$. These utilities $\{u_1^i, u_2^i\}$ are determined as follows: if platform i attracts n_1^i and n_2^i members of the two groups, the utilities on this platform are

$$u_1^i = v_1 + \alpha_1 n_2^i - p_1^i; \quad u_2^i = v_2 + \alpha_2 n_1^i - p_2^i, \tag{1}$$

where $\{p_1^i, p_2^i\}$ are the respective prices charged by the platform to the two groups, $(\alpha_1, \alpha_2) > (0, 0)$ are the coefficients capturing the cross-side network effects, and v_1 and v_2 are the respective basic benefits of joining each side of either platform.

The cross-side externality (which are represented as $\alpha_1 n_2^i$ and $\alpha_2 n_1^i$) is explained in following: when platform i attracts a Group 2 user, each Group 1 user's utility increases by $\alpha_1 > 0$ units. Similarly, adding one more Group 1 user to the platform raises each Group 2 user's utility by $\alpha_2 > 0$. To better understand the constant value terms v_1 and v_2, they exist to capture utility that is derived from functionalities that do not have significant network effects. Examples of this include WeChat and its many external functionalities including paying utility bills (in the Mainland) or platforms that have vendors that donate money to charities.

Ala Armstrong (2006) the superscript notation i and j have been used to denote two arbitrary platforms. In this paper, let us deviate from this convention slightly and utilize A and B to represent the two platforms. For our purpose, let us designate Platform A to represent the invading entrant as established prior. Much of the monopoly setting applies to both platforms and is interchangeable. Thus, we will focus our analysis on Platform A, reintroducing platform B when necessary. Carrying on, let us model some Group 1 users' heterogenous preferences for the platform. Suppose $t_1, t_2 > 0$ are the Hotelling transport-cost parameters for the two groups. Then the net payoff of the agent located in position $x \in [0,1]$ is

$$u_1^A - t_1 x.$$

Suppose n_1^A Group 1 users join the platform. In other words, everyone in the interval $\left[0, n_1^A\right]$ joins the platform. The consumer at location n_1^A will be indifferent between joining and not joining. By not joining, she receives a payoff of zero. Therefore, the indifference condition is

$$u_1^A - t_1 n_1^A = 0.$$

Similarly, we can write down the indifference condition for Group 2 users as follows:

$$u_2^A - t_2 n_2^A = 0.$$

Plugging the expressions of the utilities into the indifference conditions, we have

$$\begin{aligned} p_1^A &= v_1 + \alpha_1 n_2^A - t_1 n_1^A. \\ p_2^A &= v_2 + \alpha_2 n_1^A - t_2 n_2^A. \end{aligned}$$

Finally, let f_1 and f_2 represent the unit costs incurred to a Platform of serving each Group 1 and Group 2 user. Then the profit of the monopolist is

$$\begin{aligned} \pi^A &= \left(p_1^A - f_1\right) n_1^A + \left(p_2^A - f_2\right) n_2^A \\ &= \left(v_1 + \alpha_1 n_2^A - t_1 n_1^A - f_1\right) n_1^A + \left(v_2 + \alpha_2 n_1^A - t_2 n_2^A - f_2\right) n_2^A \end{aligned}$$

3.2 Duopoly Competition between Platforms

The scenario in which cross-border entry that has to be overcome by Platform A will be elaborated on later. However, for now, suppose the barriers have been overcome. Thus, let us explore the setting in which Platform A has invaded into Country B and is in competition with Platform B. The following establishment of setting has followed closely Section 4 "Two-sided single homing" in Armstrong (2006). For tractability and ease of explaining the key insights of my analysis, I assume that users can only single home, i.e., join only one of the platforms.

Recall that there are two Platforms, A and B, the existence of which leads to Group 1 and Group 2 agents in opposing Platforms to interact with each other. Group 1 agents and Group 2 agents obtain the utilities $\{u_1^i, u_2^i\}$ respectively if they join platform $i \in \{A, B\}$. If Platform i attracts n_1^i and n_2^i members of the two groups, the utilities on this platform are

$$u_1^i = v_1 + \alpha_1 n_2^i - p_1^i; \quad u_2^i = v_2 + \alpha_2 n_1^i - p_2^i, \tag{2}$$

where $\{p_1^i, p_2^i\}$ are the respective prices charged by the platform to the two groups, $(\alpha_1, \alpha_2) > (0, 0)$ are the coefficients capturing the cross-side network effects, and v_1 and v_2 are the respective basic benefits of joining each side of either platform.

The utility expressions for Platforms hold constant throughout the paper. However, henceforth, variation in modeling between the two settings begin. To model users' heterogenous preferences for the two platforms, suppose Platform A is located at position zero and Platform B located at position one. Assume that $t_1, t_2 > 0$, which are the Hotelling transport-cost parameters for the two groups.

