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Does Common Ownership Distort Entry Incentives In Successive Oligopolies?*

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Abstract

It is commonly believed that common ownership deters entry by internalizing market competition which warrants pro-competitive entry regulations. Using a successive oligopoly model with common ownership, we challenge this conventional wisdom. We show that if the downstream sector alone operates under common ownership, entry is always socially excessive, i.e., more firms enter the market than is socially optimal. In contrast, when the upstream sector alone operates under common ownership, entry is socially excessive (insufficient) if the degree of common ownership in the upstream market is reasonably low (high). Finally, when both sectors are characterized by common ownership, entry is socially excessive if the degree of ownership in the downstream market is stronger than that in the upstream market. Therefore, our findings provide a rationale for anti-competitive, rather than pro-competitive entry regulations.

Keywords: Common Ownership, Excessive Entry, Insufficient Entry, Successive Oligopoly.

JEL classification: D43, L11, L13, L22.

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1 Introduction

Horizontal common ownership has gained popularity in recent years where a common investor holds shares in competing firms and maximizes the aggregate profits of all rival firms it holds across the industry. For e.g., the Big Three institutional investors – BlackRock, Vanguard and State Street hold significant shares in rival companies across various sectors, such as airlines, banking and retail (Azar et al., 2018; Schmalz, 2018; Bazkus et al., 2021). The collusive nature of the ownership structure which can potentially reduce firms’ incentives to compete aggressively, has attracted criticism due to its anti-competitive effects (Posner et al., 2016).

While the literature on common ownership (noted above) mainly studied the implications of horizontal common ownership within a single sector, such as airlines, banking and retail; in practice, horizontal common ownership is prevalent across different stages of the supply chain. For e.g., BlackRock holds shares in pharmacies such as CVS Health and Walgreens Boots Alliance whereas Vanguard Group Inc. holds shares of the drug manufacturers like Pfizer, Johnson & Johnson, and Merck & Co.¹ Likewise, State Street owns shares in streaming platforms like Netflix and Hulu, whereas BlackRock holds share in content providers such as Comcast and AT&T.² Therefore, common ownership structures in supply chains is quite pervasive, yet its implications in the context of entry remain relatively unexplored.

Given this context, we study how common ownership at different levels of a supply chain (vertically related market) affects firms’ entry decisions. More specifically, we examine whether the number of firms entering the market is optimal from a welfare perspective. Our findings upend two established beliefs: (a) common ownership does not necessarily deter entry as is commonly thought, and (b) a vertically related market does not always result in socially insufficient entry, as is widely known in the literature that studies the welfare effects of free entry.^{3,4}

¹See, <https://investors.cvshealth.com/investors/stock-information/Largest-Shareholders/> for a list of investors that hold CVS Health shares. Also see, “Wonking out: The attack of the phrama Phantoms” (The New York Times, May 12, 2023) which states that “BlackRock Inc. and Vanguard Group Inc., two of the world’s largest asset managers, are among the top shareholders of Pfizer Inc., Johnson & Johnson, and Merck & Co., three of the world’s largest pharmaceutical companies.”

²See “Netflix, Inc.’s (NASDAQ:NFLX) high institutional ownership speaks for itself as stock continues to impress, up 4.0% over last week” (Yahoo Finance, February 18, 2024).

³Entry is socially excessive (insufficient) if the free entry equilibrium number of firms is more (less) than the welfare maximizing number of firms.

⁴A detailed review of the literature related to common ownership and social efficiency of entry is

We adopt a successive oligopoly model with two sectors – an upstream and a downstream sector, each of which operates under common ownership. The upstream sector produces a critical input that they supply to the downstream market for a unit cost. The firms in both sectors compete in quantities and they interact with each other by means of an endogenous demand for inputs. In order to study the effects of ownership on entry, we allow free entry in the downstream market.

Our analysis offers three interesting policy relevant results. First, if the downstream sector alone operates under common ownership, entry is always socially excessive, i.e., an excessive number of firms enter the market compared to the social optimum. Secondly, when only the upstream sector operates under common ownership, entry is socially excessive when the degree of common ownership in the upstream market is relatively low, whereas entry is socially insufficient when upstream ownership is reasonably high. Finally, when both the upstream and downstream sectors operate under common ownership, entry can still be socially excessive if the degree of common ownership in the downstream market is higher than that in the upstream market.

A socially excessive (insufficient) number of downstream firms enter the market if each marginal entrant's private incentive for entry, measured by its private returns, exceeds (falls below) the value it adds to the society. The relative strength of private and social incentives for entry depends largely on two effects. First, a *business stealing effect* where each entrant steals business from the incumbents, thereby increasing its private returns (Mankiw and Whinston, 1986). While a business stealing effect increases each downstream entrant's private incentive for entry, it also contributes to the loss of social welfare as it incorporates the loss in incumbents' profits. Second, a *competition softening effect* that arises due to common ownership in the upstream and downstream markets. It is worthwhile to note that each marginal entrant does not typically account for the positive or negative value they add to social welfare and bases their entry decision exclusively on its private returns.

When common ownership exists solely in the downstream market, each marginal entrant partly internalizes the adverse effects it imposes on its rivals. As a result, the business stealing effect and the downstream entrant's private incentive to enter the market are weakened to some extent.⁵ Ownership in the downstream sector, on the other hand, presented in Section 2.

⁵As noted, under common ownership structures, entrants partly internalize the impact of their entry

softens competition which results in higher market price, smaller aggregate output and lower consumer surplus. This reduces social welfare so drastically that the weakened business stealing effect still remains a dominant force in firms' entry decision resulting in socially excessive entry.

Next, consider the scenario where common ownership is confined only in the upstream sector. Absent downstream ownership, the business stealing effect remains strong. However, a competition softening effect in the upstream market makes the upstream suppliers less aggressive in their output (input supply) behavior, which increases the input price. As a result, production in the downstream sector becomes more costly, which in turn reduces industry output and consumer surplus. As it appears when the degree of common ownership in the upstream market is reasonably small (large), the business stealing effect, and hence the entrant's private incentive for entry remains prominent (weak), which drives more (fewer) firms into the market compared to the socially optimal level.

Finally, when common ownership prevails in both the downstream and upstream markets, the competition softening effects always reduce social welfare as consumer surplus worsens due to either reduced output or increased input price. Therefore, excessive entry occurs when the business stealing effect, and hence the private incentive for entry is strong enough to outweigh the adverse effects the competition softening effects impose on the social welfare. Intuitively, this happens only when the degree of common ownership in the downstream market exceeds that in the upstream market. Entry remains socially insufficient in all other cases.

The remainder of the paper is structured as follows. Section 2 discusses the related literature. Section 3 describes the model and discusses our key findings. Section 4 extends the analysis to an integer case and a market with differentiated goods. Finally, Section 5 concludes. All proofs are relegated to the Appendix.

2 Related literature

There is a growing concern that common ownership stifles competition and dampens firms' entry incentives. Why? Under common ownership, each entrant internalizes the negative effects they impose on the profits of the incumbent firms. The internalization

on incumbents' profits. One could term this mechanism as the *profit stealing effect*. However, we retain the term *business stealing effect* as is conventional in the literature (e.g., Mankiw and Whinston, 1986; Ghosh and Morita, 2007a; Sato and Matsumura, 2020).

of rivals' profits softens market competition by making the firms less aggressive in their behavior.⁶ As a result, entry becomes less appealing. Recent empirical studies (Ruiz Pérez, 2019; Xie and Gerakos, 2020; Xie, 2021 and Newham et al., 2025) confirm that common ownership reduces entry. However, a handful of other empirical works find no or only weak evidence that common ownership softens market competition (Schmalz, 2018; Backus et al., 2021; Gerardi et al., 2023).

The theoretical literature examining the effects of entry in the presence of common ownership is rather limited. Using a circular-market model, Sato and Matsumura (2020) show that common ownership always suppresses entry. Using a Cournot framework, Vives and Vraosinos (2025) show that entry either decreases monotonically or follows an inverted U-shaped pattern as common ownership rises. They further show that whether entry is socially excessive or insufficient depends on the returns to scale of technology.

