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Market entry into emerging two-sided markets

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Abstract

This note analyzes the impact of indirect network effects in emerging two-sided markets on prices, quantities, profits and market entry assuming market enlargement induced by indirect network effects. Only if indirect network effects are small, the conventional results of market entry apply, although weakened. If, however, the interconnection between the markets is strong, tighter market structures or even monopolies can be optimal.

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1 Introduction

Many two-sided platforms such as Internet service providers are placed in a constantly changing environment, bringing up new technologies, applications and services and therefore higher demands. As a consequence, many of these markets grow steadily and become more and more important. One reason for this success may be the existence of substantial indirect network effects. A large network of users from one market typically positively affects the utility of users from a second market and vice versa. Strong network effects therefore stimulate users to prefer a specific network over others (see Rochet and Tirole, 2003). As a consequence, markets may be enlarged by attracting new customers due to indirect network effects which in turn leads to higher concentration. Hence, a tendency towards natural monopolies may also be expected for two-sided markets.

Market structure of two-sided markets are quite versatile. While some of the markets are highly concentrated there is also a number of dynamic markets which are characterized by fierce competition and market entry. Nevertheless, recently the focus of competition authorities shifted from hard- and software producers like IBM or Microsoft to two-sided platforms such as Google, Apple's iTunes or the social network Facebook. Some of those platforms are highly concentrated. Many others such as news sites, travel agencies, online bookstores, etc. face a high number of competitors and are far from being dominant. However, in network industries intense competition is not always desirable as network effects can sometimes be better utilized by a single firm.

Concentration tendencies are a well known problem of media markets. The so called circulation spiral is supposed to lead to a high concentration (e.g. Corden, 1952; Furhoff, 1973, Gustafsson, 1978). In online media markets the discussion was fueled with the emergences of new and powerful platforms like eBay or Google. Evans and Schmalensee (2008) analyze how indirect network effects can lead to endogenous monopolization of markets but find that this is not commonly observable.

However, in network industries intense competition is not always desirable as network effects can sometimes be better utilized by a single firm. From a theoretical perspective, Caillaud and Jullien (2003) argue that agents can better coordinate or match through a single platform. However, in case of multihoming, the existence of two platforms can be efficient (Caillaud and Jullien, 2003; Jullien, 2005). Damiano and Li (2008) find that in matching models a monopoly platform can be favorable. Further works in this area are Burguet and Sákovics (1999) and Ellison, Fudenberg and Mobious (2004). Matching quality seems to be higher under monopoly structure and also larger network effects seem to favor a monopolistic platform. On the other hand, with multihoming and congestion competition is more favorable in their model.

Our work builds on the existing literature by analyzing two-sided markets, say online platforms, offering two products, say content to recipients and advertising space to advertising customers, with interrelated demands. The aim of this note is to abstract from other issues and concentrate fully on the effect of indirect network effects on market entry in a non-saturated market environment. Therefore, we first present an intuitive two-sided market model in section 2 to calculate optimal quantities, prices and profits. Then, in section 3, we look at the welfare effects of market entry and the optimal number of firms. Finally, section 4 concludes.

2 An oligopoly model of two-sided markets

Suppose that there are $i = 1, ..., n$ homogeneous two-sided platforms (2SP) serving two different but interrelated markets. Both markets are assumed to be interconnected via indirect network effects. The strategic variables in both markets are quantities.[1] The inverse demand equations of platform i for the first and second market are given by $p_i = 1 - q_i - Q_{-i} + ds_i$ and $r_i = 1 - s_i - S_{-i} + gq_i$, where p_i is the price for the first good of the two-sided platform i ($2SP_i$) and r_i the price for a second good. Quantities in both markets are given by q_i and s_i. The cost function of platform i is $K_i = cq_i + cs_i + F$ where $c \in [0, 1]$ are the marginal costs and F the fixed costs.[2] The parameters d and g (with $d + g = \theta < 2$) represent the indirect two-sided network effects from one market to the other. An increase of d (g) shifts the respective consumers demand curve outwards. That is, a stronger indirect network effect from one market leads to an increase of the customers' willingness to pay of the respective other market. This assumption of market enlargement especially holds in a non-saturated market environment. As long as markets are still growing, network effects are likely to lead to increasing markets size.[3]

2.1 Quantities

The $i = 1, ..., n$ platforms maximize profits with respect to q_i and s_i:

$$\max_{q_i, s_i} \pi_i = [p(q_i, Q_{-i}, s_i) - c]\, q_i + [r(s_i, S_{-i}, q_i) - c]\, s_i - F. \tag{1}$$

Using the first order conditions, assuming symmetry of firms and markets leads then to:

$$q_i = s_i = \frac{1 - c}{n + 1 - \theta}. \tag{2}$$

Quantities in both markets are equal and increase with stronger network effects. The pivotal factor for optimal quantities is the sum of the network effects $\theta = d + g$ rather

[1] Several papers assume quantity competition in a two-sided market environment. Prominent examples are Reisinger et. al. (2009), Anderson and Coate (2005), Anderson (2007), Gabszewicz et al. (2004) and Crampes et al. (2007).

