Entry in a Network Industry with a "Capacity-Then-Production" Choice

Domenico Buccella and Luciano Fanti

This study investigates the effect of consumption externalities on entry decision in network industries. A non-monotonic relation exists in the monopoly/duopoly profit differential. A monopolist which has to pay a cost to maintain his dominant position, such as a license fee or lobby expenditures, can block more easily entry for a wide range of network externalities unless these externalities are not exceedingly intense. Therefore, network externalities work as an "innocent" barrier to entry. The capacity choice of the incumbent in a "capacity-then-production" model reinforces the "innocent" entry barrier effect for the potential entrant.

Keywords: Network externalities, Entry, Deterrence, Capacity choice, Monopoly, Duopoly

JEL Classification: L13, L20, L21

I. Introduction

The relevance of network industries in contemporary economics is continuously increasing. The most tangible examples of this phenomenon are the broad diffusion of mobile devices and the widespread use of computers and related software in social and economic activities.

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Network goods refer to products in which the utility of a typical consumer increases when the number of other clients/users (*i.e.*, the purchase expansion) of the products further increases. The reason why a single client/user aspires to buy a product is related to the fact that other clients/users are buying this product. Moreover, other product users can positively affect the demand in the presence of network goods because their number can signify quality and availability of after-sale services for abiding consumers.

Growing literature is motivated by the recent increasing importance of network industries and has started analyzing how the presence of positive consumption externalities/network effects alters the results of standard models of imperfect competition (Katz, and Shapiro 1985; Cabral *et al.* 1999) and industrial organization. In particular, scholars have lately focused on the role of strategic delegation (Hoernig 2012; Chirco, and Scrimitore 2013; Battacharjee, and Pal 2014). The present work takes a different route and studies the effects of network externalities on entry.

Economides (1996) investigates such effects in a context without fixed entry costs. Two counterbalancing forces work to determine the outcome of the entry problem: 1) the usual standard competition effect, that is, entry reduces the profits of the incumbent; and 2) the specific network effect, that is, when the expected production by consumers is high, their willingness to pay for them is high, and thus, the demand is high. Economides (1996) mentions that the second effect will always prevail in the linear case of demand expectation functions, and thus, the incumbent monopolist will always invite entrants. Kim (2002) reconsiders the result of Economides (1996) and demonstrates that it is inapplicable, particularly for homogeneous goods.[1] However, the present study shows that the network effect cannot exceed the competition effect in the case of linear functions. Moreover, the analysis of the different influences of the network effect intensity on the profits of the incumbent and the entrant indicates that network externality favor the block of market entry when the externality is not excessively strong. To guarantee his monopoly position, we assume that the monopolist has to pay a cost to establish a barrier to entry, such as a license fee or lobby expenditures. In this sense, network externalities are structural or "innocent" barriers to

[1] "This is because, if the incumbent's profit is higher under competition (oligopoly) than under monopoly, then the incumbent monopolist can make even higher profit by simply duplicating the oligopoly price at no additional cost." (Kim, 2002, p. 398).

entry.

Church, and Ware (1999, p. 487) (reported in McAfee *et al.* 2003, p. 10) distinguish between structural ("innocent") and strategic entry barriers. However, they retain the term "barrier to entry" only for structural barriers, that is, "a structural characteristic of a market that protects the market power of incumbents by making entry unprofitable." The definition of strategic behavior differs from the previous one because strategic behavior implies that the actions of incumbents influence entrance choice (*e.g.*, inflicting losses to entrants).[2]

Spence (1977) studies the strategic choice of capacity of incumbents in the presence of potential entry in an industry with standard goods. The author distinguishes between capacity and quantity produced. The capacity amount invested by the incumbent during the first period is a constraint on the subsequent quantity produced. The incumbent will accommodate entry if the costs of the entry are sufficiently low. Under threat of entry, the incumbent can fix an adequately high capacity and eventually expand its output level to exert downward pressure on the price and deter the entry of a potential competitor. However, the capacity becomes underutilized if entry does not occur because costs are prohibitive. The current study does not use the definition of strategic barrier to entry, and instead, analyzes how the structural characteristic of network externality affects the profits of the incumbent and the entrant.[3] The present study also introduces capacity choice and extends the standard quantity game, which is mainly regarded not as a strategic choice of the incumbent to deter entry but as a post-entry strategic tool in duopoly competition.[4]

[2] For a comprehensive discussion of the various definitions of "barriers to entry" in economics, see McAfee *et al.*, (2003, 2004).