As a Group 1 users you are offered a choice of utilities u_1^A and u_1^B, which is representative of the choice between the two platforms. Equally, as a Group 2 user, you are offered a choice of utilities u_2^A and u_2^B. This choice is illustrated using the Hotelling specification. Under the Hotelling model, some Group 1 agent x located at $x \in [0, 1]$ will receive a net payoff of

$$u_1^A - t_1 x,$$

if the same agent joins platform B, he will receive a net payoff of

$$u_1^B - t_1 (1 - x).$$

If n_1^A Group 1 users join platform A and $1 - n_1^A$ Group 1 users join platform B, then the user at location n_1^A should feel indifferent between joining either platform, i.e.,

$$u_1^A - t_1 n_1^A = u_1^B - t_1 \left(1 - n_1^A\right).$$

Solving, we have

$$n_1^A = \frac{1}{2} + \frac{u_1^A - u_1^B}{2t_1}.$$

The user numbers n_1^B, n_2^A, and n_2^B are similarly determined. We therefore have

$$n_1^i = \frac{1}{2} + \frac{u_1^i - u_1^j}{2t_1}; \quad n_2^i = \frac{1}{2} + \frac{u_2^i - u_2^j}{2t_2}. \tag{3}$$

Solving the system of equations (2) and (3), and using the fact that $n_1^j = 1 - n_1^i$, we arrive at the following expressions for market shares:

$$n_1^i = \frac{1}{2} + \frac{\alpha_1 \left(2n_2^i - 1\right) - \left(p_1^i - p_1^j\right)}{2t_1}; \quad n_2^i = \frac{1}{2} + \frac{\alpha_2 \left(2n_1^i - 1\right) - \left(p_2^i - p_2^j\right)}{2t_2}. \tag{4}$$

According to expression (4), for given fixed Group 2 price, an extra Group 1 agent on a platform attracts a further α_2/t_2 Group 2 agents to that platform.

As in Armstrong (2006), we assume that the network effect is not too large to ensure there will be interior solutions in the competition in Hotelling model:

$$4t_1t_2 > \left(\alpha_1 + \alpha_2\right)^2, \tag{5}$$

and this inequality is assumed to hold throughout the following analysis. If network effects were to be too large, then there could be equilibria only where one platform corners both sides of the market. In the duopoly scenario, this is not an occurrence that we would like to model.

Suppose Platforms A and B offer the respective price pairs $\left(p_1^A, p_2^A\right)$ and $\left(p_1^B, p_2^B\right)$. Given these prices, solving the simultaneous equations (4) implies that market shares are

$$n_1^i = \frac{1}{2} + \frac{1}{2}\frac{\alpha_1 \left(p_2^j - p_2^i\right) + t_2 \left(p_1^j - p_1^i\right)}{t_1t_2 - \alpha_1\alpha_2}; \quad n_2^i = \frac{1}{2} + \frac{1}{2}\frac{\alpha_2 \left(p_1^j - p_1^i\right) + t_1 \left(p_2^j - p_2^i\right)}{t_1t_2 - \alpha_1\alpha_2} \tag{6}$$

Assumption (5) implies that the denominators $t_1t_2 - \alpha_1\alpha_2$ are positive. As one would expect, if $\alpha_1, \alpha_2 > 0$, demand by the two groups is complementary, in the sense that a platform's market share for one group is decreasing in its price for the other group.

Suppose each platform has a per-agent cost f_1 for serving group 1 and f_2 for serving group 2 . Therefore, platform i's profit is

$$\pi^i = \left(p_1^i - f_1\right)\left[\frac{1}{2} + \frac{1}{2}\frac{\alpha_1 \left(p_2^j - p_2^i\right) + t_2 \left(p_1^j - p_1^i\right)}{t_1t_2 - \alpha_1\alpha_2}\right] + \left(p_2^i - f_2\right)\left[\frac{1}{2} + \frac{1}{2}\frac{\alpha_2 \left(p_1^j - p_1^i\right) + t_1 \left(p_2^j - p_2^i\right)}{t_1t_2 - \alpha_1\alpha_2}\right]$$

4 Monopoly equilibrium

Again, the Platform superscripts have been dropped as to avoid creating visually cluttered notation. Superscripts will be reintroduce when its inclusion is useful. The profit function in the monopoly equilibrium is given simply as

$$\pi = (v_1 + \alpha_1 n_2 - t_1 n_1 - f_1)\, n_1 + (v_2 + \alpha_2 n_1 - t_2 n_2 - f_2)\, n_2.$$

The transportation costs (t_1, t_2) lower agents' willingness to pay in this monopoly setting. Thus, the transportation cost serves to drive the monopolist to offer discounts to attract users from afar to join their platform.