While the above theoretical contributions offer valuable insights, they are predominantly based on one-tier industries where the input market is assumed to be perfectly competitive. However, in reality many final products pass through different stages of production, for e.g., the upstream firms first process the inputs before they are transferred to the downstream sector, who then transform them into final goods. In order to capture such industrial structures more accurately, we consider a vertically related market.

In another theoretical study, Chen et al. (2024) adopt a vertical ownership model and examine the effects of common ownership on social welfare. Their findings suggest that vertical common ownership improves welfare only when downstream competition is relatively weak. Matsumura et al. (2025) extend this analysis to a successive oligopoly model and show that whether vertical ownership improves or deteriorates social welfare depends on the competitiveness of the downstream sector and whether the downstream firms compete in prices or quantities.

It is worthwhile to note that vertical ownerships discussed in Chen et al. (2024) and Matsumura et al. (2025) refer to a situation where a common investor maximizes the aggregate profits of the firms it holds across the vertical market, i.e., the common investor maximizes the share of profits of both the upstream and downstream firms. As a result, the firms in their framework partially internalize the vertical externality, thereby mitigating the double marginalization effect. Our work is different from these studies in

⁶The theoretical understanding of common ownership dates back to Reynolds and Snapp (1986), who showed that partial ownerships among firms reduce their incentives to compete aggressively.

two key aspects. First, we consider horizontal common ownership that prevails in each production tier, upstream and downstream sectors, respectively. As horizontal ownership does not accommodate a cross-market competition softening effect, our setting does not automatically absorb the vertical externality which may promote entry. Secondly, while both Chen et al. (2024) and Matsumura et al. (2025) consider a short run scenario by assuming fixed number of firms, we offer a more long run perspective by assuming endogenous entry.

Our work is also related to another very prominent strand of literature that studies whether too many or too few firms enter the market under free entry – what is commonly known as the literature on social efficiency of entry. This literature gained popularity with the seminal work of Mankiw and Whinston (1986) who, by considering a one-tier homogeneous goods market, showed that entry is always socially excessive. As alluded in the introduction, Mankiw and Whinston (1986) argue that each marginal entrant creates a “business stealing” effect by reducing the output and profits of the incumbent firms. While the business stealing effect increases each entrant’s private profit, it reduces the overall social welfare which includes the loss in incumbents’ profits. As the entrants do not account for this welfare loss, free entry exceeds the social optimum.⁷

In two other influential works, Ghosh and Morita (2007a,b) extended this analysis to vertically related markets where the downstream firms buy inputs from the upstream input suppliers to manufacture the final goods. Allowing downstream entry in a bilateral oligopoly model, Ghosh and Morita (2007a) show that if the upstream input suppliers have significant bargaining power in input price determination, fewer firms enter the downstream market compared to the socially optimal level. They show that under a bilateral oligopoly setting, each downstream firm’s private incentive for entry diminishes as part of its private gain is shifted to the upstream firms when the upstream sector possess a significant bargaining power. In a related work, adopting a successive oligopoly model and assuming free entry in the upstream market, Ghosh and Morita (2007b), again show that entry in the upstream market is socially insufficient rather than excessive. They argue that upstream entry creates a “business creation effect” by increasing the

⁷Since the seminal work of Mankiw and Whinston (1986), the topic of social efficiency of entry has been studied extensively in imperfectly competitive markets. For a representative sample, see, Von Weizsäcker (1980), Suzumura and Kiyono (1987), Okuno-Fujiwara and Suzumura (1993), Anderson et al. (1995), Ghosh and Saha (2007), Stähler and Upmann (2008), Mukherjee (2012), Amir et al. (2014), Basak and Petrakis (2021).

production of the downstream firms. The marginal upstream entrant disregards this socially beneficial outcome of entry and does not capture it as its own profit. As a result, entry becomes socially insufficient instead of excessive.

The conclusions drawn by Ghosh and Morita (2007a,b), therefore, suggest that pro-competitive entry regulations are more viable when a market is vertically related. In contrast, our analysis shows that anti-competitive regulations may be more effective in vertically related markets where the downstream market exclusively operates under common ownership, resulting in socially excessive entry. Furthermore, the antitrust authority must design entry regulations with caution, as vertically related markets may still give rise to excessive entry depending on whether the upstream markets alone or both the downstream and upstream firms work under common ownership.

Few recent studies have revisited the welfare effects of entry in vertically related markets and found that whether entry is socially excessive or insufficient, depends on the returns to scale technology (Basak and Mukherjee, 2016), curvature of the demand curve (De Pinto and Goerke, 2020) and cost asymmetries between the downstream firms (Cao and Wang, 2020). Our work, on the other hand, centers on how common ownership affects social efficiency of entry in vertically related markets.

3 The model

We adopt a successive oligopoly model with two vertically related industries – an upstream sector and a downstream sector.⁸ Suppose there is a fixed number of upstream firms, $m > 2$ while there is free entry in the downstream market. Suppose there are $n > 1$ potential entrants in the downstream market. If a downstream firm decides to enter the market, it incurs a fixed entry cost, $F > 0$. The upstream firms produce homogeneous inputs at a unit cost $c > 0$ and sell them to the downstream market at a uniform price, w . Using these inputs, the downstream firms produce homogeneous final goods.⁹ One unit

⁸The successive oligopoly gained its prominent since Greenhut and Ohta (1979) and later has been used and extended in various contexts, see for e.g., Salinger (1988), Ishikawa and Spencer (1999), Ghosh and Morita (2007a), Peitz and Raising (2014).

⁹We purposefully depart from the differentiated goods market, where consumers' preference for product variety can result in a "love for variety effect" (see Spence, 1976; Dixit and Stiglitz, 1977). As noted by Mankiw and Whinston (1986), in such markets, each new entrant can increase social welfare more than its own profit, potentially leading to *socially insufficient entry*. In order to clearly reiterate the ownership effects, we exclude this additional *love for variety effect* and keep our focus solely on the homogeneous goods market. However, we will discuss the implications of a differentiated goods market

of the final product requires exactly one unit of input. We assume that the downstream firms face no other costs than sourcing the inputs from the upstream firms. Firms in both industries compete à la Cournot and the two sectors interact with each other through an endogenous demand for inputs. More specifically, for a given input price, w , the downstream firms compete in quantities to choose their output levels that determine the industry output and derived demand for inputs. The upstream firms then simultaneously choose their quantities with respect to the derived demand.

We assume that the inverse demand function of the i th downstream firm is linear and takes the form of $P = a - Q$, where P is price and $Q = \sum_{i=1}^n q_i$ is the total output and $a > c$. Therefore, the gross profit of the i th downstream firms is given by $\pi_i = (P - w)q_i$ with $i = 1, 2, \dots, n$ and the profit of the upstream firm is $\Omega_k = (w - c)I_k$ where I_k denotes the supply of inputs by the k th upstream firm with $I = \sum_{k=1}^m I_k$ and $k = 1, 2, \dots, m$ such that $\sum_{k=1}^m I_k = \sum_{i=1}^n q_i$. The social welfare (SW) is given by the sum of consumers surplus (CS) and industry profit, i.e., $SW = CS + \sum_{i=1}^n \pi_i + \sum_{k=1}^m \Omega_k$ where $CS = Q^2/2$.

Suppose that both the downstream and upstream sectors operate under common ownership. Following López and Vives (2019), we assume that downstream firm i has the following objective function:

$$D_i = \pi_i + \lambda \sum_{i \neq j} \pi_j \quad (1)$$

whereas upstream firm k maximizes the objective function below:

$$U_k = \Omega_k + \theta \sum_{k \neq s} \Omega_s \quad (2)$$

where $i, j = 1, 2, \dots, n$ and $i \neq j$; $k, s = 1, 2, \dots, m$ and $k \neq s$. The parameter $\lambda \in (0, 1)$ and $\theta \in (0, 1)$ denote the degree of common ownership in rival firms in the downstream and upstream sectors, respectively. When λ and θ are zero, the downstream and upstream firms independently maximize their own profits, whereas when the parameters approach unity, the firms maximize joint profits.