[3] We note that in a different multi-stage game context with unions, Bughin (1999), Buccella (2011), and Fanti, and Buccella (2015, 2016) study the effect on entry of different alternative labor market institutions and various bargaining agendas both as structural and strategic barriers because agenda selection during negotiation can be used as an entry-deterrence tool.

[4] In general, an increasing market competition caused by entry is widely known to lead to a reduction in incumbent profits; however, numerous papers have recently challenged this view and offered different alternative reasons for the possibility of profit raising entry (Tyagi 1999; Naylor 2002a, b; Mukherjee *et al.*, 2009 for a profit raising entry effect of vertical relationships). Lee, and Choi (2002) extend the analysis to the cost of entry and the social benefit in a Cournot-Nash framework when the government attempts to eliminate entry regulations.

This study adopts the definition of Church and Ware (1999) and finds that network externalities represent a structural barrier to entry. A non-monotonic relation exists in the monopoly/duopoly profit differential, which depends on the intensity of network externalities with and without capacity choice. Thus, if the monopolist has to pay a license fee to the government or for the cost of lobbying to influence market regulations to deter entry, then the costs can be considerably high, and the entry cannot be prevented in a market with standard goods. By contrast, the profit differential in a market with consumption externalities increases. Thus, the costs for deterring entry may be safely sustained. Therefore, the incumbent can deter market entry because of the network effect, unless the intensity of the externalities is not excessively strong. The incentive to block market entry increases up to a certain level of network externalities and then subsequently decreases. Moreover, when the capacity choice is considered, the “capacity-then-production” game alters the results as follows. 1) The incumbent is able to pay relatively higher license fees/lobby expenditures to block entry. 2) The strategic capacity choice in the presence of network effects has a costly influence on the duopoly profits that is stronger than without capacity. This condition amplifies the incumbent/entrant profit differential. 3) The incumbent blocks entry to all degrees of network externality if license fees/ lobby expenditures are not prohibitive. Therefore, the role of the network effect as barrier to entry is magnified by the presence of capacity choice.

The remainder of the article is organized as follows. Section II describes the proposed model. First, the basic ingredients of an industry with network effects are presented. Second, a “capacity-then-production” framework is developed, and the analysis of entry in this context is discussed. Finally, the last section summarizes the key results and implications and suggests possible directions for future research.

II. Proposed Model

The present work assumes that the simple mechanism of network externalities is as follows. The surplus obtained by the client of a firm increases directly with the number of clients of the firm (Katz, and Shapiro 1985).

From the recent literature (Hoernig 2012; Battacharjee, and Pal 2014; Chirco, and Scrimitore 2013), the monopolist faces the following linear direct demand:

$$q = a - p + ny, \tag{1}$$

where q denotes the quantity of the goods produced, and y denotes consumer expectation of the equilibrium production of the monopolist. The parameter $n \in [0, 1)$ represents the strength of the network effects. When the value of the parameter is high, the externalities are strong.

The inverse demand function is

$$p = a - q + ny, \tag{2}$$

where p is the price of goods. The marginal cost of a firm is considered $c=0$ to focus on the effects of network externalities in this industry. An alternative interpretation of the latter condition is that the labor market is not unionized, and the firm can hire workers at a competitive wage, which is normalized to zero.

A. Benchmark: No capacity choice

The profit function of a monopolist in a framework without capacity choice is

$$\Pi = (a - q + ny)q. \tag{3}$$

The maximization of Equation (3) yields

$$q = \frac{a + ny}{2}. \tag{4}$$

As shown in Equation (4), the equilibrium output level is obtained after imposing the "rational expectation" condition $y=q$

$$q^M = \frac{a}{2-n}, \tag{5}$$

where the upper script M stands for "monopoly." After substituting Equation (5) into Equation (3), the monopoly profits are

$$\Pi^M = \frac{a^2}{(2-n)^2}. \tag{6}$$

The case of entry is now considered. Firm 1 is defined as the incumbent, whereas Firm 2 is defined as the potential entrant. The demand function in duopoly becomes

$$p = a - q_1 - q_2 + n(y_1 + y_2). \tag{7}$$

The profit functions of firms are

$$\Pi_1 = pq_1, \tag{8}$$

$$\Pi_2 = pq_2 - E, \tag{9}$$

for the incumbent and the entrant, respectively. E represents an exogenous fixed cost faced by the entrant.