The first and second derivatives of the profit with respect to n_1 are

$$\begin{aligned}
\frac{\partial \pi}{\partial n_1} &= -f_1 + v_1 + \alpha_1 n_2 + \alpha_2 n_2 - 2n_1 t_1, \\
\frac{\partial^2 \pi}{\partial (n_1)^2} &= -2t_1 < 0.
\end{aligned}$$

Similarly, the first and second derivatives of the profit with respect to n_2 are

$$\begin{aligned}
\frac{\partial \pi}{\partial n_2} &= -f_2 + v_2 + \alpha_1 n_1 + \alpha_2 n_1 - 2n_2 t_2 \\
\frac{\partial^2 \pi}{\partial (n_2)^2} &= -2t_2 < 0
\end{aligned}$$

It can also be easily checked that

$$\frac{\partial^2 \pi^M}{\partial n_1 \partial n_2} = \alpha_1 + \alpha_2.$$

The main assumption of $4t_1t_2 > (\alpha_1 + \alpha_2)^2$ ensures that the second-order condition for maximum profit is satisfied:

$$\frac{\partial^2 \pi^M}{\partial (n_1)^2} \frac{\partial^2 \pi^M}{\partial (n_2)^2} - \left(\frac{\partial^2 \pi^M}{\partial n_1 \partial n_2} \right)^2 = 4t_1t_2 - (\alpha_1 + \alpha_2)^2 > 0.$$

In other words, if we have an interior solution for the profit-maximizing number of agents for both groups, they are determined by the First-Order Conditions:

$$\begin{aligned}
-f_1 + v_1 + \alpha_1 n_2 + \alpha_2 n_2 - 2n_1 t_1 &= 0, \\
-f_2 + v_2 + \alpha_1 n_1 + \alpha_2 n_1 - 2n_2 t_2 &= 0.
\end{aligned}$$

Solving this system of equations gives us

$$\begin{aligned}
n_1^M &= \frac{(\alpha_1 + \alpha_2)(v_2 - f_2) + 2t_2 (v_1 - f_1)}{4t_1t_2 - (\alpha_1 + \alpha_2)^2}, \qquad (7) \\
n_2^M &= \frac{(\alpha_1 + \alpha_2)(v_1 - f_1) + 2t_1 (v_2 - f_2)}{4t_1t_2 - (\alpha_1 + \alpha_2)^2},
\end{aligned}$$

where the superscript M is added to denote expressions related to monopoly equilibrium. In this case, the market share expression in relation to monopoly equilibrium. Plugging these into the profit function, we have

$$\begin{aligned}\pi^M &= (v_1 + \alpha_1 n_2 - t_1 n_1 - f_1)\, n_1 + (v_2 + \alpha_2 n_1 - t_2 n_2 - f_2)\, n_2 \\ &= \frac{(f_1)^2 t_2 + (f_2)^2 t_1 + t_1 (v_2)^2 + t_2 (v_1)^2 + \alpha_1 f_1 f_2 + \alpha_2 f_1 f_2 - \alpha_1 f_1 v_2 - \alpha_1 f_2 v_1 - \alpha_2 f_1 v_2 - \alpha_2 f_2 v_1 + \alpha_1 v_1 v_2 + \alpha_2 v_1 v_2 - 2 f_1 t_2 v_1 - 2 f_2 t_1 v_2}{4 t_1 t_2 - (\alpha_1 + \alpha_2)^2}, \end{aligned} \tag{8}$$

To simplify our analysis of the whole game, we assume that

$$\left.\frac{\partial \pi}{\partial n_1}\right|_{(n_1,n_2)=(1,1)} = v_1 + \alpha_1 + \alpha_2 - 2t_1 - f_1 \geq 0; \tag{9}$$

$$\left.\frac{\partial \pi}{\partial n_2}\right|_{(n_1,n_2)=(1,1)} = v_2 + \alpha_1 + \alpha_2 - 2t_2 - f_2 \geq 0. \tag{10}$$

With this assumption, we ensures that the monopolist profit is maximized with the corner solution of

$$\left(n_1^M, n_2^M\right) = (1, 1)\,.$$

The equilibrium monopoly profit has a very clean form:

$$\pi^M = (v_1 + \alpha_1 - t_1 - f_1) + (v_2 + \alpha_2 - t_2 - f_2)\,.$$

The main result for this subsection can be summarized as follows

Lemma 1 *Suppose there is a measure one (unit measurement) of potential agents on both sides (Group 1 and 2) of the platforms in country $i \in \{A, B\}$. Under Assumption (5), if there are interior solutions for the equilibrium numbers of users, then in country $i \in \{A, B\}$, the equilibrium number of users are*

$$n_1^M = \frac{(\alpha_1 + \alpha_2)(v_2 - f_2) + 2t_2 (v_1 - f_1)}{4t_1 t_2 - (\alpha_1 + \alpha_2)^2}, \tag{11}$$

$$n_2^M = \frac{(\alpha_1 + \alpha_2)(v_1 - f_1) + 2t_1 (v_2 - f_2)}{4t_1 t_2 - (\alpha_1 + \alpha_2)^2}, \tag{12}$$

and the equilibrium profit is given by (8).

