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Efficient regulated entry in competitive markets with demand uncertainty

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Abstract

It is well-known that, in a competitive market, the number of firms in a free-entry equilibrium is the efficient one. This paper shows that this textbook result breaks down if firms face demand uncertainty. In this case, entry is excessive relative to the optimum and, therefore, regulation improves market efficiency. This occurs because, in the absence of regulation, entry is motivated by the profits that firms expect to receive if market demand turns out to be high. However, when choosing the optimal regulated entry, the planner also considers that some surplus is lost if demand turns out to be low.

KEYWORDS

competitive market, demand uncertainty, entry regulation, free-entry

JEL CLASSIFICATION

D41, D60, D80, L10, L51

1 | INTRODUCTION

In economic theory it is well known that, under perfect competition, free entry into markets is desirable, as it leads to an efficient outcome—see, for instance, Chapter 10.F in Mas-Colell et al. (1995) and Chapter 14.3 in Cabral (2017).[1] In particular, in a renowned, seminal paper, Mankiw and Whinston (1986) [*RAND Journal of Economics, 17*(1), pp. 48–58] (MW1986

[1]In fact, free entry is one of the conditions underlying the First Welfare Theorem—Cabral (2004).

hereafter) set up a general theoretical framework to study firms' entry in a homogeneous product market. They compare the number of firms that enter the market when there is free entry with the optimal number of firms that a welfare-maximizing planner would choose, assuming that entrants incur a positive and fixed entry cost. Under the usual assumptions of perfect competition,[2] they show that the free-entry equilibrium number of firms exactly equals the efficient number of firms (see MW1986, p. 52).

MW1986 (and the aforementioned authors) assume an environment of certainty, in which firms know everything about the future and behave optimally. However, this is not usually the case, as entering a new market typically entails some risks—Creane (2007) and Szczutkowski (2010). One natural deviation from this perfect-information world that has been surprisingly overlooked by previous authors[3] is the assumption that, when deciding whether to enter a market, firms are uncertain about the realization of the demand. In reality, whenever a firm decides to enter a market, it encounters the problem of accurately estimating future demand—especially if, after entry, production decisions and sales are lagged. Therefore, a natural question is whether the well-established "optimal entry" result would hold in this seemingly plausible alternative scenario.

Acknowledging this gap in the literature, in this paper we borrow the simple, yet general formulation by MW1986 to study whether a perfectly competitive market leads to the optimal level of entry in the presence of demand uncertainty. To keep the analysis simple, we assume that market demand can be of two types, namely, either low or high (with certain probabilities).[4] Firms are uncertain about the level of demand at the time when they decide whether to enter the market, and they observe the realization of this demand only after having entered the market—Perrakis and Warskett (1983) and Maskin (1999). In this alternative scenario, as MW1986 do, we compare the number of firms that enter a market when there is free entry with the regulated number of entrants that would be desired by a planner, taking the firms' competitive behavior after entry as given.

Contrary to the results in MW1986, we find that in a perfectly competitive market in which firms face demand uncertainty, the level of entry is excessive relative to the optimum. To reach this conclusion, we proceed as follows. First, we show that the free-entry equilibrium number of firms under uncertainty is strictly greater than the free-entry equilibrium number of firms if the low-demand state occurs with certainty. Therefore, if the low-demand state is (ex-post) realized, there are *too many* firms in the market (relative to the low-demand, perfect-information case). Thus, firms find it optimal to reduce production, leaving some consumers unserved (i.e., some surplus is lost). Since firms anticipate zero profits if the low-demand state occurs, entry is exclusively driven by the expected (positive) profits generated if the high-demand state is (ex-post) realized. As a result, the number of entrants exactly equals the level of entry if the high-demand state occurs with certainty.

[2]Although they primarily focus on the case in which firms do not act as price-takers after entry (imperfect competition), they extend the analysis to the perfectly competitive market case.

[3]We acknowledge the existence of a large body of research on capacity investment followed by capacity-constrained competition in the presence of demand uncertainty—inaugurated by Brown and Johnson (1969). However, in the same fashion as in the classic paper by MW1986, we focus on the level of entry (of capacity unconstrained firms) in the presence of demand uncertainty.