From Equations (8) and (9), the maximization problem and "rational expectation" conditions of firms $y_i = q_i$, $i = 1, 2$ lead to

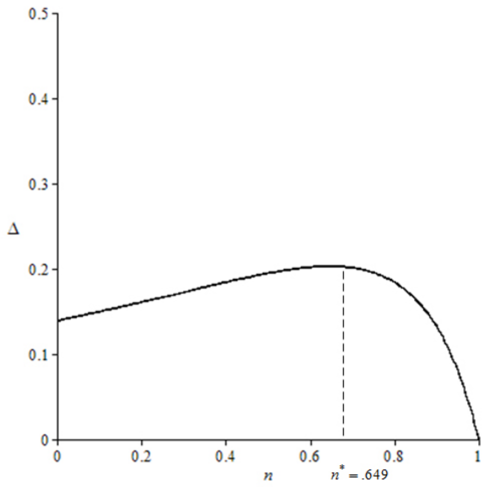
$$q_i = \frac{a - (1-n)q_j}{2-n} \qquad i \neq j, \qquad i, j = 1, 2. \tag{10}$$

The condition $n \in [0, 1)$ ensures that the reaction functions are negatively sloped (*i.e.*, $(\partial q_i)/(\partial q_j) < 0$) and that goods are strategic substitutes. Moreover, $|(\partial q_i)/(\partial q_j)| < 1$, which guarantees the stability of the system.[5] The system of equations in Equation (10) is solved, and the output decision of firms is

$$q_i = \frac{a}{3-2n}, \quad i = 1, 2. \tag{11}$$

The duopoly profits in equilibrium are obtained by substituting

[5] The intensity of network effects cannot be excessively strong with linear demand and expectation functions. Thus, the network effect cannot counterbalance the competition effect. Therefore, the network effect can never represent an invite to entry, which is in contrast to the claim of Economides (1996).



Note: The graph is drawn for $a = 1$.

FIGURE 1
PLOT OF THE PROFIT DIFFERENTIAL
BETWEEN MONOPOLY AND DUOPOLY
$\Delta = \Pi_1^M - \Pi_1^D$

Equation (11) into the profit functions of firms,

$$\Pi^D = \frac{a^2}{(3-2n)^2}, \tag{12}$$

where the superscript D stands for "duopoly."

The results are briefly discussed as follows. Figure 1 plots the monopoly/duopoly differential, which is defined by $\Delta = \Pi_1^M - \Pi_1^D$. The humped shape of Δ suggests that the incumbent has an incentive to block entry up to a certain level. The following exercise shows this nonlinear relationship between n and the incentive to block.

Suppose that the monopolist has to pay cost T to establish a barrier to entry, such as a license fee to be paid to the government or lobby expenditures. The first column presents the intensity of the network effect. The second column shows the monopoly profits in Equation (6), whereas the third column shows the duopoly profits in Equation (12). The fourth column describes the amount of the license fee/lobby costs.

TABLE 1
NETWORK EFFECTS AS "INNOCENT" BARRIERS TO ENTRY

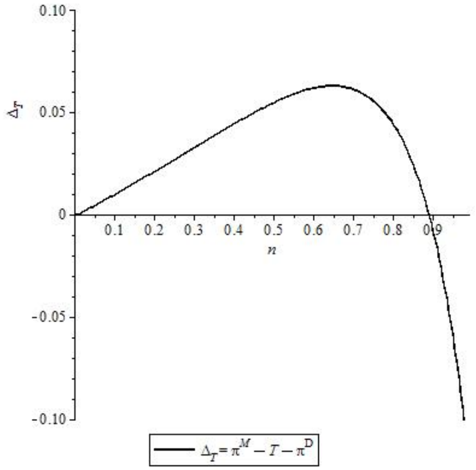
n	Pi(mono)	Pi(duo)	T	Pi(mono)-T	Δ(diff)
0	0.25	0.111111	0.14	0.11	-0.00111111
0.05	0.262985	0.118906	0.14	0.122984878	0.004078814
0.1	0.277008	0.127551	0.14	0.13700831	0.00945729
0.15	0.292184	0.137174	0.14	0.152184076	0.015009865
0.2	0.308642	0.147929	0.14	0.168641975	0.020712981
0.25	0.326531	0.16	0.14	0.186530612	0.026530612
0.3	0.346021	0.173611	0.14	0.206020761	0.03240965
0.35	0.367309	0.189036	0.14	0.227309458	0.038273541
0.4	0.390625	0.206612	0.14	0.250625	0.04401343
0.45	0.416233	0.226757	0.14	0.276233091	0.049475721
0.5	0.444444	0.25	0.14	0.304444444	0.054444444
0.55	0.475624	0.277008	0.14	0.335624257	0.058615947
0.649	0.547885	0.345208	0.14	0.407884863	0.062676834
0.65	0.548697	0.346021	0.14	0.408696845	0.062676084
0.7	0.591716	0.390625	0.14	0.451715976	0.061090976
0.75	0.64	0.444444	0.14	0.5	0.055555556
0.8	0.694444	0.510204	0.14	0.554444444	0.044240363
0.85	0.756144	0.591716	0.14	0.616143667	0.024427691
0.9	0.826446	0.694444	0.14	0.686446281	-0.00799816
0.95	0.907029	0.826446	0.14	0.767029478	-0.0594168
0.99	0.980296	0.961169	0.14	0.840296049	-0.12087273