Suppose (9) and (10) also holds, then the equilibrium numbers of users are $(1, 1)$ and the equilibrium profit is

$$\pi^M = (v_1 + \alpha_1 - t_1 - f_1) + (v_2 + \alpha_2 - t_2 - f_2)\,. \tag{13}$$

To understand the equilibrium profit, note that the equilibrium prices are

$$\begin{aligned} p_1^M &= v_1 + \alpha_1 - t_1, \\ p_2^M &= v_2 + \alpha_2 - t_2. \end{aligned}$$

The platform owner can charge Group 1 agents v_1 for its intrinsic value derived from services a platform may provide outside those related to network effects, α_1 for the cross-group network effect derived from measure one of Group 2 users, but needs to give a discount of t_1 to attract the Group 1 user located at the far end of position 1 to join the platform. That is why $p_1^M = v_1 + \alpha_1 - t_1$. Since the unit cost is f_1 and the entire measure one of Group 1 users join the platform, it earns $(v_1 + \alpha_1 - t_1 - f_1)(1)$ from Group 1. The profit from Group 2 users can be analogously explained.

Note that Lemma (1) is by itself a new result to the literature. Armstrong (2006) did not consider a monopoly setting in which a single firm serves users on two Hotelling lines on each side of its platform.

5 Duopoly equilibrium

Since the duopoly equilibrium post-entry is already solved in Armstrong (2006), I will summarize the equilibrium without proof. Interested readers can refer to his paper.

Lemma 2 *Suppose (5) holds. Then the model with two-sided single-homing has a* ***unique equilibrium*** *that is* ***symmetric****. This will be shown in the following, To begin, equilibrium prices for Group 1 and Group 2 are given respectively*

$$p_1^D = f_1 + t_1 - \alpha_2; \quad p_2^D = f_2 + t_2 - \alpha_1, \tag{14}$$

and equilibrium profit of each platform is given by

$$\pi^D = \frac{t_1 + t_2 - \alpha_1 - \alpha_2}{2}. \tag{15}$$

There is very interesting economics in the comparison between $\left(p_1^D, p_2^D\right)$ and $\left(p_1^M, p_2^M\right) = (v_1 + \alpha_1 - t_1, v_2 + \alpha_2 - t_2)$. First of all, the intrinsic value Platform's posses (v_1, v_2) allow monopolists to charge higher prices to both groups of users as compared to the duopoly model where both platforms A and B offer the same intrinsic values. Thus, these homogenous values are competed away in price competition, not showing up on $\left(p_1^D, p_2^D\right)$. Second, the network effects due to (α_1, α_2) allow the monopolist to charge higher prices. By contrast, in the duopoly setting, the incentive to capture more users to generate such network effects drive the competing platforms to do the *opposite*, lowering their prices. Third, the transportation costs (t_1, t_2) lower users' willingness to pay in the monopoly setting and drive the monopolist to offer some discount to attract users far away from it. By contrast, the transportation costs create differentiation between the duopolists and allow them to raise their prices. Finally, monopoly pricing is value-based, so (f_1, f_2) do not show up in $\left(p_1^M, p_2^M\right)$, but since duopoly pricing under price competition is cost-based, (f_1, f_2) show up in $\left(p_1^D, p_2^D\right)$. Among these effects, the contrasting impacts of network effects on monopoly and duopoly prices is particularly interesting.

In the above analysis, we assume that the number of potential users on each side is one. It is obvious to see that if the numbers of potential users on both side is η instead, then the prices will remain the same and the profit of each platform receives becomes

$$\eta\pi^D = \eta\frac{t_1 + t_2 - \alpha_1 - \alpha_2}{2}.$$

6 Including foreign vendors in the platform

As part of Platform A's tactic to build up a Group 2 user base in Country B, it will first invite Group 2 users in Country B to join its established platform in Country A. We assume that each Country B Group 2 agent has to incur a fixed cost to enter Country A, denoted by $E > 0$. This is a cost of exploring the new market and will be paid whether the agent ends up joining the domestic platform or not.

Unlike joining a new platform without any existing agents on the other side, these foreign Group 2 agents brought over to sell in Country A know that they are guaranteed to benefit from the pre-existing cross-side network effect. This is because of the pre-established monopolist Platform A has its pre-established userbase. On the other hand, they still need to make sure the expected profit they generate from joining platform A exceeds the entry cost.

Suppose the monopolist platform in Country A has invited some quantity of Group 2 users from Country B to sell on its platform denoted by $\eta \in (0, 1)$. Suppose these Group 2 users from Country B are also uniformly distributed on the $[0, 1]$ Hotelling line after they start selling in Country A, and that their location on Country A's Hotelling line is independent of their location on the Hotelling line in Country B. This captures the idea that a vendor's preference for a platform in a country does not inform us of his preference for a platform in another country.