[4]With additional algebra, the analysis can be easily extended to the case in which there are more than two types of demand.

We show, however, that the planner finds it optimal to regulate entry by reducing the number of firms relative to the free-entry equilibrium case. By doing so, she reduces the loss of social surplus if the low-demand state is (ex-post) realized, while leaving strictly positive profits for firms if the high-demand state is (ex-post) realized. That is, choosing the optimal level of regulated entry involves balancing the trade-off between the expected gains of (strictly) positive profits—which induces additional entry in a free-entry equilibrium—and the expected reduction in the loss of social surplus—which entrants ignore in a free-entry equilibrium, leading thus to the "entry bias" result.

As mentioned above, some previous authors have already studied free entry under uncertainty, with a particular focus on imperfectly competitive markets. However, most of these papers introduce uncertainty ad hoc to study entry in specific cases, such as in the presence of R&D investment—Quirmbach (1993) and Erkal and Piccinin (2010)—, divisionalization—Ziss (1999)—, or adverse selection—Creane and Jeitschko (2016). Likewise, some other papers have explored optimal regulated entry with a focus on imperfectly competitive markets—Crew and Kleindorfer (1998), Lee (1999), and Lee and Cheong (2005). However, the effect of demand uncertainty on endogenous entry and the characterization of the optimal regulated entry in competitive markets has remained as an unexplored topic in the field.

The rest of the paper proceeds as follows. Section 2 presents the theoretical environment. In Section 3 we provide the free-entry equilibrium solution. Section 4 characterizes optimal regulated entry and elucidates the intuitive forces that lie behind the "entry bias" result. Finally, Section 5 concludes. All proofs are in Supporting Information: Appendix A.

2 | THE THEORETICAL MODEL

We consider a two-period model in the same spirit as in MW1986. In the first stage, a large (infinite) number of identical potential entrants decide whether to enter an industry. Upon entry, firms incur a fixed set-up cost of K. In the second stage, firms that have entered the market make production decisions and serve consumers. Each entrant can produce a simple homogeneous good using its own technology, which is given by the (continuous) cost function $c(q)$, where $c'(\cdot) > 0$, and $c''(\cdot) \geq 0$.

In line with the long-standing literature on market entry under uncertainty—see, for instance, Perrakis and Warskett (1983), Maskin (1999), and Goyal and Netessine (2007)—we assume that the (inverse) market demand for the homogeneous good is uncertain in the first stage, and is realized at the beginning of the second stage. For the sake of simplicity, we assume that demand can be either low (L) or high (H) with probability $\theta^i \in (0, 1)$, where $i \in \{L, H\}$ and $\theta^H + \theta^L = 1$. Thus, market demand is given by $p^i(Q)$, where Q is aggregate market production, $\frac{\partial p^i}{\partial Q} < 0$ for all Q, and $p^H(Q) > p^L(Q)$ for all Q.

As MW1986 do, we assume that the equilibrium in this stage is symmetric. Let us define q_N^i as the equilibrium output per firm—provided that N firms have entered the market and that state i was realized—and let π_N^i denote the (*ex-post*) profit for a representative firm, which is given by $\pi_N^i \equiv p^i(Nq_N^i)q_N^i - c(q_N^i) - K$. Moreover, as they do, we assume that firms' costs are not *too high* relative to the (potential) revenue that they could obtain by producing and selling in the market.

Given this environment, and following MW1986, we define the free-entry equilibrium number of firms as the number of firms for which firms expect zero profits. Thus, following

Asplund (2002) and Azevedo and Gottlieb (2012), let us define $E\Pi_N$ as the ("von Neumann-Morgenstern") expected profit given that N firms have entered the market; that is, $E\Pi_N \equiv \theta^H \pi_N^H + \theta^L \pi_N^L$.[5] Thus, the free-entry equilibrium number of firms, denoted N^*, is such that *(i)* $E\Pi_{N^*} \geq 0$ and *(ii)* $E\Pi_{N^*+1} < 0$. As discussed by MW1986, ignoring the integer constraint on the number of firms implies that condition *(i)* in a free-entry equilibrium holds with equality.