We consider the following game timing. At stage 1, the final goods producers decide whether to enter the market. At stage 2, the upstream firms determine their outputs like Cournot oligopolists and the input price is determined from the derived demand function for the inputs. At stage 3, given the input price, the downstream firms produce their

in Section 4.2.

outputs like Cournot oligopolists and the profits are realized. We solve the game through backward induction to find the subgame perfect Nash.

We assume that the following condition holds throughout our analysis:

Assumption 1. $F < \frac{(a-c)^2 m^2}{4[1+m+(m-1)\theta]^2}$

which ensures that at least one potential downstream entrant will enter the market.

3.1 Equilibrium analysis

We begin at stage 3, where the downstream firms simultaneously choose their quantities to maximize D_i in (1). The first order condition, i.e., $\frac{\partial D_i}{\partial q_i} = 0$, gives

$$P - w + \frac{\partial P}{\partial q_i} q_i + \lambda \sum_{i \neq j} \frac{\partial P}{\partial q_i} q_j = 0 \quad (3)$$

The term $\frac{\partial P}{\partial q_i}$ in (3) is negative as an increase in q_i reduces the market price, P which in turn reduces the profits of the rival firms. As each downstream firm partly internalizes its rivals' profits, an increase in the degree of common ownership in the downstream market, λ makes downstream firm i less aggressive in its output decision. Therefore, $\lambda \sum_{i \neq j} \frac{\partial P}{\partial q_i} q_j$ captures the *competition softening effect* in the downstream market which results in a higher market price, P and a lower output, q_i compared to a market without common ownership ($\lambda = 0$).

Solving the first order conditions, we obtain the equilibrium output of the i th downstream firm

$$q_i(w) = \frac{a - w}{1 + n + (n - 1)\lambda} \quad (4)$$

where $i = 1, 2, \dots, n$. As $Q = nq_i$ holds for a given input price, it follows that the total input demand, $I(w) = Q(w) = \frac{n(a-w)}{1+n+(n-1)\lambda}$. This scenario resembles a competitive input market. It is intuitive that for a given w , an increase in input price reduces the industry output (Q), leading to an overall decrease in input demand (I). Furthermore, I becomes less elastic as the degree of common ownership in the downstream market (λ) rises.¹⁰ The reasoning is as follows. An increase in w not only reduces the downstream firm i 's profit, but also raises the market price which subsequently increases the profits of its rivals. Since each downstream firm partly internalizes rivals' profits via λ , the shared

¹⁰Check that for a given w , $\frac{\partial^2 Q}{\partial w \partial \lambda} = \frac{n(n-1)}{[1+n+(n-1)\lambda]^2}$.

benefits weaken downstream firm i 's marginal incentive to adjust its output in response to the change in input price. As a result, an increase in λ makes the total input demand less elastic to changes in w . Naturally, for a given input price, θ plays no role in shaping the input demand.

Next, we discuss stage 2 where the equilibrium input price is determined. The total demand for input is $\sum_k I_k = \sum_i q_i$, which gives the derived demand for input as

$$w = a - \left[\frac{1 + n + (n-1)\lambda}{n} \right] \left(I_k + \sum_{k \neq s} I_s \right) \quad (5)$$

where $k, s = 1, 2, \dots, m$ and $k \neq s$. Using (5), each upstream firm maximizes (2) with respect to I_k . The first order condition, i.e., $\frac{\partial U_k}{\partial I_k} = 0$, gives

$$w - c + I_k \frac{\partial w}{\partial I_k} + \theta \sum_{k \neq s} \frac{\partial w}{\partial I_k} I_s = 0. \quad (6)$$

Analogous to the downstream market, the term $\theta \sum_{k \neq s} \frac{\partial w}{\partial I_k} I_s$ in (6) captures the *competition softening effect* in the upstream sector. A rise in upstream firm k 's output, I_k reduces the input price, w (due to a downward sloping derived demand). This reduced w lowers the upstream rivals' profits, a part of which firm k internalizes through θ . This results in a higher input price than would prevail in a market without upstream common ownership ($\theta = 0$).

Solving the first order conditions, gives the equilibrium output of the k th upstream firm,

$$I_k^* = \frac{(a - c)n}{[1 + m + \theta(m - 1)][1 + n + \lambda(n - 1)]} \quad (7)$$

Note that an increase in θ reduces I as a higher degree of upstream ownership restricts individual output (input supply) via the competition softening effect. Similarly, an increase in λ also reduces I as competition softening effect in the downstream market indirectly reduces the derived demand for inputs, thus reducing the supply of inputs.

Substituting (7) into (5), we find the equilibrium input price:

$$w^* = \frac{a(1 - \theta + m\theta) + cm}{1 - \theta + m(1 + \theta)} \quad (8)$$

Lemma 1. *For a given n , the equilibrium input price (w^*) increases in θ , decreases in m and is independent of λ and n .*

An increased degree of upstream common ownership, θ strengthens the competition softening effect as the upstream input supplier internalizes a larger share of the adverse effect its output imposes on its rivals' profits. This leads to an overall decrease in input supply and an increase in the equilibrium input price. In contrast, an increase in m intensifies upstream competition, which boosts aggregate input supply and lowers w^* .

While w^* remains independent of the degree of downstream common ownership, λ and the number of downstream firms, n , both influence the sensitivity of the derived demand for inputs with respect to the changes in input price. This sensitivity is essentially captured by the slope of the derived demand function, $\frac{\partial I}{\partial w}$ as can be seen in (5). An increase in λ , softens downstream competition, causing downstream firms to compete in quantities less aggressively with respect to the changes in input price.¹¹ Therefore, a higher degree of common ownership in the downstream market reduces the elasticity of input demand, since an increase in λ results in a smaller overall change in industry output and input demand. On the other hand, an increase in n intensifies competition in the downstream sector, causing downstream firms to compete more aggressively. This makes the input demand more responsive to the changes in input price.¹²

Therefore, while λ and n do not directly influence the equilibrium input price, they still play a crucial role in determining the quantities of output and input supply in the downstream and upstream markets, respectively.

Next, by incorporating (8) into (4), we find i th downstream firm's equilibrium output

$$q^*(n; \lambda, \theta) = \frac{(a - c)m}{[1 + m + \theta(m - 1)][1 + n + \lambda(n - 1)]} \quad (9)$$

As intuitive, the downstream firm's output increases in m and decreases in n , λ and θ .

The equilibrium net profit of the downstream firm that has entered the market is given by

$$\begin{aligned} \pi^*(n; \lambda, \theta) &= [1 + \lambda(n - 1)] (q^*)^2 - F \\ &= \frac{(a - c)^2 m^2 [1 + \lambda(n - 1)]}{[1 + m + \theta(m - 1)]^2 [1 + n + \lambda(n - 1)]^2} - F \end{aligned} \quad (10)$$

Check that the downstream firm's net profit increases in m and λ but decreases in n and

¹¹See that $\frac{\partial^2 I}{\partial w \partial \lambda} = \frac{n(n-1)}{[1+n+(n-1)\lambda]^2} > 0$.

¹²Note that $\frac{\partial^2 I}{\partial w \partial n} = -\frac{1-\lambda}{[1+n+(n-1)\lambda]^2} > 0$.

θ .

Now, we determine the social welfare. If n firms have entered the downstream market, the social welfare is given by

$$SW^*(n; \lambda, \theta) = \frac{(a - c)^2 mn [2(1 - \theta)(1 + n + \lambda(n - 1)) + m\Psi_1]}{2 [1 + m + \theta(m - 1)]^2 [1 + n + (n - 1)\lambda]^2} - nF \quad (11)$$

where $\Psi_1 = 2 + n + 2\theta(1 + n) + 2(n - 1)(1 + \theta)\lambda$.