Given the addition of the η term, analysis to define the utility term differs slightly from the monopoly case. For the invading monopolist of Country A, that the number of Group 2 users in its userbase is now $(1 + \eta)\, u_2^A$ instead of u_2^A. This also implies that the utility of Group 1 consumers are slighted modified as follows:

$$\begin{aligned} u_1^A &= v_1 + \alpha_1 (1+\eta) n_2^A - p_1^A \\ &= v_1 + \hat{\alpha}_1 n_2^A - p_1^A, \end{aligned}$$

where $\hat{\alpha}_1 \equiv \alpha_1 (1+\eta)$. Otherwise, the analysis of the monopoly equilibrium in Country A is very similar to the case without foreign vendors. In particular, Group 2 users' utility function remains unchanged:

$$u_2^A = v_2 + \alpha_2 n_1^A - p_2^A.$$

Suppose Platform A is again situated at point zero on the Hotelling line, if n_1^A Group 1 agents join the platform, all agents in the interval $[0, n_1^A]$ will join the platform. However, the consumer at exactly location n_1^A will be indifferent between joining and not joining. The indifferent condition is as follows

$$u_1^A - t_1 n_1^A = 0.$$

Similarly, when $(1+\eta) n_2^A$ Group 2 users join the platform, the consumer at location n_2^A is indifferent between joining and not joining:

$$u_2^A - t_2 n_2^A = 0.$$

Plugging the expressions of the utilities into the indifference conditions, we have

$$\begin{aligned} p_1^A &= v_1 + \hat{\alpha}_1 n_2^A - t_1 n_1^A, \\ p_2^A &= v_2 + \alpha_2 n_1^A - t_2 n_2^A. \end{aligned}$$

Let f_1 and f_2 be the unit costs of serving each Group 1 and Group 2 user. Then the profit of the monopolist is

$$\begin{aligned} \pi^A &= \left(p_1^A - f_1\right) n_1^A + \left(p_2^A - f_2\right)(1+\eta) n_2^A \\ &= \left[v_1 + \alpha_1 (1+\eta) n_2^A - t_1 n_1^A - f_1\right] n_1^A + \left(v_2 + \alpha_2 n_1^A - t_2 n_2^A - f_2\right)(1+\eta) n_2^A \end{aligned}$$

Again, with the superscript dropped for simplicity of notation, we have

$$\pi = (v_1 + \alpha_1 (1+\eta) n_2 - t_1 n_1 - f_1) n_1 + (v_2 + \alpha_2 n_1 - t_2 n_2 - f_2)(1+\eta) n_2. \tag{16}$$

The first and second derivatives of the profit with respect to n_1 are

$$\begin{aligned} \frac{\partial \pi}{\partial n_1} &= -f_1 + v_1 + \alpha_1 n_2 + \alpha_2 n_2 - 2 n_1 t_1 + \eta \alpha_1 n_2 + \eta \alpha_2 n_2, \qquad (17) \\ \frac{\partial^2 \pi}{\partial (n_1)^2} &= -2 t_1 < 0. \end{aligned}$$

Similarly, the first and second derivatives of the profit with respect to n_2 are

$$\begin{aligned}\frac{\partial \pi}{\partial n_2} &= (1+\eta)\left(-f_2+v_2+\alpha_1 n_1+\alpha_2 n_1-2n_2 t_2\right) \qquad (18)\\ \frac{\partial^2 \pi}{\partial (n_2)^2} &= -2(1+\eta)\,t_2<0\end{aligned}$$

It can also be easily checked that

$$\frac{\partial^2 \pi}{\partial n_1 \partial n_2}=(1+\eta)(\alpha_1+\alpha_2).$$

Therefore, we have

$$\begin{aligned}\frac{\partial^2 \pi}{\partial (n_1)^2}\frac{\partial^2 \pi}{\partial (n_2)^2}-\left(\frac{\partial^2 \pi}{\partial n_1 \partial n_2}\right)^2 &= (-2t_1)\left(-2(1+\eta)\,t_2\right)-(1+\eta)^2(\alpha_1+\alpha_2)^2\\ &= (1+\eta)\left[4t_1t_2-(1+\eta)(\alpha_1+\alpha_2)^2\right]\end{aligned}$$

For simplicity, we consider an assumption stronger than Assumption (5):

$$4t_1t_2>(1+\eta)(\alpha_1+\alpha_2)^2. \qquad (19)$$

This stronger assumption is in the same spirit of Assumption (5) proposed by Armstrong (2006), except that it is adapted to a setting with unequal numbers of potential users on both sides of the platform, one with measure one of potential users and the other side with measure $(1+\eta)$ of potential users. Both assumptions captures the idea that the cross-group network effective is not large relative to the transportation costs, only that we need the adapted version to ensure that the second-order condition of profit-maximization is still satisfied after foreign Group 2 users join the platform.