Definition 1. A free-entry equilibrium (ignoring the integer constraint on the number of firms) is given by any number of firms, N^*, such that $E\Pi_{N^*} = 0$.

Given this definition, our goal is to compare the number of firms that enter in a free-entry equilibrium with the efficient regulated level of entry assuming that firms act as perfect competitors. The perfectly-competitive market environment is captured in the following assumption.

Assumption 1. Given N, q_N^i is such that $p^i(Nq_N^i) - c'(q_N^i) = 0$ if $\pi_N^i \geq 0$. Otherwise, q_N^i is such that $\pi_N^i = 0$ and $p^i(Nq_N^i) - c'(q_N^i) > 0$.

Assumption 1—which is consistent with Assumption 3 in MW1986—says that, for any number of entrants, the resulting equilibrium price equals marginal cost (as required in competitive markets; see MW1986, p. 52, line 17). This condition holds as long as (*ex-post*) profits are nonnegative. Otherwise, as explained by Baron (1970), Sandmo (1971), and Duncan (1990) among many others, each firm will unilaterally deviate by reducing production until profits are exactly equal to zero.[6] It follows that, in this case, the price will exceed the firms' marginal costs—which is a direct consequence of the fact that $\frac{\partial p^i}{\partial Q} < 0$ and $c'(\cdot) > 0$.[7] This consequence has been acknowledged by some other previous authors dealing with competitive firms' optimal production when facing uncertainty—see, for instance, Holthausen (1976), De Vany and Saving (1983), and Emons (1988).

3 | FREE-ENTRY EQUILIBRIUM

3.1 | Perfect information

Suppose first that there is no demand uncertainty and, therefore, firms know with certainty that state i occurs in the second stage. Ignoring the integer constraint on the number of firms

[5]As Azevedo and Gottlieb (2012) did—but contrary to Asplund (2002)—we assume that firms are risk-neutral. However, our model can be easily adjusted to accommodate other types of attitudes toward risk. In Section 5 we briefly discuss how our results would differ if we consider alternative attitudes toward risk/ambiguity.

[6]Baron (1970) states that if a (perfectly competitive) firm anticipates negative profit, then it finds it optimal to reduce output. In a similar vein, Sandmo (1971) explains that in perfect competition under uncertainty, output turns out to be smaller than "certainty output". See also the next footnote.

[7]Consistent with this idea, Duncan (1990) states that "a price-taking firm will restrict output and may exhibit a positive economic profit, even in the face of free entry (although, on the average industry profits are zero)."

(as stated by Definition 1), the free-entry equilibrium number of firms, denoted $\widehat{N}^i$, requires that $\pi^i_{\widehat{N}^i} = 0$, which implies that

$$p^i\left(q^i_{\widehat{N}^i}\widehat{N}^i\right) = \frac{c\left(q^i_{\widehat{N}^i}\right) + K}{q^i_{\widehat{N}^i}}. \tag{1}$$

Moreover, Assumption 1 implies that, in a free-entry equilibrium (and provided that $\pi^i_{\widehat{N}^i} = 0$),

$$p^i\left(q^i_{\widehat{N}^i}\widehat{N}^i\right) = c'\left(q^i_{\widehat{N}^i}\right). \tag{2}$$

It is straightforward to show that the free-entry equilibrium number of firms if the low-demand state occurs with certainty is strictly smaller than the free-entry equilibrium number of firms if the high-demand state occurs with certainty. This result will be useful in the following sections.

Lemma 1. $\widehat{N}^H > \widehat{N}^L$.

3.2 | Imperfect information

Suppose now that the realization of the demand is uncertain in the first period. That is, when firms decide whether to enter the market, they do not know which state will occur in the second stage—they just know the probabilities, θ^i, assigned to these two alternative states. In this new scenario, we can show that the free-entry equilibrium number of firms, denoted N^*, is always strictly greater than the number of firms that enter the market if the low-demand state occurs with certainty.