Lemma 2. *For a given n , the social welfare decreases in λ and θ , but increases in m and n .*

The social welfare decreases in λ and θ due to the *competition softening effects* in the downstream and upstream markets, respectively. With an increase in λ , the downstream firms reduce their output and internalize a larger share of their rivals' profits. This results in a fall in industry output (Q), consumer surplus and a rise in downstream profits. Similarly, a rise in θ causes the upstream firms to restrict input supply, which raises the equilibrium input price (w^*). This leads to a reduction in total output (Q), consumer surplus and an increase in upstream profits. In both cases, the adverse effect on consumer surplus due to restricted output outweighs any gains in producers' profits. This leads to an overall decrease in social welfare.

And social welfare increases with m and n . Higher m intensifies competition in the upstream market which reduces the equilibrium input price, w^* leading to an increase in downstream profits and consumers surplus. Similarly, a rise in n intensifies competition in the downstream market, which in turn increases the industry output and hence, the social welfare.

Finally, we discuss the entry game (stage 1). The equilibrium number of downstream firms in free entry equilibrium is given by

$$D^*(n; \lambda, \theta) = \hat{D}(n - 1; \lambda, \theta) \quad (12)$$

where $D^*(n; \lambda, \theta) = \pi^*(n; \lambda, \theta) + \lambda(n - 1)\pi^*(n; \lambda, \theta)$ is the value of the downstream firm's objective function when it enters the market and $\hat{D}(n; \lambda, \theta) = n\lambda\pi^*(n; \lambda, \theta)$ represents the value of its objective function when it does not enter the market. Suppose n^* denotes the free entry equilibrium number of downstream firms that have entered the market.

Rearranging (12) we get

$$\pi^*(n^*; \lambda, \theta) - \lambda(n^* - 1) [\pi^*(n^* - 1; \lambda, \theta) - \pi^*(n^*; \lambda, \theta)] - F = 0 \quad (13)$$

Substituting the relevant values for $\pi^*(n^*; \lambda, \theta)$ and $\pi^*(n^* - 1; \lambda, \theta)$, equation (13) above reduces to

$$G^*(n^*; \lambda, \theta) = \frac{(1 - \lambda)m^2(a - c)^2\Psi_2}{[1 + m + \theta(m - 1)]^2 [1 + n + \lambda(n - 1)]^2} - F = 0 \quad (14)$$

$$\text{where } \Psi_2 = \frac{\lambda + \lambda(n^2 - 3)n + n^2 + \lambda^3(n - 2)(n - 1)^2 + \lambda^2[(n - 2)(2n - 1)n + 1]}{[\lambda(n - 2) + n]^2}.$$

As traditional in the literature, we consider the number of firms as a continuous variable.¹³ Also, following the literature, we consider the second-best problem of welfare maximization, i.e., we determine the welfare maximizing number of final goods producers subject to Cournot behavior of the firms. This means that the social planner can control the number of downstream firms entering the market, but cannot control the downstream firms' output behavior.

The social planner chooses n to maximize social welfare in (11). Therefore, the welfare maximizing n is given by¹⁴

$$SW' = \frac{(a - c)^2 m(1 - \lambda) [(1 - \theta)(1 + n + (n - 1)\lambda) + m\Psi_3]}{[1 + m + \theta(m - 1)]^2 [1 + n + \lambda(n - 1)]^2} - F = 0 \quad (15)$$

where $\Psi_3 = 1 + (n + 1)\theta + (n - 1)(1 + \theta)\lambda$.

Clearly, entry is socially excessive (insufficient) if at the free entry equilibrium number of firms (n^*), the marginal social welfare from an additional firm (SW') is negative (positive). In other words, if $SW' - G^*(n^*; \lambda, \theta) < 0$, entry is socially excessive; whereas when $SW' - G^*(n^*; \lambda, \theta) > 0$ entry is socially insufficient.

3.2 Results

To reiterate the respective effects of common ownership in the downstream and upstream markets on entry, we begin with two extreme cases: one in which there is common ownership only in the downstream market and one in which there is common ownership

¹³In Section 4.1, we will, however, discuss the case where the number of firms is treated as a discrete variable.

¹⁴It can be checked that $\frac{\partial^2 SW}{\partial n^2} < 0$.

only in the upstream market. We will later discuss a more generalized case where common ownership co-exists in both the downstream and upstream markets.

Proposition 1. *Assume that there is common ownership only in the downstream market ($\theta = 0$). Entry in the downstream market is always socially excessive.*

Whether entry in the downstream market is socially excessive or insufficient, is primarily driven by two incentives: a private incentive for entry (determined by the free entry equilibrium number of firms) and a social incentive for entry (determined by the welfare maximizing number of firms). When the former exceeds the latter, entry becomes socially excessive and vice versa. The result stated in Proposition 1 hinges upon two effects – a *business stealing effect* and a *competition softening effect* in the downstream market that we will illustrate below.

Considering a one-tier homogeneous goods market, Mankiw and Whinston (1986) argue that entry creates a *business stealing effect* as a new entrant steals business and the associated profits from the incumbents. They show that while a marginal entrant values its own profit increase (via business stealing), it does not account for the adverse effect it inflicts on its rivals, which reduces the social welfare. As the marginal entrant's entry decision is induced solely by the private incentive for entry, more firms enter the market than is socially warranted (socially excessive entry). As we will discuss below, while the presence of downstream common ownership, λ weakens the private incentive for entry to some extent, it still remains dominant leading to a socially excessive entry.

In our model, each marginal downstream entrant partially internalizes the adverse effect it imposes on the incumbent downstream firms via λ . This is reflected in (13) which captures the downstream firm's private incentive for entry. The first term $\pi^*(n^*; \lambda, \theta)$, in (13), accounts for the profit of the entering firm, whereas the second term $\lambda(n^* - 1)[\pi^*(n^* - 1; \lambda, \theta) - \pi^*(n^*; \lambda, \theta)]$, represents the extent to which the downstream entrant internalizes the reduction in the profit of each incumbent, weighted by the degree of downstream common ownership, λ . As each entrant partially internalizes the negative externality it imposes on the incumbent firms, it essentially internalizes the business stealing effect. Therefore, the presence of λ weakens the private incentive for entry compared to the no ownership case ($\lambda = 0$).

Let us now discuss the implications of entry on social welfare. As discussed in Mankiw and Whinston (1986), while each entrant internalizes the business stealing effect, they

do not account for the loss in incumbents' profits which reduces social welfare. Next, recall from Section 3.1 that λ introduces a *competition softening effect* in the downstream market resulting in lower aggregate output and higher market price than would have prevailed in a market without common ownership. This reduces the consumer surplus. Furthermore, as shown in Lemma 1, each new entrant causes a smaller increase in aggregate output compared to a market without common ownership. This further suppresses output expansion, causing the consumer surplus to become significantly smaller. As a result, more downstream firms enter the market than is socially optimal, leading to socially excessive entry.

Proposition 2. *Assume that there is common ownership only in the upstream market ($\lambda = 0$). Entry in the downstream market is socially excessive if $0 < \theta < \frac{mn-n-1}{(m-1)(n+1)}$ and it is socially insufficient if $\frac{mn-n-1}{(m-1)(n+1)} < \theta < 1$.*

The above result follows from two key effects – the traditional *business stealing effect* and an input price effect that stems from the *competition softening effect* in the *upstream market*.

We begin with the downstream firm's private incentive for entry. In the absence of downstream common ownership ($\lambda = 0$), the business stealing effect is more pronounced, which generates a greater private incentive for entry (see Proposition 1). Also, recall that upstream common ownership, θ creates a competition softening effect in the upstream market which results in an increased input price (w) relative to the no ownership case ($\theta = 0$). The increased w reduces downstream profits and dampens their private incentives for entry.

Notably, both the business stealing effect and the input price effect contribute to welfare loss. As noted earlier, while the private incentive for entry is significantly higher due to a strong business stealing effect, the downstream firms do not account for the negative impact it imposes on the incumbents, which reduces social welfare. Similarly, higher input prices, although increase upstream profits, make output expansion more costly, thereby reducing consumer surplus.