In other words, if we have an interior solution for the profit-maximizing user numbers for both groups, similar to Section 4, they are determined by the First-Order Conditions:

$$\begin{aligned}-f_1+v_1+\alpha_1 n_2+\alpha_2 n_2-2n_1t_1+\eta\alpha_1 n_2+\eta\alpha_2 n_2 &= 0, \qquad (20)\\ (1+\eta)\left(-f_2+v_2+\alpha_1 n_1+\alpha_2 n_1-2n_2t_2\right) &= 0. \qquad (21)\end{aligned}$$

We are ready to state the main result of this section:

Lemma 3 *Suppose there is measure one of Group 1 potential users and measure $(1+\eta)$ of Group 2 users in Country A. Under Assumption (19), if there are interior solutions for the equilibrium numbers* *of users, then in country $i \in \{A, B\}$, the equilibrium number of users are*

$$\begin{aligned} n_1^{MM} &= \frac{(1+\eta)(\alpha_1+\alpha_2)(v_2-f_2)+2t_2(v_1-f_1)}{4t_1t_2-(1+\eta)(\alpha_1+\alpha_2)^2}, \\ n_2^{MM} &= \frac{(\alpha_1+\alpha_2)(v_1-f_1)+2t_1(v_2-f_2)}{4t_1t_2-(1+\eta)(\alpha_1+\alpha_2)^2}. \end{aligned}$$

Suppose the following also holds:

$$v_1+(1+\eta)(\alpha_1+\alpha_2)-2t_1-f_1 \geq 0 \tag{22}$$

$$(1+\eta)(v_2+\alpha_1+\alpha_2-2t_2-f_2) \geq 0. \tag{23}$$

Then the equilibrium numbers of users are $\left(n_1^{MM}, n_2^{MM}\right) = (1,1)$ and the equilibrium profit is

$$\pi^{MM} = (v_1+\alpha_1(1+\eta)-t_1-f_1)+(v_2+\alpha_2-t_2-f_2)(1+\eta). \tag{24}$$

Proof: Since the Second-order Conditions are satisfied given Assumption (19), solving this system of equations (20) and (21) gives the profit-maximizing user numbers n_1^{MM} and n_2^{MM} stated in the lemma.

By directly substituting (n_1, n_2) in (17) and (18) by $(1,1)$, we have

$$\begin{aligned} \left.\frac{\partial\pi}{\partial n_1}\right|_{(n_1,n_2)=(1,1)} &= v_1+(1+\eta)(\alpha_1+\alpha_2)-2t_1-f_1, \\ \left.\frac{\partial\pi}{\partial n_2}\right|_{(n_1,n_2)=(1,1)} &= (1+\eta)(v_2+\alpha_1+\alpha_2-2t_2-f_2). \end{aligned}$$

If $\left.\frac{\partial\pi}{\partial n_1}\right|_{(n_1,n_2)=(1,1)} \geq 0$ and $\left.\frac{\partial\pi}{\partial n_2}\right|_{(n_1,n_2)=(1,1)} \geq 0$, then we have a corner solution, and the optimal equilibrium user numbers are $\left(n_1^{MM}, n_2^{MM}\right) = (1,1)$. Plugging these values into (16), it immediately follows that the equilibrium profit is (24). ■

A natural question one would ask is how much additional profit can the additional Group 2 users bring to the platform A owner. Can can obtain that by directly comparing (24) with (13):

$$\begin{aligned} \Delta\pi &= (v_1+\alpha_1(1+\eta)-t_1-f_1)+(v_2+\alpha_2-t_2-f_2)(1+\eta)-((v_1+\alpha_1-t_1-f_1)+(v_2+\alpha_2-t_2-f_2)) \\ &= \eta(\alpha_1+v_2+\alpha_2-t_2-f_2). \end{aligned}$$

There are two sources for the increased profit. First, having η additional Group 2 users increase the cross-side network effect enjoyed by Group 1 users so they each is willing to pay $\alpha_1\eta$ more. The second part simply comes from the increase in the number of Group 2 users by η. Since the profit margin per Group 2 user remains at $(v_2+\alpha_2-t_2-f_2)$, that increase in profit is $\eta(v_2+\alpha_2-t_2-f_2)$.