Lemma 2. $N^* > \widehat{N}^L$.

Lemma 2 states that, if there is demand uncertainty, the number of firms in a free-entry equilibrium is strictly greater than the number of entrants if the low-demand state occurs with certainty. Therefore, under demand uncertainty, if the low-demand state is (ex-post) realized, there are *too many* firms in the market relative to the low-demand, perfect-information benchmark (which entails zero profits for the firms). This implies that producing the same level of output as in this benchmark would generate negative profits for the firms—which is impossible by Assumption 1. Therefore, firms must reduce production in order not to incur a loss.

Lemma 3. *Given that N^* firms have entered the market, if the low-demand state occurs, $q^L_{N^*}$ is such that $\pi^L_{N^*} = 0$, and such that $q^L_{N^*} < q^L_{\widehat{N}^L}$.*

Lemma 3 is a direct consequence of firms' *rational* choices under perfect competition (Assumption 1). Given that N^* firms have entered the market—which is excessive in the low-demand state relative to the low-demand, perfect-information benchmark—, *rational* firms will reduce production (relative to the perfect-information case) until they just break even; that is,

$\pi^L_{N^*} = 0$. Otherwise, they will incur a loss. As a consequence, (*ex-ante*) profits are given by $E\Pi_{N^*} = \theta^H \pi^H_{N^*}$. Therefore, (ignoring the integer constraint on the number of firms) free entry implies that $\pi^H_N = 0$, which yields the same (free-entry) equilibrium number of firms as in the case in which the high-demand state occurs with certainty.

Proposition 1. *In a free-entry equilibrium under demand uncertainty, the number of firms that enter the market is equal to the number of firms that enter the market if the high-demand state occurs with certainty. That is,* $N^* = \widehat{N}^H$.

4 | OPTIMAL REGULATED ENTRY

Our goal is now to compare the number of firms that enter in a free-entry equilibrium with the optimal regulated level of entry, denoted $\widetilde{N}$. The latter is defined as the number of entrants in the market chosen by a planner (or a regulator) that seeks to maximize welfare. As MW1986 do, we assume that the planner can control the number of firms that enter the industry, but not their (competitive) behavior once they have entered.

4.1 | Perfect information

First, suppose again that the planner knows with certainty that state i occurs in the second stage. In this case, Corollary 1 in MW1986 applies immediately. Hence, we can conclude that the unregulated competitive-market solution is efficient. That is, $\widehat{N}^i = \widetilde{N}^i$ is the optimal number of firms—that is, the first-best (see MW1986, p. 52, footnote 6).

Proposition 2 (Corollary 1, MW1986). *Suppose that state i occurs with certainty. Then, the free-entry equilibrium number of firms exactly equals the efficient number of firms* (*i.e.*, $\widehat{N}^i = \widetilde{N}^i$).

4.2 | Imperfect information

Second, let us assume that the realization of the demand is uncertain in the first period.[8] In this case, the goal of the planner is to choose the number of firms that maximizes (ex-ante) welfare. That is, she chooses the number of firms that solves the following maximization problem

$$\max_N W(N) \equiv \sum_{i=L,H} \theta^{i*} \left[\underbrace{\int_0^{Nq_N^i} p^i(s)ds - Nc\left(q_N^i\right) - NK}_{W^i(N)} \right],$$

[8]As shown above, the planner obtains the first-best solution in the (uninteresting) case in which she knows *ex-ante* the realization of the demand in the second stage. However, throughout this Section, we maintain the (more interesting) assumption that the realization of the demand is also uncertain for the planner.