Therefore, whether too many or too few firms enter the market largely depends on whether the business stealing effect or the input price effect has a greater influence on the private incentives for entry. When the upstream ownership effect is reasonably small, i.e., $0 < \theta < \frac{mn-n-1}{(m-1)(n+1)}$ the associated increase in input price is not significant. As a

result, the downstream profit remains largely unaffected, allowing the business stealing effect to dominate, which drives more firms to enter the market than what is socially optimal. Naturally, entry becomes socially insufficient when the upstream ownership effect is relatively large, i.e., $\frac{mn-n-1}{(m-1)(n+1)} < \theta < 1$. In this case, the input price increases significantly, downstream profits and private incentives for entry decline sharply leading to socially insufficient entry.

Now, we return to a more general case where common ownership exists in both the upstream and downstream markets.

Proposition 3. *Assume that both the upstream and downstream markets operate under common ownership. Entry in the downstream market is always socially excessive if $\lambda > \theta$. In all other cases, entry is socially insufficient.*

Proposition 3 suggests that if the degree of common ownership in the downstream market is higher than the degree of common ownership in the upstream market, entry is socially excessive. Otherwise, entry is socially insufficient.

It is evident from Propositions 1-2 that, while a downstream entrant partly internalizes the negative impact it leaves on the incumbents via λ , thereby reducing the private entry incentives to some extent; the presence of upstream ownership, θ always reduces the private incentives for entry by increasing the input price. From a welfare point of view, both λ and θ reduce consumer surplus through either a reduction in output or an increase in input price.

Therefore, the overall entry distortion depends on whether private or social incentives for entry dominate. When the magnitude of ownership in the downstream market is significantly higher than that in the upstream market, i.e., $\lambda > \theta$, the internalization of rivals' profits reduces entry incentives, but not enough to counteract the welfare loss from higher prices and reduced output due to softened upstream competition. As the rise in input costs is modest (lower θ), downstream profits remain relatively high, and the business stealing effect remains dominant. As a result, entry exceeds the social optimum. As is intuitive, entry is socially insufficient in all other cases.

4 Extensions

4.1 An integer case

Following the literature, so far we treated the number of downstream entrants as a continuous variable. We now turn our discussion to the case where the number of firms is treated as integers (discrete variable), $n \in \{2, 3, 4, \dots\}$. Each downstream entrant must satisfy the following conditions: (i) when n downstream firms enter the market, each firm earns non-negative profit, and (ii) when $(n + 1)$ firms enter the market, each earns strictly negative profit. In other words, the free entry equilibrium number of firms, n^* must satisfy $\pi^*(n^* - 1; \lambda, \theta) - \lambda(n^* - 2) [\pi^*(n^* - 2; \lambda, \theta) - \pi^*(n^* - 1; \lambda, \theta)] < F \leq \pi^*(n^*; \lambda, \theta) - \lambda(n^* - 1) [\pi^*(n^* - 1; \lambda, \theta) - \pi^*(n^*; \lambda, \theta)]$. To streamline the analysis, we normalize $F = f^2(a - c)^2$ without any loss of generality.

Given the above, free entry equilibrium number of firms (n^*) will enter the market if and only if $f \in \left(\frac{m\sqrt{1-\lambda}\sqrt{1-\lambda+n(1+\lambda)(1+(n-1)\lambda)(2+n\lambda)}}{\Psi_4(1+n+(n-1)\lambda)(2+n\lambda)}, \frac{m\sqrt{1-\lambda}\sqrt{\Psi_5}}{\Psi_4(n+(n-2)\lambda)(1+n+(n-1)\lambda)} \right]$ where $\Psi_4 = 1 + m + (m-1)\theta$ and $\Psi_5 = n^2 + \lambda + n(n^2 - 3)\lambda + [1 + (n-2)n(2n-1)]\lambda^2 + (n-2)(n-1)^2\lambda^3$. Similarly, using (11) we find the lower bound and upper bound of f for which the socially optimal number of firms, n^s will enter the market.¹⁵

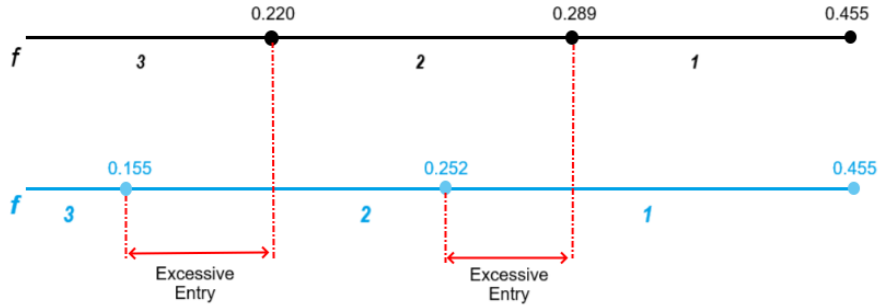


Figure 1: Entry distortions for $m = 10$, $\theta = 0$ and $\lambda = 0.1$

Example 1 ($\theta = 0$): Assuming $m = 10$ and $\lambda = 0.1$ we plot the free entry and socially optimal number of firms in Figure 1 for various values of normalized entry cost, f . We find that entry is socially excessive for $0.252 < f \leq 0.289$ and $0.155 < f \leq 0.220$. It can be easily checked that a similar pattern arises for $\lambda = 0.4$ and $\lambda = 0.9$, respectively. This finding supports Proposition 1 which shows that in the absence of upstream common

¹⁵The interval of f for which n^s number of firms will enter the market is too large to be reported here. They can be obtained from the author upon request.

ownership ($\theta = 0$), an excessive number of firms enter the market than is socially optimal.

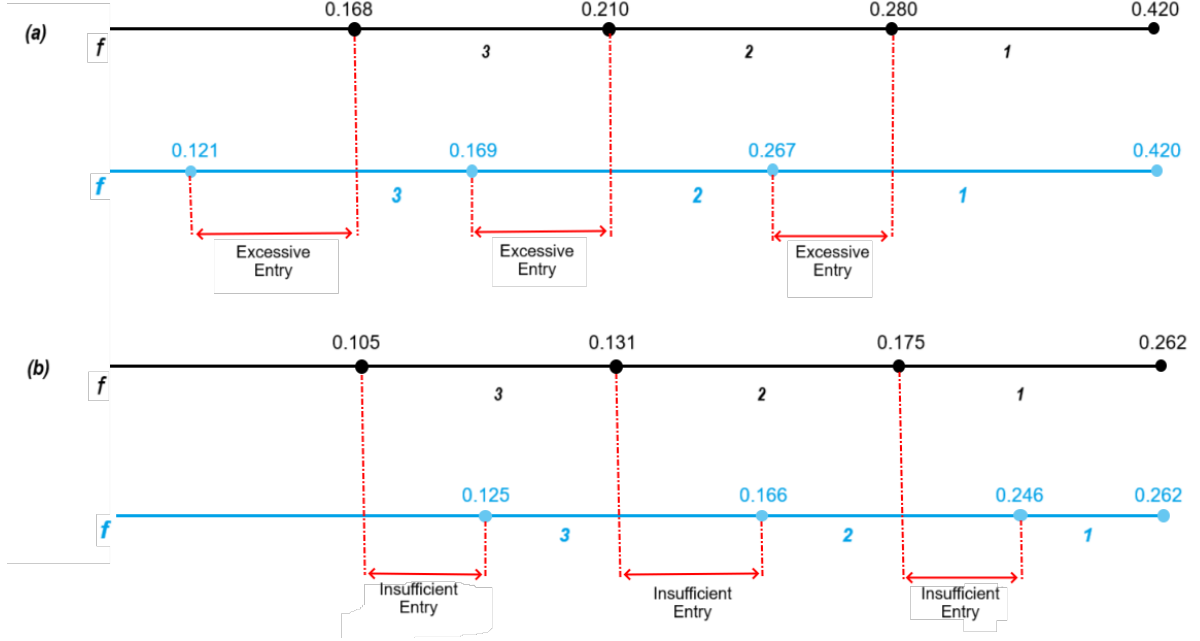


Figure 2: Entry distortions for (a) $m = 10$, $\lambda = 0$, $\theta = 0.1$ and (b) $m = 10$, $\lambda = 0$, $\theta = 0.9$

Example 2 ($\lambda = 0$): Assume again $m = 10$. Absent downstream ownership, here we plot different entry outcomes for various values of normalized entry cost (f) under two distinct scenarios when $\theta = 0.1$ (low θ) and $\theta = 0.9$ (high θ). Analogous to Proposition 2, Figure 2a reveals that when θ is reasonably low, such as $\theta = 0.1$, entry is socially excessive for $0.267 < f \leq 0.280$, $0.169 < f \leq 0.210$ and $0.121 < f \leq 0.168$; whereas when θ is significantly large, such as $\theta = 0.9$, Figure 2b depicts that entry is socially insufficient for $0.175 < f \leq 0.246$, $0.131 < f \leq 0.166$ and $0.105 < f \leq 0.125$.