[2] Arguable, marginal costs play a minor role in many two-sided markets, especially in online markets. Assuming $c = 0$ would therefore also be a possible assumption.

[3] Market size is normalized to 1 in both markets in absence of network effects.

than each single network externality. That is, even if a single network effect is negative a positive effect on quantities can be observed as long as the negative effect is dominated by the second (positive) network effect ($|d| < g$).[4]

Proposition: *Total quantities in both markets only increase with market entry if indirect network effects are relatively small. If $\theta > 1$, market entry leads to lower total quantities.*

In the symmetric case total quantities are: $Q = nq_i = S = ns_i = \frac{n(1-c)}{n+1-\theta}$, respectively. Thus, the effect of market entry on optimal quantities is:

$$\frac{\partial Q}{\partial n} = \frac{\partial S}{\partial n} = \frac{(1-c)(1-\theta)}{(n+1-\theta)^2} \gtreqless 0, \tag{3}$$

which is negative for $\theta > 1$.

As long as network effects are relatively weak, tougher competition leads (as usual) to higher total quantities. Given the sum of network effects is relatively high the *competition effect* is dominated by the, as we call it, *aggregated network effect*. This effect increases firm specific quantities through the market enlargement effect. In case of large network effects the increase in platform specific quantities is more valuable than an increase in market volumes caused by stronger competition. Further competitors entering the market reduce the quantity of each single platform which results in lower quantities since network effects can be internalized only to a lower extent. The increase of total quantity by market entry is then overcompensated by the loss due to not internalized network effects.

Comparing the absolute changes in quantity of the standard Cournot model with our two-sided market Cournot model, the trade-off between competition and indirect network effects becomes clear. Defining ΔQ_C as the absolute change in quantity for one additional firm $(n+1)$ entering the market in the Cournot model and ΔQ as the absolute change in quantity for our model, we can calculate the indirect network effect for an additional firm entering the market as:

$$\Delta NE = \Delta Q - \Delta Q_c = \frac{(1-c)\theta(1-n^2-n-\theta)}{(n+2-\theta)(n+1-\theta)(n+2)(n+1))}, \tag{4}$$

which is always negative for $n > 1$. A new 2SP entering the market causes two effects: the competition effect which is, as in one-sided markets, always positive and the aggregate network effect which is always negative. For $\theta > 1$, when the interconnection between the two markets is strong enough, the effect induced by the indirect network

[4]As both network effects represent the interrelationship of the two markets the sum instead of the single effects is decisive for the quantities. Since each shift in quantities in one market has an effect on the quantity in the other market feedback effects can be observed. The strength of the overall effect therefore depends directly on θ.

effects dominates and the total quantity in the market decreases. Figure 1 shows both the competition and the network effect for two different θ.

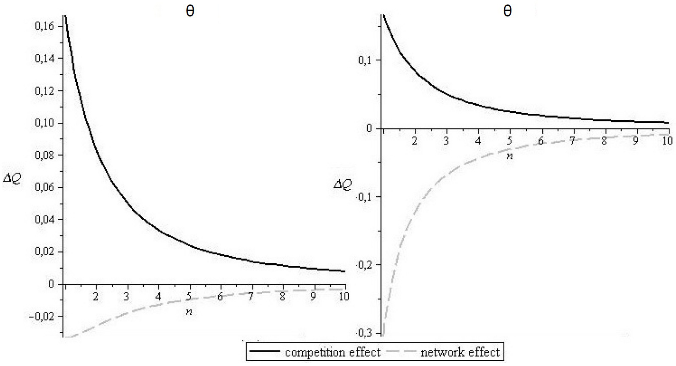

Figure 1: Network and aggregate competition effect depending on n for c=0

The effect on total quantity of an additional company entering the market is steadily decreasing in n. The network effect is always negative but approaching zero. The competition effect is always positive and also approaching zero with more firms entering. As long as $\theta < 1$, consumers on both markets benefit from market entry as total quantities increase.

2.2 Prices

Substituting optimal quantities into the inverse demand functions leads to optimal prices for both markets expressed as a markup on marginal costs:

$$p = c + \frac{(1-g)(1-c)}{n+1-\theta} \quad \text{and} \quad r = c + \frac{(1-d)(1-c)}{n+1-\theta}. \tag{5}$$

Markups for p (r) turn negative in case that g (d) exceeds one. Note, that even if the sum of network effects is limited to two, a single parameter is not limited to be smaller than one.[5] If $d \neq g$, prices differ and the market which exerts the relatively higher positive externality will be subsidized by the other. A platform charges the market with the stronger indirect network effect less or even a price below marginal costs.