Note: All values are calculated for $a=1$ and $E=0$.

The costs in the current exercise are set as $T=0.14$, such that the firm cannot preserve the monopoly position at $n=0$ (standard goods). The fifth column reports the net profit of the monopolist. Finally, column six evaluates the difference between the net profits of the monopolist and the duopoly profits. When the value is positive, the incumbent finds paying T to be profitable and keeps the competitor out of the market. By contrast, a duopoly will be better when the value is negative.

The column shows that the monopolist is increasingly able to pay the costs as the network effect intensifies until $n^*=0.649$. The incumbent has no incentive to pay T at $n=0.9$. The conceivable presence of fixed costs for the entrant simply reinforces this mechanism.

Table 1 reports the findings of this exercise, which is graphically represented in Figure 2, in which $\Delta_T=\Pi^M-T-\Pi^D$. The preceding discussion is summarized in the following result.



Note: The graph is depicted for $a=1$ and $E=0$.

FIGURE 2
NETWORK EFFECTS AS "INNOCENT" BARRIERS TO ENTRY (GRAPHICAL REPRESENTATION)

***Result* 1.** *Network externalities represent "innocent" barriers to entry unless they are excessively strong.*

Therefore, apart from investment in technology and in research and development activities, the presence of various intensities of network effects in different segments of network industries can represent an additional factor that may explain both the presence of monolithic giants and competitive product markets. In other words, network effects may influence the market structure.

B. "Capacity-then-production" choice

A "capacity-then-quantity" game is considered. Following Vives (1986), Nishimori, and Ogawa (2004), Ogawa (2006), Barcena-Ruiz, and Garzón (2007), and Fanti, and Meccheri (2016), the firm has the following quadratic cost $C(x, q) = (x-q)^2$, where x is the capacity scale of the firm, and q is the production quantity. When Equation (2) is given, the profit function of the monopolist becomes

$$\Pi = (a - q + ny)q - (x - q)^2. \tag{13}$$

The cost function $C(x, q)$ has a U-shaped form, such that the long-run average cost reaches the minimum when production is equal to capacity, that is, when $x=q$. When the firm chooses output (*i.e.*, the second and last stage), over capacity is achieved if $x>q$, whereas under capacity is achieved if $x<q$. The capacity choice represents a commitment on capacity. However, the quantity choice of a firm is not committed. That is, the capacity choice provides consumers with nothing more but information that the discrepancy between the capacity and the optimal output level is costly for the firm. However, the capacity commitment of the firm does not directly alter the formation of expectations with regard to the output level produced by the firm.