Therefore, the above two numerical illustrations suggest that sector-specific common ownerships (λ and θ) play a significant role in firms' entry decisions and further support our main findings presented in Section 3.2 that are more general in nature.

4.2 Differentiated goods

In this section, we extend our analysis to a differentiated goods market. As consumers value variety, differentiated goods introduce a '*love for variety*' effect (Spence, 1976; Dixit and Stiglitz, 1977) which affects both the private and social incentives for entry. Mankiw and Whinston (1986) argue that in the presence of product variety (differentiated

goods), a marginal entrant increases social welfare, but they do not fully capture this additional surplus as their own profit. As each entrant bases their entry decision on private incentive alone, too few firms enter the market than is socially desired, resulting in *socially insufficient entry*. Based on this argument, we anticipate that the presence of product variety in our model will weaken the business stealing effect thereby reducing the downstream firm's private incentive for entry. Therefore, our findings in Section 3.2 which show that entry is always socially excessive or can be excessive or insufficient under different parameterizations, will move more towards insufficient entry.

To show our point clearly, we consider an inverse demand function that takes the form $P_i = a - q_i - \gamma \sum_{i \neq j} q_j$ where $i, j = 1, 2, \dots, n$ and $i \neq j$. The parameter $\gamma \in (0, 1)$ denotes the degree of product differentiation. When $\gamma = 0$ the goods are isolated and when $\gamma = 1$, the goods are perfect substitutes. Suppose \hat{n} denotes the free entry equilibrium number of firms that have entered the downstream market that produces differentiated products. Now, by repeating the exercise as in Section 3.1, we obtain the condition that satisfies the free entry equilibrium number of firms¹⁶

$$\hat{G}(\hat{n}; \gamma, \lambda, \theta) = \frac{(a - c)^2 m^2 [(\gamma \lambda (n - 1) + 1)(\gamma (\lambda + 1)(n - 2) + 2)^2 + \Psi_6]}{[1 + m + \theta(m - 1)]^2 [2 + \gamma(\lambda + 1)(n - 2)]^2 [2 + \gamma(\lambda + 1)(n - 1)]^2} - F = 0. \quad (16)$$

Similarly, we derive the condition for socially optimal number of firms

$$S\hat{W}' = \frac{(a - c)^2 m [2(1 - \theta)(2 - \gamma - \gamma \lambda)(2 + (n - 1)(1 + \lambda)\gamma) + \Psi_7]}{2 [1 + m + \theta(m - 1)]^2 [2 + \gamma(\lambda + 1)(n - 1)]^3} - F = 0 \quad (17)$$

where $\Psi_6 = \gamma \lambda (n - 1) [-\gamma(\lambda + 1)^2 (\gamma \lambda (n - 2)(n - 1) + 2n - 3) - 4]$ and $\Psi_7 = m [6 + 8\theta - (n - 1)\gamma^2(1 + \lambda)(1 + 2\lambda + 2\theta(1 + \lambda)) + \gamma(n - 5 - 8\theta + 4n\theta - 7\lambda + 5n\lambda - 8\theta\lambda + 4n\theta\lambda)]$.

Analogous to Section 3.2, entry is socially excessive when $S\hat{W}' - \hat{G}(\hat{n}; \gamma, \lambda, \theta) < 0$, and it is socially insufficient when $S\hat{W}' - \hat{G}(\hat{n}; \gamma, \lambda, \theta) > 0$. Given the complexity of the expressions (16) and (17) above, it was not possible to analytically derive the conditions under which entry is socially excessive or insufficient. Therefore, to understand how entry distortions vary with the degree of product differentiation (γ), we offer a few numerical and graphical illustrations. To broaden our understanding, we proceed with the generalized case where common ownership prevails in both the upstream and downstream sectors.

¹⁶To avoid analytical repetition, we relegate full derivations to Appendix A.2.

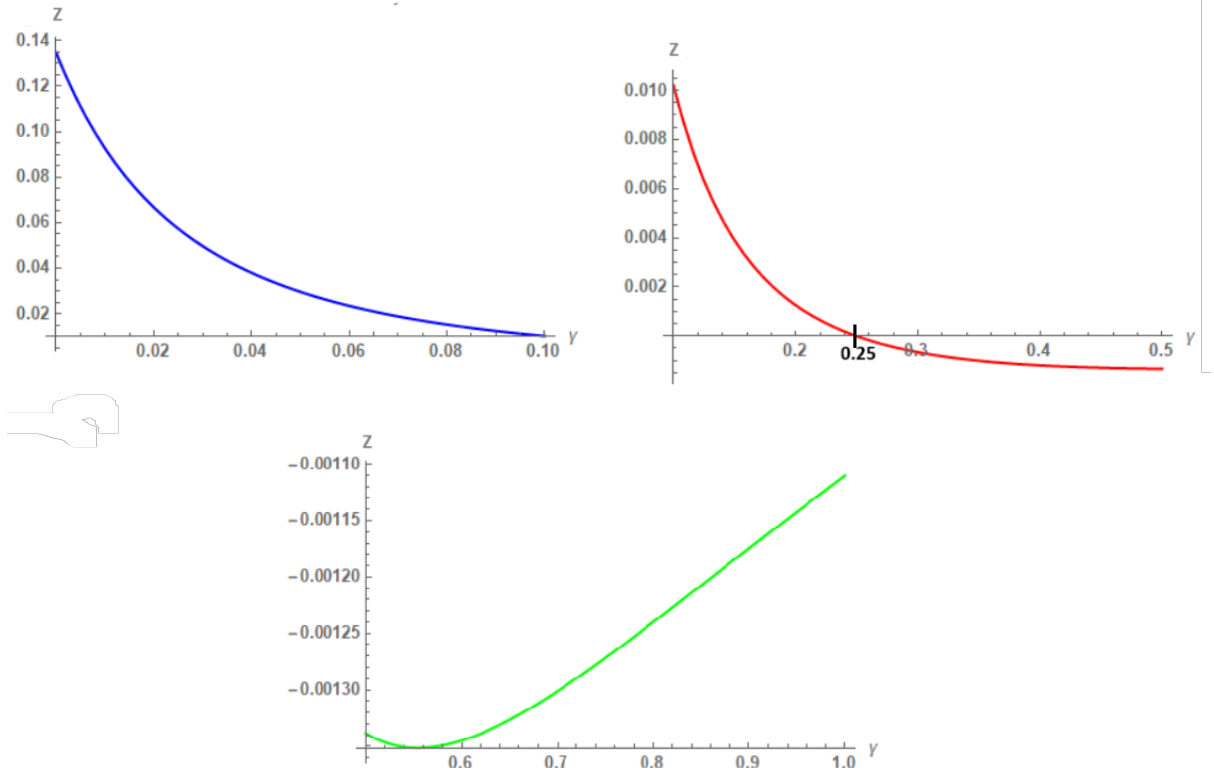


Figure 3: Entry distortions under $m = 30$, $n = 20$, $\lambda = 0.9$, $\theta = 0.01$ shown for $\gamma \in (0, 0.1)$, $\gamma \in (0.1, 0.5)$ and $\gamma \in (0.5, 1)$