where $W^i(N)$ is (*ex-post*) welfare if state i is realized. Differentiating this expression with respect to the number of firms yields

$$W'(N) = \sum_{i=L,H} \theta^{i*}\left\{p^i\left(Nq_N^i\right)\left[q_N^i + N\frac{\partial q_N^i}{\partial N}\right] - c\left(q_N^i\right) - Nc'\left(q_N^i\right)\frac{\partial q_N^i}{\partial N} - K\right\},$$

which, rearranging terms and recalling the expression for equilibrium profits per firm in state i, π_N^i, can be rewritten as follows[9]

$$W'(N) = \sum_{i=L,H} \theta^{i*}\left\{\pi_N^i + \left[p^i\left(Nq_N^i\right) - c'\left(q_N^i\right)\right]N\frac{\partial q_N^i}{\partial N}\right\}.$$

The optimal solution, $\widetilde{N}$, is thus characterized by the first-order condition obtained by equating the previous expression to zero; that is, $W'(\widetilde{N}) = 0$. Using this condition, we can easily show that the optimal regulated number of firms, $\widetilde{N}$, is always strictly greater than $\widehat{N}^L$ and strictly smaller than $\widehat{N}^H$.

Lemma 4. *$\widetilde{N}$ is such that $\widetilde{N} \in (\widehat{N}^L, \widehat{N}^H)$.*

As a result, we can conclude that the unregulated, free-entry equilibrium number of firms in a competitive market that faces demand uncertainty is not efficient, as it exceeds the optimal level of entry that a regulator would choose.

Proposition 3. *Suppose that there is demand uncertainty. Then, the free-entry equilibrium number of firms strictly exceeds the optimal number of firms; that is, $N^* > \widetilde{N}$.*

As shown in the Supporting Information: Appendix A (see the proof of Lemma 4), the expression that characterizes the optimal level of entry, $\widetilde{N}$, is as follows[10]

$$\underbrace{\theta^H \pi_{\widetilde{N}}^H}_{\text{Profit gain if } \Delta\widetilde{N} \text{ if} H} = \underbrace{-\theta^L\left[p^L\left(\widetilde{N}q_{\widetilde{N}}^L\right) - c'\left(q_{\widetilde{N}}^L\right)\right]\widetilde{N}\frac{\partial q_{\widetilde{N}}^L}{\partial \widetilde{N}}}_{\text{Surplus lost due to less output if } \Delta\widetilde{N} \text{ if } L}. \tag{3}$$

This expression is very similar to equation (2) in MW1986, with the difference that our equation (3) includes the probabilities assigned to each of the states. As argued by these authors, the (first-order) change in (ex-ante) welfare attributable to a marginal entrant is composed of two terms. First, the new entrant contributes directly to social surplus through its

[9]Note that this expression is very similar to equation (2) in MW1986.

[10]As shown in the proof of Lemma 4, both the left-hand side (LHS) and the right-hand side (RHS) of this expression are positive. Moreover, the LHS is a continuous function in $\widetilde{N}$ that takes a strictly positive value in a neighborhood around $\widehat{N}^L$ and approaches to zero as $\widetilde{N}$ gets close to $\widehat{N}^H$, while the RHS is a continuous function in $\widetilde{N}$ that approaches to zero as $\widetilde{N}$ gets close to $\widehat{N}^L$ and takes a strictly positive value in a neighborhood around $\widehat{N}^H$. Thus, the LHS and the RHS of (3) "intersect" at least once, which guarantees the existence of a solution.

(strictly) positive profit[11] if the high-demand state is (ex-post) realized—see the left-hand side of Equation (3).

Second, the entrant causes all existing firms to contract their output levels if the low-demand state occurs—recall that, in this case, there are *too many* firms in the market ($\widetilde{N} > \widehat{N}^L$), so firms reduce production in order not to incur a loss (see Lemma 3). In particular, the aggregate contraction of the output level is given by $\widetilde{N}\frac{\partial q^L_{\widetilde{N}}}{\partial \widetilde{N}}$.[12] This aggregate output contraction increases the (strictly positive) difference between the equilibrium market price and the firms' marginal costs,[13] leaves some (additional) consumers unserved and, hence, causes a reduction in welfare of $\left[p^L(\widetilde{N}q^L_{\widetilde{N}}) - c'(q^L_{\widetilde{N}})\right]\widetilde{N}\frac{\partial q^L_{\widetilde{N}}}{\partial \widetilde{N}}$ if the low-demand state occurs—see the right-hand side of equation (3).