The maximization of Equation (13) yields

$$q = \frac{a + ny + 2x}{4}. \tag{14}$$

From Equation (14), the output level in equilibrium after imposing the "rational expectation" condition is

$$q = \frac{(a + 2x)}{4 - n}. \tag{15}$$

After substituting Equation (15) into Equation (13), the monopoly profits are

$$\Pi_c^M = \frac{2a^2 + 8ax - (n^2 - 8n + 8)}{(4 - n)^2}, \tag{16}$$

where the subscript c stands for "capacity." Therefore, the monopolist maximizes Equation (16) with respect to x when choosing its capacity level. Thus,

$$x_c^M = \frac{4a}{n^2 - 8n + 8}, \tag{17}$$

with $(\partial x)/(\partial n)>0$: An increase in the intensity of network externalities causes the firm to expand its capacity.[6] The following equation is obtained when Equation (17) is substituted back into Equation (15):

$$q_c^M = \frac{4(a-n)}{n^2 - 8n + 8}. \tag{18}$$

The direct comparison between Equations (17) and (18) shows that $x_c^M > q_c^M$. That is, the firm selects over capacity. Moreover,

$$\frac{\partial(x_c^M - q_c^M)}{\partial n} > 0,$$

excess capacity increases as network externalities increase. Equations (17) and (18) are substituted into Equation (13). Rational expectations are realized (*i.e.*, $y=q$); thus, the monopoly profits are

$$\Pi_c^M = \frac{2a^2}{n^2 - 8n + 8}. \tag{19}$$

When the case of entry is considered, the demand function is presented in Equation (7). However, the profit functions of firms are

$$\Pi_1 = pq_1 - (x_1 - q_1)^2, \tag{20}$$

$$\Pi_2 = pq_2 - (x_2 - q_2)^2 - E, \tag{21}$$

for the incumbent and the entrant, respectively, with E as the exogenous fixed cost faced by the entrant.

The maximization of Equations (20) and (21) in the product market competition stage and the further imposition of the “rational expectation” conditions yield

[6] Note that the monopolist, by definition, has not to use strategically the capacity. Indeed, in the case of standard goods (*i.e.* $n=0$), $x_c^M = q^M$(as easily shown by comparing Equations (17) and (18)). This means that the presence of network effects crucially makes profitable to invest in costly unused capacity. The rationale for this choice is that the monopolist is able to meet a larger demand, and this effect is particularly magnified when the market size is not too large (*i.e.* a is relatively small, see Equation (18)).

$$q_i = \frac{a - (1-n)q_j + 2x_i}{4-n} \qquad i \neq j, \quad i, j = 1, 2. \tag{22}$$

The system of equations is solved in Equation (22). The output of firms as a function of the capacities is

$$q_i = \frac{3a + 8x_i - 2x_j - 2n(x_i - x_j)}{15 - 6n}, \quad i \neq j, \quad i, j = 1, 2. \tag{23}$$

The substitution of the equations in Equation (23) into the profit functions of the firms allows us to derive the expressions for the duopoly profits as the functions of capacity choices.

$$\Pi_{i,c}^{D} = \frac{\left\{ \begin{array}{l} (8x_i^2 - 16x_i x_j - 28x_i^2)n^2 + [116x_i^2 + (80x_j - 24a)x_i + 24ax_j - 16x_j^2]n \\ -97x_i^2 + (96a - 64x_j)x_i + 18(a - \frac{2}{3}x_j)^2 \end{array} \right\}}{9(5-2n)^2} \tag{24}$$

Thus, each firm in the capacity choice stage maximizes Equation (24) with respect to x_i, $i=1, 2$, which implies that

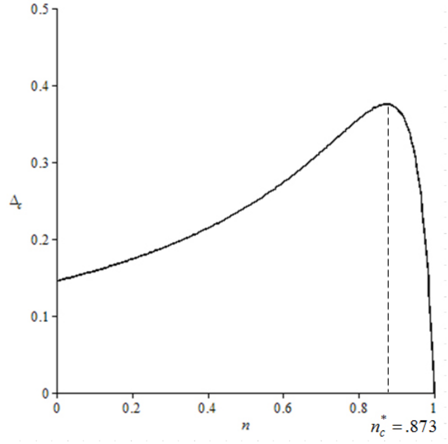
$$x_i = \frac{4(12a - 3an - 8x_j + 10nx_j - 2n^2 x_j)}{28n^2 - 116n + 97}, \quad i \neq j, \quad i, j = 1, 2, \tag{25}$$

with $(\partial x_i)/(\partial n) > 0$, similar to before, and $(\partial x_i)/(\partial x_j) < 0$. The capacity choice of one firm is negatively related to the capacity choice of its rival. The system of equations in Equation (25) is solved. The capacity in equilibrium of firms is

$$x_{i,c} = \frac{4a(4-n)}{12n^2 - 52n + 43} \qquad i = 1, 2. \tag{26}$$

Substituting Equation (26) into Equation (23) yields

$$q_{i,c} = \frac{3a(5-2n)}{12n^2 - 52n + 43} \qquad i = 1, 2. \tag{27}$$



Note: The graph is drawn for $a = 1$.