Assuming $m = 30$ and $n = 20$, $\lambda = 0.9$, $\theta = 0.01$, we plot $Z \equiv S\hat{W}' - \hat{G}(\hat{n}; \gamma, \lambda, \theta)$ for $\gamma \in (0, 0.1)$, $\gamma \in (0.1, 0.5)$ and $\gamma \in (0.5, 1)$ in Figure 3. We begin with the top left diagram in Figure 3 where Z is strictly positive, indicating that entry is always socially insufficient even when the degree of common ownership in the downstream market strictly exceeds that in the upstream market ($\lambda > \theta$). This is in stark contrast to the result derived in a homogeneous goods market (see Proposition 3). When $\gamma \in (0, 0.1)$, the products are almost isolated and the love for variety effect is considerably strong. As a result, each marginal downstream entrant generates a substantial surplus from the welfare perspective that far exceeds its own profit. This drives down the entrant's private entry incentive quite significantly. As a consequence, equilibrium entry falls short of the social optimum. The top right diagram in Figure 3 shows that Z is positive, i.e., entry is socially insufficient for $\gamma \in (0.1, 0.25)$ whereas Z is negative, i.e., entry is socially excessive for $\gamma \in [0.25, 0.5)$. When $\gamma \in (0.1, 0.25)$, the love for variety effect remains strong such that the social contribution of each downstream firm still exceeds its private return. Therefore, entry is still socially insufficient. However, when the products become more substitutable in

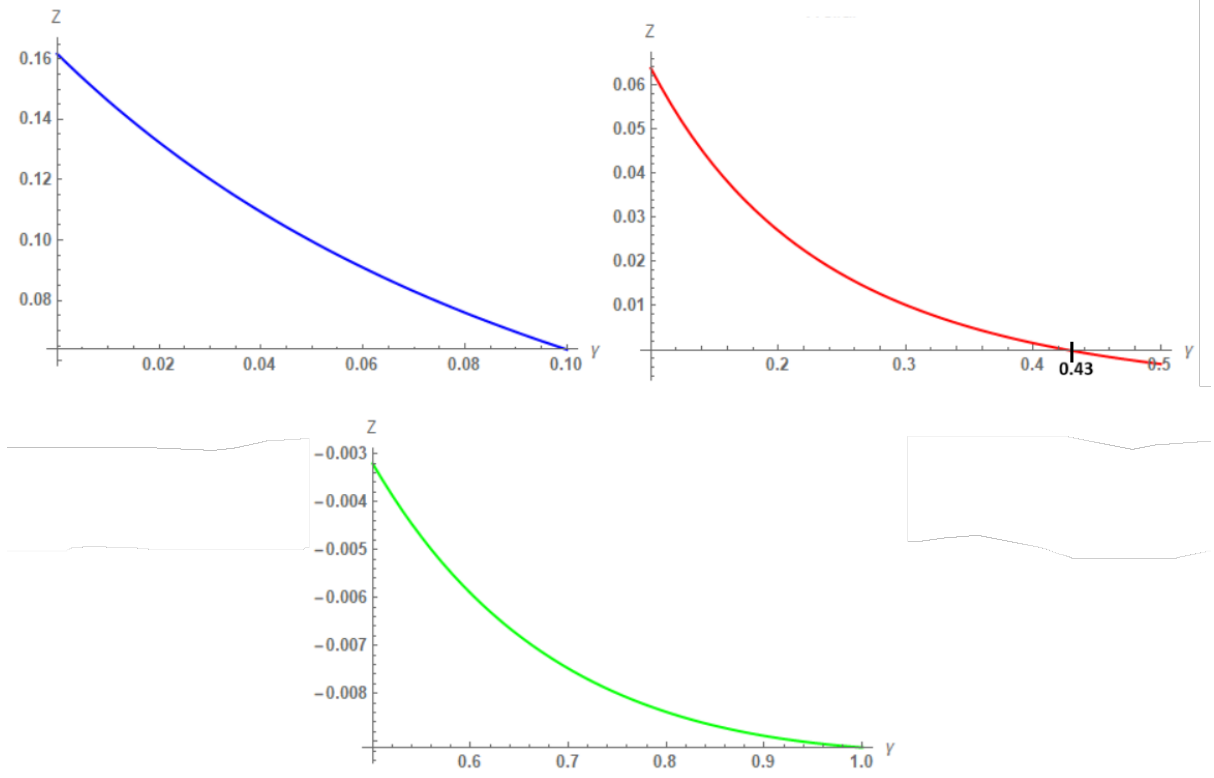


Figure 4: Entry distortions under $m = 30$, $n = 20$, $\lambda = 0.5$, $\theta = 0.2$ shown for $\gamma \in (0, 0.1)$, $\gamma \in (0.1, 0.5)$ and $\gamma \in (0.5, 1)$

the range $\gamma \in [0.25, 0.5)$, the love for variety effect starts to weaken to the extent that the marginal entrant's contribution to the welfare declines eventually falling below the entrant's private incentive for entry. This results in an excessive number of firms entering the market compared to the socially optimal level.

Finally, the bottom diagram in Figure 3 shows that Z is negative for $\gamma \in (0.5, 1)$ meaning that entry is always socially excessive. This outcome resembles our finding in Proposition 3. As product substitutability increases even further, the private incentive to enter the market always dominates, resulting in socially excessive entry.

Assuming again $m = 30$ and $n = 20$, we obtain qualitatively similar results for $\lambda = 0.5$ and $\theta = 0.2$. These scenarios are presented in Figure 4 where the switchover from insufficient entry to excess entry occurs at $\gamma = 0.43$. Therefore, the above discussion summarizes that differentiated products increase the likelihood of socially insufficient entry.

5 Conclusion

Common wisdom suggests that common ownership discourages entry as the entering firms internalize a part of the negative externality they inflict upon the incumbents. The literature on the social efficiency of entry, on the other hand, suggests that entry in a vertically related market (without common ownership) often makes entry socially insufficient. Considering a successive oligopoly model with common ownership at different tiers of production, we challenge these two well-known views and show that common ownership does not always deter entry, nor the vertically related markets inherently result in insufficient entry outcomes.

Interestingly, our findings show that entry is always socially excessive if common ownership prevails only in the downstream sector. When the upstream sector alone is characterized by common ownership, entry is socially excessive (insufficient) when the degree of upstream ownership is reasonably small (large). Furthermore, when both sectors operate under common ownership, entry can still be socially excessive if the degree of common ownership in the downstream market is larger than that in the upstream market.

Given the growing popularity of common ownership and related concerns about its competitive implications on entry and the economy overall, our findings offer important policy implications. Our analysis suggests that whether entry is more (or less) desirable from the standpoint of social welfare depends largely on sector-specific ownership structures. Therefore, there is a need for regulatory authorities to deviate from a uniform anti-competitive policy approach. In particular, our results imply that anti-competitive policy regulation may be a more viable policy choice than previously thought. However, this view changes quite drastically when the goods are differentiated that increases the likelihood of insufficient entry.

A Appendix

A.1 Homogeneous goods market

Proof of Lemma 1: Given (8), it can be checked that $\frac{\partial w^*}{\partial \theta} = \frac{(m-1)m(a-c)}{[\theta(m-1)+m+1]^2} > 0$ and $\frac{\partial w^*}{\partial m} = -\frac{(1-\theta)(a-c)}{[\theta(m-1)+m+1]^2} < 0$. ■

Proof of Lemma 2: Given (11), it can be verified that $\frac{\partial SW^*}{\partial \lambda} = -\frac{m(a-c)^2\Phi_1}{[\theta(m-1)+m+1]^2[\lambda(n-1)+n+1]^3}$