As shown above, firms anticipate zero profits if the low-demand state occurs in an unregulated, free-entry equilibrium under demand uncertainty (see Lemma 3). As a consequence, entry is driven by the expected (positive) profits generated if the high-demand state is (ex-post) realized. As a result, the number of entrants exactly equals the level of entry if the high-demand state occurs with certainty. However, this level of entry ignores the (additional) output reduction entry causes in other firms if the low-demand state occurs. That is, in the absence of entry regulation, marginal entry is more desirable to the entrant than it is to society. However, at the optimal solution, the regulator balances the expected gains of (strictly) positive profits (if demand turns out to be high) and the expected loss of surplus (if demand turns out to be low) caused by a marginal entrant.

5 | CONCLUSIONS

Economists have long believed that, in perfectly competitive markets, unencumbered and unregulated entry is desirable for social efficiency. This *textbook* result, however, has been derived (and taken for granted) in a world of certainty. This paper shows that, if firms face demand uncertainty when entering the market, this result no longer holds: under this plausible alternative assumption, the level of entry is excessive relative to the optimum. This is because, as we show, in a free-entry equilibrium entry is motivated by the profits that firms expect to receive if market demand turns out to be high. However, this (equilibrium) level of entry is *excessive* if market demand turns out to be low and, as a consequence, firms find it optimal to reduce output (in order not to incur a loss) in this case. This output contraction in the low-demand state leaves some consumers unserved and, hence, causes a reduction in welfare. However, when finding the optimal level of entry, a regulator also considers such a reduction in surplus that occurs if market demand turns out to be low. Our paper thus shows that, in

[11]We know that firms' profits are strictly positive because the number of firms in the socially optimal solution is strictly smaller than $\widehat{N}^H$ (which yields zero profits)—see Supporting Information: Appendix A, Lemma A.1, cases $(i) - (iii)$.

[12]In the Supporting Information: Appendix A we formally show that, in this case, $\frac{\partial q^L_{\widetilde{N}}}{\partial \widetilde{N}} < 0$—see Supporting Information: Appendix A, Lemma A.2.

[13]We know that the difference between the price and the marginal cost is strictly positive because the number of firms in the socially optimal solution is strictly greater than $\widehat{N}^L$ —see Supporting Information: Appendix A, Lemma A.1, cases $(iii) - (v)$.

perfectly competitive markets, uncertainty creates a wedge between the private and social evaluation of marginal entry.

Finally, it is important to remark that our analysis assumes the benchmark case in which perfectly competitive firms are risk-neutral and, hence, we consider that their decisions are based on expected profits at the entry stage. Nevertheless, there is a substantial literature documenting that firms often deviate from this assumption—Åstebro (2003), Kremer et al. (2013), and Brenner (2015). If we assume instead that firms are risk-averse, entry at the competitive equilibrium will be lower relative to that found in Section 3. This is because entering the market is a "risky lottery" that risk-averse firms dislike vis-à-vis the certain outcome of zero profit obtained if they do not enter. Consequently, in this case, the problem of excessive entry will be mitigated. If we consider that firms are risk-loving, the opposite result will occur; that is, the problem of excessive entry will be exacerbated. Less interesting in our setup is the case in which firms assume when entering the market that the least (most) profitable scenario that can happen in the second stage will—that is, if firms' decisions at the ex-ante stage are based on the maximin (maximax) criterion (Wald, 1949). In this case, the number of firms at the competitive equilibrium is $\widehat{N}^L$ ($\widehat{N}^H$) and, hence, the level of entry is lower (higher) than the socially optimal one per Lemma 4. Future researchers are encouraged to consider these alternative assumptions in combination with some other deviations from the perfectly competitive benchmark.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no data sets were generated or analyzed during the current study.

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REFERENCES

Asplund, M. (2002) Risk-averse firms in oligopoly. *International Journal of Industrial Organization*, 20(7), 995–1012.

Åstebro, T. (2003) The return to independent invention: evidence of unrealistic optimism, risk seeking or skewness loving? *The Economic Journal*, 113(484), 226–239.