Increasing network effects always lead to lower respective prices when $n \geq d$ ($n \geq g$). Since $\theta < 2$, only monopolists might have an incentive to raise prices with stronger network effects when $d > 1$ ($g > 1$). Thus, only monopolists are able to fully benefit from network effects.

Prices r_i and p_i only decrease with increasing number of firms as long as $d \leq 1$ or $g \leq 1$, respectively. Hence, prices will be higher under a more competitive market structure

[5]For $\theta > 2$ negative quantities would be possible in the monopoly case. We therefore allow for one negative price but exclude negative quantities.

when one of the indirect network effects is strong. A seemingly more competitive market could therefore possibly end up in a less favorable situation in terms of prices, and market enlargement will also only take place to a limit extend.

Many customers of two-sided platforms are interested in relative instead of absolute prices. Referring to newspapers prices per recipient or prices per thousand recipients which are commonly known as *cost per thousand* is a more adequate measure. Calculating prices (r/q_i and p/s_i) yields:

$$\frac{r}{q_i} = \frac{(1-d)+c(n-g)}{1-c} \quad \text{and} \quad \frac{p}{s_i} = \frac{(1-g)+c(n-d)}{1-c}. \tag{6}$$

If marginal costs are zero relative prices simplify to $\frac{r}{q_i} = 1-d$ and $\frac{p}{s_i} = 1-g$. And relative prices are constant with respect to market entry as quantities vary with the same rate as prices as long as marginal costs are negligible. In case one network effect exceeds 1 the respective price will be negative which is not uncommon in two-sided markets. However, if marginal costs are not negligible relative prices are increasing with the number of firms. That is, firm specific quantities decrease faster than absolute prices. Again, a more competitive market might end up in a less favorable situation.

2.3 Profits

Firm specific profits are:

$$\pi_i = \left(\frac{1-c}{n+1-\theta}\right)^2 (2-\theta)\,. \tag{7}$$

Individual profits decrease with market entry, as $\frac{\partial \pi_i}{\partial n} < 0$. However, profits increase with stronger network effects, as long as the market structure is monopolistic. In the duopoly case, stronger network effects only lead to higher profits if $\theta < 1$. If $n > 2$ stronger network effects always have a negative impact on individual profits.[6]

An increase in indirect network effects lowers prices in oligopolies but only monopolies can fully internalize the market enlargement effect caused by stronger network effects. Thus, only monopolists can benefit from stronger indirect network effects in terms of profits in any case. With increasing total network externalities prices fall faster than quantities increase, when $\theta > 1$. However, with $n > 2$ prices fall always faster than quantities increase. Therefore, increasing total network effects lead always to lower profits in oligopolistic markets.[7]

[6] $\frac{\partial \pi_i}{\partial \theta} > 0$ for $n = 1$, $\frac{\partial \pi_i}{\partial \theta} \gtrless 0$ for $n = 2$ and $\frac{\partial \pi_i}{\partial \theta} < 0$ for $n > 2$.
[7] This result is due to quantity competition and the market sized being one.

3 Market entry

To analyze the impact of indirect network effects on market entry the maximum number of firms entering the two-sided market is calculated. Assuming that platforms will enter the market as long as they realize positive profits the number of platforms will be lower than the smallest integer which solves

$$n_{max} < (1-c)\sqrt{\frac{2-\theta}{F}} + \theta - 1. \tag{8}$$

As can be seen from equation (8) the maximum number of firms decreases as expected with fixed and marginal costs. In contrast, the number of firms is increasing in θ when network effects are small, i.e. when

$$\theta < 2 - \frac{(1-c)^2}{4F}. \tag{9}$$

Moreover, if marginal costs are zero, the optimal number of companies in the market gets one when θ approaches 2, so the market has a tendency towards a "natural" monopoly with large indirect network effects. If marginal costs are relevant and network effects are relatively large the optimal number of platforms decreases in θ.

Hence, small and moderate indirect network effects attract a larger number of companies. If network effects increase the maximum number of companies decreases and monopolies can be optimal.

3.1 Welfare Analysis

Each inverse demand function is shifted outward by the product of network effects and quantities (ds_i and gq_i). The reservation price is no longer determined by normalized vertical market size of 1 but by $1 + ds_i$ and $1 + gq_i$, respectively.