< 0 where $\Phi_1 = \lambda n(n-1)^2 [\theta(m-1) + m + 1] + n(n-1) [\theta(m-1)(n+1) + m + n + 1] > 0$; $\frac{\partial SW^*}{\partial \theta} = -\frac{m(m-1)n(a-c)^2\Phi_2}{[\theta(m-1)+m+1]^3[\lambda(n-1)+n+1]^2} < 0$ where $\Phi_2 = m[\theta + (\theta+1)\lambda(n-1) + \theta n + 1] + (1-\theta)[\lambda(n-1) + n + 1] > 0$; $\frac{\partial SW^*}{\partial m} = -\frac{n(a-c)^2(1-\theta)\Phi_3}{[\theta(m-1)+m+1]^3[\lambda(n-1)+n+1]^2} < 0$ where $\Phi_3 = (\theta+1)\lambda m(n-1) + m(\theta + \theta n + 1) + (1-\theta)[\lambda(n-1) + n + 1] > 0$; and $\frac{\partial SW^*}{\partial n} = \frac{m(a-c)^2(1-\lambda)\Phi_4}{[\theta(m-1)+m+1]^2[\lambda(n-1)+n+1]^3} > 0$ where $\Phi_4 = m[\theta + (\theta+1)\lambda(n-1) + \theta n + 1] + (1-\theta)[\lambda(n-1) + n + 1] > 0$. ■

Proof of Proposition 1: Setting $\theta = 0$, we get, $SW' - G^*(n^*; \lambda) \equiv -\frac{(a-c)^2 m(1-\lambda)\Phi_5}{(1+m)^2[1+n+(n-1)\lambda]^3}$. It can be checked that $\Phi_5 = \left[\frac{m(1+n+(n-1)\lambda)(n^2 + \lambda + n(n^2 - 3)\lambda + (1+(n-2)n(2n-1))\lambda^2 + (n-2)(n-1)^2\lambda^3)}{(n+(n-2)\lambda)^2} - (1+m)(1+(n-1)\lambda) - n \right] > 0$ which implies $SW' - G^*(n^*; \lambda) < 0$. Hence, entry is always socially excessive. ■

Proof of Proposition 2: Setting $\lambda = 0$, we find, $SW' - G^*(n^*; \theta) \equiv -[(mn - n - 1) - \theta(m-1)(n+1)] \left[\frac{(a-c)^2 m}{(1+n)^3(1+m+(m-1)\theta)^2} \right]$. Check that $SW' - G^*(n^*; \theta) < 0$, i.e., entry is socially excessive if $0 < \theta < \frac{mn-n-1}{(m-1)(n+1)}$. And, $SW' - G^*(n^*; \theta) > 0$, i.e., entry is socially insufficient if $\theta < \frac{mn-n-1}{(m-1)(n+1)} < 1$. ■

Proof of Proposition 3: Recall that (14) and (15) represent conditions that satisfy the free entry and welfare maximizing number of downstream firms. We have, $SW' - G^*(n^*; \lambda, \theta) = \frac{(1-\lambda)m(a-c)^2\Phi_6}{[\theta(m-1)+m+1]^2[\lambda(n-1)+n+1]^3} - \frac{(1-\lambda)m^2(a-c)^2\psi_7}{[\theta(m-1)+m+1]^2[\lambda(n-2)+n]^2[\lambda(n-1)+n+1]^2}$ where $\Phi_6 = m[(\theta+1)\lambda(n-1) + \theta(n+1) + 1] + (1-\theta)[\lambda(n-1) + n + 1]$ and, $\psi_7 = \lambda + \lambda(n^2 - 3)n + n^2 + \lambda^3(n-2)(n-1)^2 + \lambda^2[(n-2)(2n-1)n + 1]$. It can be checked that $SW' - G^*(n^*; \lambda, \theta) < 0$ only if $\lambda > \theta$. ■

A.2 Differentiated goods market

Assume that the inverse demand function is $P_i = a - q_i - \gamma \sum_{i \neq j} q_j$ where $\gamma \in (0, 1)$. We proceed with the game timing described in Section 3. Assumption 1 outlined in the main text still applies here, ensuring that at least one downstream firm will enter the differentiated goods market.

We begin at stage 3, where the downstream firms simultaneously choose their quantities to maximize (1). Solving the first order conditions, yield the equilibrium output of the i th downstream firm, $q_i = \frac{a-w}{2+(n-1)\gamma(1+\lambda)}$.

Next, we move to stage 2, where the upstream firm maximizes the following to determine the equilibrium input price

$$\Omega_k = \left[a - c - \left(\frac{2 + (n-1)\gamma(1+\lambda)}{n} \right) \left(I_k + \sum_{k \neq s} I_s \right) \right] I_k \quad (\text{A.1})$$

where $k, s = 1, 2, \dots, m$ and $k \neq s$. Substituting (A.1) in (2) and maximizing (2) with respect to I_k , we obtain the equilibrium output of the k th upstream firm $\hat{I}_k = \frac{(a-c)n}{[1+m+(m-1)\theta][2+(n-1)\gamma(1+\lambda)]}$, using which we find the equilibrium input price $\hat{w} = \frac{a(1-\theta+m\theta)+cm}{1-\theta+m(1+\theta)}$. Notably, the equilibrium input price is independent of γ but the total input supply $I = \sum_k I_k$ increases as the products become more differentiated. Note that when the products are highly differentiated (low γ), the downstream firms face a more inelastic demand for final goods which induces them to produce more. This in turn increases the aggregate input supply.

The equilibrium profit of the i th downstream firm gives

$$\hat{\pi}(n; \gamma, \lambda, \theta) = \frac{(a-c)^2[1+(n-1)\gamma\lambda]m^2}{[1+m+(m-1)\theta]^2[2+(n-1)\gamma(1+\lambda)]^2} - F \quad (\text{A.2})$$

And, the social welfare is

$$S\hat{W} = \frac{mn(a-c)^2[2(1-\theta)(2+(n-1)\gamma(1+\lambda)) + \Psi_0]}{2[1+m+(m-1)\theta]^2[2+(n-1)\gamma(1+\lambda)]^2} \quad (\text{A.3})$$

where $\Psi_0 = m[3 + 4\theta + (n-1)\gamma(1+2\lambda + (1+\lambda)2\theta)]$.

Next, we discuss the entry game (stage 1). The equilibrium number of downstream firms in free entry equilibrium is given by $\hat{\pi}(\hat{n}; \gamma, \lambda, \theta) - \lambda(\hat{n}-1)[\hat{\pi}(\hat{n}-1; \gamma, \lambda, \theta) - \hat{\pi}(\hat{n}; \gamma, \lambda, \theta)] - F = 0$, where \hat{n} denotes the free entry equilibrium number of downstream firms that have entered the differentiated goods market. Substituting the values for $\hat{\pi}(\hat{n}; \gamma, \lambda, \theta)$ and $\hat{\pi}(\hat{n}-1; \gamma, \lambda, \theta)$, we obtain the condition that satisfies the free entry equilibrium number of firms

$$\hat{G}(\hat{n}; \gamma, \lambda, \theta) = \frac{(a-c)^2m^2[(\gamma\lambda(n-1)+1)(\gamma(\lambda+1)(n-2)+2)^2 + \Psi_6]}{[1+m+\theta(m-1)]^2[2+\gamma(\lambda+1)(n-2)]^2[2+\gamma(\lambda+1)(n-1)]^2} - F = 0. \quad (\text{A.4})$$

Similarly, we derive the condition for socially optimal number of firms

$$S\hat{W}' = \frac{(a-c)^2m[2(1-\theta)(2-\gamma-\gamma\lambda)(2+(n-1)(1+\lambda)\gamma) + \Psi_7]}{2[1+m+\theta(m-1)]^2[2+\gamma(\lambda+1)(n-1)]^3} - F = 0 \quad (\text{A.5})$$

where $\Psi_6 = \gamma\lambda(n-1)[- \gamma(\lambda+1)^2(\gamma\lambda(n-2)(n-1) + 2n-3) - 4]$ and $\Psi_7 = m[6+8\theta -$

$$(n-1)\gamma^2(1+\lambda)(1+2\lambda+2\theta(1+\lambda)) + \gamma(n-5-8\theta+4n\theta-7\lambda+5n\lambda-8\theta\lambda+4n\theta\lambda].$$

Entry is socially excessive when $S\hat{W}' - \hat{G}(\hat{n}; \gamma, \lambda, \theta) < 0$, and it is socially insufficient when $S\hat{W}' - \hat{G}(\hat{n}; \gamma, \lambda, \theta) > 0$. We discuss these outcomes in Section 4.2.

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