Next, we analyze the foreign vendors' decisions to join platform A. Suppose Assumption (19) holds. First look at the case when there there is an interior solution for $\left(n_1^{MM}, n_2^{MM}\right)$. In this case, for any foreign Group 2 user at $x \in [0, n_2^{MM}]$, the net payoff of joining platform A is

$$U_2 = v_2 + \alpha_2 n_1^{MM} - p_2^{MM} - t_2 x - E,$$

where $p_2^{MM} = v_2 + \alpha_2 n_1^{MM} - t_2 n_2$. If the Group 2 user is located in the interval $(n_2^{MM}, 1]$, the payoff will be simply $U_2 = -E$ because it pays the fixed cost of entry only to discover that it will not profit from joining the monopolist platform. Therefore, the expected profit is

$$\begin{aligned} E(U) &= \int_0^{n_2^{MM}} \left(v_2 + \alpha_2 n_1^{MM} - \left(v_2 + \alpha_2 n_1^{MM} - t_2 n_2^{MM}\right) - t_2 x - E\right) dx - \int_{n_2^{MM}}^1 E dx \\ &= \int_0^{n_2^{MM}} \left(t_2 n_2^{MM} - t_2 x\right) dx - E. \end{aligned}$$

where $n_2^{MM} = \frac{(\alpha_1+\alpha_2)(v_1-f_1)+2t_1(v_2-f_2)}{4t_1t_2-(1+\eta)(\alpha_1+\alpha_2)^2}$.

If the entry cost E is low so that $E(U) \geq 0$, then it is optimal for foreign Group 2 users to come to explore platform A. On the other hand, when E is high so that $E(U) < 0$, then the foreign Group 2 users will not find it optimal to explore platform A. In this case, platform A has to subsidize these foreign Group 2 users by $E - \int_0^{n_2^{MM}} \left(t_2 n_2^{MM} - t_2 x\right) dx$ to attract them join its platform.

To sum up this section, we derive the required subsidy to attract these foreign Group 2 users when the optimal solution for platform A is a corner solution.

Lemma 4 *Suppose Assumptions (19), (22) and (23) hold. Then foreign Group 2 users will join platform A if and only if*

$$v_2 + \alpha_2 - \frac{t_2}{2} - E \geq 0$$

or, if $v_2 + \alpha_2 - \frac{t_2}{2} - E < 0$ but platform A subsidizes each of them by

$$S = E - \left(v_2 + \alpha_2 - \frac{t_2}{2}\right).$$

The argument for this lemma is straightforward. Given that $\left(n_1^{MM}, n_2^{MM}\right) = (1, 1)$, the payoff of a Group 2 user located at x is $(v_2 + \alpha_2 - t_2 x) - E$. This implies that a foreign Group 2 user's expected payoff is

$$\begin{aligned} E(U) &= \int_0^1 (v_2 + \alpha_2 - t_2 x)\, dx - E \\ &= v_2 + \alpha_2 - \frac{t_2}{2} - E. \end{aligned}$$

If $E(U) \geq 0$, then it will join without any subsidy. Otherwise, the platform has to provide a subsidy enough to cover its loss.

In the next section, we would analyze how the domestic platform owner may use the invitation of foreign Group 2 users as a stepping stone to enter the foreign market.

7 Analysis of the Whole Game: Decision to Invade by Way of Inviting Foreign Group 2 users

For the analysis of platform A's tactical entry into Country B, we retain the the key assumptions made in Section 6. That is Assumptions (19), (22) and (23). Note that Assumption (19) implies that Assumption (5) holds and that, if Assumptions (22) and (23) hold, then so do Assumptions (9) and (10).

To accommodate more general situations, we also allow the markets in the two countries to be of different sizes. In particular, we assume that there are η potential users of each group in Country B.

Recall the timing of the game. In period 1, platform A decides whether to invite Group 2 users from Country B to join its platform and whether to provide them with a subsidy. After it makes that decision, Group 2 users from Country B decide whether to join platform A. If Group 2 users do not join platform A in the first period, then both platform A and platform B will remain as monopolists in their respective markets in both periods.

If Group 2 users join platform A, then in the first period, platform A and platform B will still be monopolists in period 1, except that Group 2 users in Country B will sell in both countries and there will be $(1+\eta)$ Group 2 potential users in Country A. In period 2, platform A will remain a monopolist in Country A and simultaneously compete with platform B in Country B as Hotelling duopolists.

Also note that when users in Group 2 of Country B decide whether to join the platform in Country A in period 1, it makes that decision independently of their expectation of whether the platform will enter Country B. This is because every user has a zero measure and cannot affect platform A's decision. In other words, their decision of whether to enter platform A in the first period is purely based on the profitability of that decision in that period.

Proposition 1 *Suppose Assumptions (19), (22) and (23) hold.*

(i) Suppose $v_2 + \alpha_2 - \frac{t_2}{2} - E \geq 0$. Then in period 1, Group 2 users in Country B will join platform A, and in period 2, platform A will enter the market in Country B.