Firm specific consumer surplus for the content and advertising market is thus given by

$$KR_i^1 = KR_i^2 = \frac{1}{2}\frac{n(1-c)^2}{(n+1-\theta)^2}. \tag{10}$$

and total consumer surplus by

$$KR = \frac{n^2(1-c)^2}{(n+1-\theta)^2}. \tag{11}$$

Combining total consumer surplus with total producer surplus $n\pi_i$ yields total welfare:

$$W = \frac{n(1-c)^2(n+2-\theta)}{(n+1-\theta)^2}, \tag{12}$$

As indirect network effects lead to market enlargement, they always have a positive impact on social welfare ($\partial W/\partial\theta > 0$). The effect of market entry, however, is ambiguous. The impact of the number of competitors on welfare depends heavily on the size of the network effects. If network effects are large, welfare is monotonically decreasing with n. If network effects are below $\theta < 2-\sqrt{2}$, there exists a maximum number of firms which is bigger than 1.[8] Otherwise a monopolistic market structure is desirable.

$\frac{\partial KR}{\partial n}$ shows that consumer welfare is always increasing with additional firms entering the market as long as $\theta < 1$, and decreasing otherwise. Consumers in both markets always benefit from market entry when network effects are small. In case that network effects are relatively large, consumer would lose from a further firm entering the market, as total quantities decrease with $\theta > 1$

For total welfare, monopolies are almost always favorable with respect to indirect network effects. Again, only if the aggregate network effect is relatively small an oligopoly would earn a higher total surplus. In order for market entry to increase welfare the number of firms in the market n must be smaller than a certain threshold, depending on θ:

$$n_W < \frac{2}{\theta} - 3 + \theta. \quad (13)$$

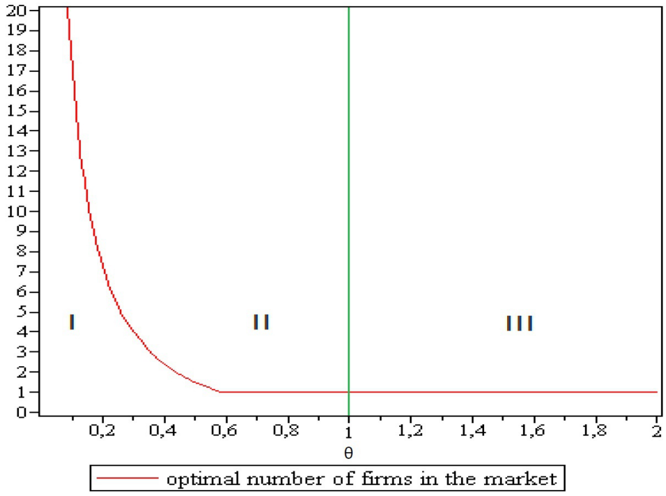

Figure 2: Maximum number of firms in the market for market entry to still be desirable

Figure 2 presents the number of maximum platforms when market entry is still socially desirable.[9] Taking welfare as well as consumer surplus into account, three areas can be distinguished regarding market entry: In area I, too few companies are in the market,

[8]Without loss of generality we fully abstract from fixed costs and concentrate entirely on the impact of indirect network effects

[9]To obtain this figure we differentiated welfare with respect to the number of firms and then solved for the optimal number depending on θ.

both total welfare and consumer surplus would increase with further entry. In area II, too many firms are in the market. Total surplus would therefore decrease (increase) with further firms entering (leaving) the market. Market entry, however, would increase consumers surplus. Thus, following a pure consumer standard, market entry in area II could also be preferable. In area III, again, too many firms are in the market, however, market entry would be detrimental for both, consumers and 2SPs.
For large indirect network effects monopolies maximize both total welfare and consumer surplus. For smaller values, consumer surplus always increases with market entry, whereas welfare is maximized at a smaller number of firms.

4 Conclusion

This note analyzes the impact of indirect network effects in emerging two-sided markets on market entry as well as on welfare. The results show that market entry in two-sided markets depends on the strength of the interconnection between the two markets, i.e. the indirect network effects. When the two-sided nature of the market is only weak to moderate, if the indirect network effects are small or moderate, then the normal effects of market entry apply but are weakened. When indirect network effects are strong, i.e. the markets are strongly interrelated, market entry will not longer occur. Network effects then lead to some kind of a natural monopoly.

As indirect network effects lead to market enlargement, they always have a positive impact on total welfare. The effect of market entry, however, is ambiguous and depends heavily on the strength of the network effects. In case that network effects are large, total welfare may decrease with market entry and a monopolistic market structure may be desirable. Consumers, however, always benefit from entry due to market enlargement effects.

Overall, highly concentrated two-sided markets may be less of a problem in markets with strong network effects and may even lead to maximum total surplus. As monopolists are able to internalize network externalities best, monopolistic platforms may be able to produce highest effects of market enlargement and therefore highest utility for consumers. This positive effect may overcompensate dead weight losses from monopolization.

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