FIGURE 3

PLOT OF THE PROFIT DIFFERENTIAL BETWEEN MONOPOLY AND DUOPOLY WITH CAPACITY CHOICE $\Delta_c = \Pi_{1,c}^M - \Pi_{1,c}^D$

Similar to that in monopoly, we obtain $x_{i,c}^D > q_{i,c}^D$. That is, the firms select over capacity, with

$$\frac{\partial(x_{i,c}^D - q_{i,c}^D)}{\partial n} > 0.$$

Excess capacity increases with network externalities.

When Equations (26) and (27) are substituted back into Equation (24), we obtain the equilibrium profits in duopoly as follows:

$$\Pi_{i,c}^D = \frac{2a^2(28n^2 - 116n + 97)}{(12n^2 - 52n + 43)^2} \qquad i = 1, 2. \tag{28}$$

Similar to the previous subsection, $\Delta_c = \Pi_{i,c}^M - \Pi_{i,c}^D$, which is depicted in Figure 3. The non-monotonic relation in the profit differential in the presence of network externalities is confirmed in the "capacity-then-production" model, which shows that the incentive to block entry persists. The exercise presented in the previous subsection is repeated to analyze the effect of capacity choice. The costs of the incumbent are

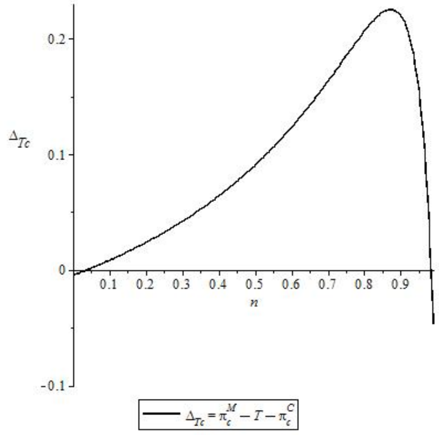
TABLE 2
NETWORK EFFECTS AS "INNOCENT" BARRIERS TO ENTRY IN A "CAPACITY-THEN-PRODUCTION" MODEL.

n	Pi(mono)	Pi(duo)	T	Pi(mono)-T	Δ(diff)
0	0.25	0.104922	0.15	0.1	-0.00492
0.05	0.263071	0.111674	0.15	0.113071	0.00140
0.1	0.277393	0.119172	0.15	0.127393	0.00822
0.15	0.293148	0.127539	0.15	0.143148	0.01561
0.2	0.310559	0.136929	0.15	0.160559	0.02363
0.25	0.329897	0.147531	0.15	0.179897	0.03237
0.3	0.351494	0.159584	0.15	0.201494	0.04191
0.35	0.375763	0.173392	0.15	0.225763	0.05237
0.4	0.403226	0.189352	0.15	0.253226	0.06387
0.45	0.434546	0.207986	0.15	0.284546	0.07656
0.5	0.470588	0.23	0.15	0.320588	0.09059
0.55	0.512492	0.256367	0.15	0.362492	0.10613
0.6	0.561798	0.288469	0.15	0.411798	0.12333
0.65	0.620636	0.328336	0.15	0.470636	0.14230
0.7	0.692042	0.379068	0.15	0.542042	0.16297
0.75	0.780488	0.445646	0.15	0.630488	0.18484
0.8	0.892857	0.536591	0.15	0.742857	0.20627
0.873	1.124778	0.749472	0.15	0.974778	0.22531
0.9	1.242236	0.871987	0.15	1.092236	0.22025
0.95	1.535509	1.23007	0.15	1.385509	0.15544
0.99	1.886614	1.783867	0.15	1.736614	-0.04725

Note: All values are calculated for $a=1$ and $E=0$.

set as $T=0.15$, such that the monopoly position cannot be maintained at $n=0$. The results in Table 2 indicate that the monopolist is progressively more able to pay the costs as network externalities increase until $n_c^*=0.873$. Moreover, the duopoly is more profitable for the incumbent at $n=0.985$. The possible presence of fixed costs for the entrant simply reinforces the result. Figure 4 depicts the findings, where $\Delta_{Tc}=\Pi_c^M-T-\Pi_c^D$.