(ii) Suppose $v_2 + \alpha_2 - \frac{t_2}{2} - E < 0$. Then in period 1, platform A will subsidize Group 2 users in Country B by $S = E - \left(v_2 + \alpha_2 - \frac{t_2}{2}\right)$, these foreign Group 2 users will join platform A, and in period 2, platform A will enter the market in Country B if and only if

$$T \equiv -2\left(E - v_2 - \alpha_2 + \frac{t_2}{2}\right) + 2\eta\left(\alpha_1 + v_2 + \alpha_2 - t_2 - f_2\right) + \eta\frac{t_1 + t_2 - \alpha_1 - \alpha_2}{2} \geq 0. \tag{25}$$

Proof. The proof of our main finding is based on applying the previously derived lemmas. Part (i) of the proposition is straightforward. When it is profitable for foreign Group 2 users to join platform A, the owner of platform A will simply enjoy higher profits in its market by $\Delta\pi$ in both periods. In period 2, since entering Country B with the help of foreign Group 2 users allows it to earn $\eta\pi^D$, it will do so to earn that additional profit.

For Part (ii), when platform A has to provide a subside to the foreign Group 2 users, it has to do so for both periods. In this case, it weighs that cost and the benefits of increased profit of $\Delta\pi$ in its home market for two periods and $\eta\pi^D$ in the second period. In particular,

$$S = E - \left(v_2 + \alpha_2 - \frac{t_2}{2}\right).$$

Platform A's net gain of profit is

$$-2S + 2\Delta\pi + \eta\pi^D.$$

The key condition for Part (ii) is equivalent to $-2S + 2\Delta\pi + \eta\pi^D \geq 0$. ■

Our finding allows us to study how different parameters affect the profitability of the indirect and tactical entry strategy. The comparative statics are clean and shed light on when the strategy we propose are more effective:

$$\begin{aligned}
\frac{\partial T}{\partial \alpha_1} &= \frac{3}{2}\eta > 0 \\
\frac{\partial T}{\partial \alpha_2} &= \frac{1}{2}(3\eta + 4) > 0 \\
\frac{\partial T}{\partial v_1} &= 0 \\
\frac{\partial T}{\partial v_2} &= 2(\eta + 1) > 0 \\
\frac{\partial T}{\partial \eta} &= \frac{1}{2}(3\alpha_1 + 3\alpha_2 + 4v_2 - 4f_2 + t_1 - 3t_2) \\
\frac{\partial T}{\partial f_1} &= 0 \\
\frac{\partial T}{\partial f_2} &= -2\eta < 0 \\
\frac{\partial T}{\partial t_1} &= \frac{1}{2}\eta > 0 \\
\frac{\partial T}{\partial t_2} &= -\frac{1}{2}(3\eta + 2) < 0.
\end{aligned}$$

For illustration, when v_2 or α_2 increases, it is more likely that $v_2 + \alpha_2 - \frac{t_2}{2} - E \geq 0$ so that foreign Group 2 users voluntarily join platform A. Even if that does not happen, since $\frac{\partial T}{\partial v_2} = 2(\eta + 1)$ and $\frac{\partial T}{\partial \alpha_2} = \frac{1}{2}(3\eta + 4) > 0$, it is more likely that platform A finds it profitable to subsidize Country$B$ Group 2 users to join platform A. We may similarly show that increase in α_1 or t_1 or decrease in f_2 increases the profitability of this platform invasion strategy.

The main focus of this paper is to analyze when it is profitable for platforms to implement the novel invasion strategy we propose. We only allow one platform to use this invasion strategy for simplicity. Future studies should study both platforms' simultaneous decisions to adopt this strategy. Depending on the model parameters, we have one, two, or no platform adopting our strategy. Our analysis allows us to qualitatively assess the likelihood of these possible outcomes.

8 Conclusion

This paper is inspired by the observation that many markets are dominated by a few powerful platforms. While large platforms can create a lot of value through the network effect, the lack of competition could limit the extent to which users capture the surplus created. With the motivation to promote competition, this paper studies the important and relevant question of how platforms can profitably enter markets that are already dominated by monopolist incumbents. Our analysis is of interests to policy makers and and antitrust authorities as promoting competition and enhancing consumer welfare is also their mission. Our research question is also theoretically interesting because intuition would suggest that any entrant would find it very difficult to overcome the chicken-and-egg problem due to the platform business model.

We proposed a novel approach for platforms to leverage the strength in their home market to enter another market already dominated by an incumbent monopolist platform. Our entry strategy requires the entrant to use its userbase to first attract users on one side of the target market's platform before using these new users to attract users on the other side of the target market. We formally derived plausible conditions under which such entry strategy is profitable. Our clean equilibrium outcomes also allow us to assess how various the environmental factors affect the likely of successful platform invasion.

As the first paper to study this form of entry, we have left a number of issues for future studies. For instance, we only allow one firm to enter the other market. It would be useful for future research to study the platforms' simultaneous decision to enter each other's market. We also have made some simplifying assumptions to keep the analysis tractable. It would be interesting to studies market outcomes when some of these simplifying assumptions are relaxed. Hope our paper can inspire these and other further research on this topic.

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