Azevedo, E.M. & Gottlieb, D. (2012) Risk-neutral firms can extract unbounded profits from consumers with prospect theory preferences. *Journal of Economic Theory*, 147(3), 1291–1299.

Baron, D.P. (1970) Price uncertainty, utility, and industry equilibrium in pure competition. *International Economic Review*, 11, 463–480.

Brenner, S. (2015) The risk preferences of us executives. *Management Science*, 61(6), 1344–1361.

Brown, G. & Johnson, M.B. (1969) Public utility pricing and output under risk. *The American Economic Review*, 59(1), 119–128.

Cabral, L.M. (2004) Simultaneous entry and welfare. *European Economic Review*, 48(5), 943–957.
Cabral, L.M. (2017) *Introduction to industrial organization*. Cambridge, MA: MIT Press.
Creane, A. (2007) Note on uncertainty and socially excessive entry. *International Journal of Economic Theory*, 3(4), 329–334.
Creane, A. & Jeitschko, T.D. (2016) Endogenous entry in markets with unobserved quality. *The Journal of Industrial Economics*, 64(3), 494–519.
Crew, M.A. & Kleindorfer, P.R. (1998) Efficient entry, monopoly, and the Universal Service Obligation in postal service. *Journal of Regulatory Economics*, 14(2), 103–126.
De Vany, A.S. & Saving, T.R. (1983) The economics of quality. *Journal of Political Economy*, 91(6), 979–1000.
Duncan, G.M. (1990) The effect of probabilistic demands on the structure of cost functions. *Journal of Risk and Uncertainty*, 3(3), 211–220.
Emons, W. (1988) Warranties, moral hazard, and the lemons problem. *Journal of Economic Theory*, 46(1), 16–33.
Erkal, N. & Piccinin, D. (2010) Cooperative R&D under uncertainty with free entry. *International Journal of Industrial Organization*, 28(1), 74–85.
Goyal, M. & Netessine, S. (2007) Strategic technology choice and capacity investment under demand uncertainty. *Management Science*, 53(2), 192–207.
Holthausen, D.M. (1976) Input choices and uncertain demand. *The American Economic Review*, 66(1), 94–103.
Kremer, M., Lee, J., Robinson, J. & Rostapshova, O. (2013) Behavioral biases and firm behavior: Evidence from Kenyan retail shops. *American Economic Review*, 103(3), 362–68.
Lee, S. & Cheong, K. (2005) Rent dissipation and social benefit in regulated entry contests. *European Journal of Political Economy*, 21(1), 205–219.
Lee, S.-H. (1999) Optimal taxation for polluting oligopolists with endogenous market structure. *Journal of Regulatory Economics*, 15(3), 293–308.
Mankiw, N.G. & Whinston, M.D. (1986) Free entry and social inefficiency. *The RAND Journal of Economics*, 17, 48–58.
Mas-Colell, A., Whinston, M.D., Green, J.R. (1995) *Microeconomic theory*, Vol. 1. New York: Oxford University Press.
Maskin, E.S. (1999) Uncertainty and entry deterrence. *Economic Theory*, 14(2), 429–437.
Perrakis, S. & Warskett, G. (1983) Capacity and entry under demand uncertainty. *The Review of Economic Studies*, 50(3), 495–511.
Quirmbach, H.C. (1993) R&D: competition, risk, and performance. *The RAND Journal of Economics*, 24, 157–197.
Sandmo, A. (1971) On the theory of the competitive firm under price uncertainty. *The American Economic Review*, 61(1), 65–73.
Szczutkowski, A. (2010) The social value of cost information in a monopolistically competitive economy. *Journal of Public Economic Theory*, 12(2), 345–362.
Wald, A. (1949) Statistical decision functions. The Annals of Mathematical Statistics, 165–205
Ziss, S. (1999) Divisionalization and strategic managerial incentives in oligopoly under uncertainty. *International Journal of Industrial Organization*, 17(8), 1163–1187.

SUPPORTING INFORMATION

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