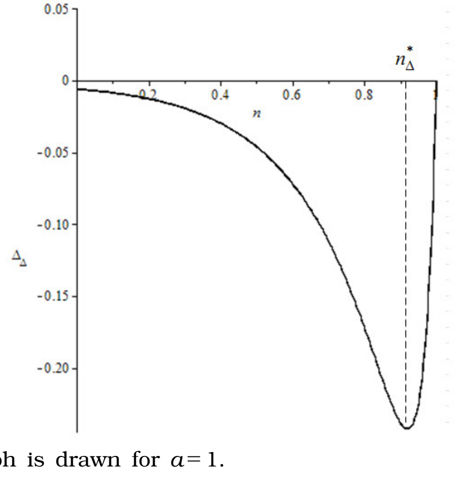
A direct comparison with the results in Subsection II-A. shows the following findings with capacity choice. 1) The incumbent can pay higher license fees/lobby expenditures to block entry than without capacity. 2) The maximal residual profits after paying T is at a level of network intensity that is higher than without capacity ($n_c^*>n^*$). 3) If T is not prohibitive, the incumbent may virtually block entry no matter degree of n. The next result summarizes the preceding discussion.



Note: The graph is depicted for $a = 1$ and $E = 0$.

FIGURE 4

NETWORK EFFECTS AS "INOCENT" BRRIERS TO ENTRY IN A "CAPACITY-THEN-PRODUCTION" MODEL



Note: The graph is drawn for $a = 1$.

FIGURE 5

PLOT OF THE DIFFERENTIAL BETWEEN PROFIT DIFFERENTIALS WITHOUT CAPACITY CHOICE AND THE "CAPACITY-THEN-PRODUCTION" GAME $\Delta_\Delta = \Delta - \Delta_c$

Result 2. *Capacity choice reinforces the "innocent" barriers to the entry effect of network externalities.*

Figure 5 defines $\Delta_\Delta = \Delta - \Delta_c$ and presents how the introduction of a priori decision about capacity makes entry difficult from a different perspective. For given levels of $\bar{E}$ and $\bar{T}$, 1) the capacity choice allows the incumbent to block entry in an easier manner than without capacity commitment even in the absence of network effects,[7] and 2) the level of network effects, in which capacity choice provides the highest relative net profit residual, is at $n^*_\Delta = 0.91$. However, the capacity choice of firms virtually makes no difference in an industry characterized by strong network externalities, that is, for values of $n \to 1$, $\Delta_\Delta \to 0$.

III. Conclusion

The present work has investigated the effect of network externalities on entry. A non-monotonic relation exists in the monopoly/duopoly profit differential, which depends on the intensity of the network effect with and without capacity choice. If the monopolist has to pay a cost to establish a barrier to entry, such as a license fee or lobby expenditures, then as profit differential increases, the ability of the incumbent to block market entry increases up to a certain level and then subsequently decreases. Network externalities represent "innocent" barriers to entry for a wide range of parameter space.

The "capacity-then-production" game changes the results when capacity choice is considered. The findings are as follows. 1) The incumbent can pay higher license fees/lobby expenditures to block entry with capacity choice than without it. 2) The strategic capacity choice in the presence of network externalities has a costly effect on duopolists which is stronger with capacity than without it. As a consequence, the incumbent/entrant profit differential is amplified. 3) The incumbent may practically block entry for any degree of network externality if license fees/lobby expenditures are not prohibitive. Thus, the presence of capacity choice magnifies the role of the network effect as an "innocent" barrier to entry.

The present study adds to an extensive understanding of the subject of industry entry, which is a central aspect in the comprehension of product market competition. The issues investigated in the current work

[7] In this sense, the capacity choice represents by itself an "innocent" barrier to entry, which reinforces each other with network effects.

are far from exhaustive. First, this study has focused on the "innocent" effect of network externality on entry. It does not study the incumbent/leader strategic moves, such as the output decision that can deter/accommodate the entry of the entrant/follower according to the Stackelberg-Dixit-Spence model.

Second, the analysis has disregarded the effects on consumers and overall social welfare. The peculiarity of the network industries should be considered when governments and antitrust authorities design an appropriate regulatory framework intervention. Therefore, further investigations in this direction are essential. Moreover, the results are based on specific assumptions. The marginal cost of production has been considered constant at zero. The positive cost of production with different production technologies, such as decreasing returns to scale, and the role of research and development investments are other elements that merit further research.

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