Regulatory Barriers and Entry into a New Competitive Industry*

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Abstract

We model the effects of license fees and bureaucratic delay on firm entry into a new competitive industry, whose profitability is initially unknown. A license fee alone reduces the number of first movers and the steady-state number of firms. The combination of license fee and delay may cause some entrepreneurs to purchase licenses speculatively, only using them to enter production later if profitability is revealed to be sufficiently favourable. Alternatively, some entrepreneurs may wait, possibly buying a license only after profitability is revealed; but it is never found that some entrepreneurs adopt one of these strategies and some the other.

Keywords: Entry, License Fees, Bureaucratic Delay

JEL Classification: L50, O14

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1 Introduction

Entry processes in advanced economies have commonly been modeled in terms of the characteristics of firms, such as plant size, age, and ownership type (Dunne et al., 1989). In developing economies, however, institutional weaknesses also have to be taken into account (Tybout, 2000), and entry rates have been found to be lower where governments impose more onerous regulations on entry (Klapper et al., 2006). In this paper we analyze how entry by new firms in a developing economy may be affected by two forms of regulatory barrier: the imposition of a license fee for entry and bureaucratic delay in issuing the license once the fee has been paid. As would be expected intuitively, both of these forms of barrier are found generally to have an adverse impact on entry, but our focus is on how the timing of entry is affected. In particular, we show how bureaucratic delays may lead to speculative behavior amongst potential entrants, with more entry licenses being purchased than may then be used. An implication is that data on new firm registration in economies where entry barriers are high may overstate reality.

To analyze these issues we formulate a model of the entry of firms into a newly-established market. It is assumed that, initially, there is uncertainty about the profitability of the industry; but, with a lag, entry by first movers reveals this profitability to all potential entrants. In the first version of the model each entrepreneur must decide whether to be a first mover, sinking costs before the profitability of the industry is known, or to wait, entering late if revealed profitability justifies the sinking of costs. However, to enter, an entrepreneur must purchase a non-tradeable license, and we analyze the effects this has on the pattern of entry (and exit). We find that both first-mover entry and the steady-state number of firms are weakly decreasing in the level of the fee, as well as in other cost parameters and in the extent to which the future is discounted.

We then formulate a second version of the model that includes a delay between payment of the license fee and receipt of the license. The license fee and the delay influence in different ways the balance of net advantages of being a first-mover compared to waiting. In particular, we examine how the existence of a delay may generate the speculative purchase of licenses by some entrepreneurs, buying early, before the profitability of early entrants is revealed. Depending on the level of profitability that is then observed, some or all of the speculators may enter without further delay, while any remaining speculators never enter. We show that in equilibrium speculative purchase of licenses may occur, or there may be late (non-speculative) purchase of licenses, but not both.

Unlike in the entry models of Jovanovic (1982) and Ericson and Pakes (1995), in our analysis entrepreneurs are \textit{ex ante} identical: rather than learning about their individual abilities, they learn about their environment, which is common to all of them. This also distinguishes our formulation from models of stochastic
competitive equilibrium where firms experience idiosyncratic shocks (see, in particular, Hopenhayn, 1992). Our analysis bears some similarity to the literature on information revelation and strategic delay. In particular, Chamley and Gale (1994) model investment by individual agents where information about the state of nature is revealed through investment by others. However, they do not allow for competition between agents, which (through the input market) is at the heart of our model. Instead, they focus on the roles of period length and the number of potential entrants, issues that are beyond the scope of our analysis.

The trade-off between the potentially higher profits for first movers and the benefits to second movers of learning from the experience of first movers is emphasized by Jovanovic and Lach (1989). In a continuous-time framework they show how competition generates S-shaped diffusion of an innovation. Also, Rob (1991) develops a dynamic model in which entry by each firm marginally improves the information available to late entrants, and he allows for earnings differentials due to luck. He finds that equilibrium entry decreases monotonically over time. In these two models the main concern is with the general properties of the equilibrium, whereas we formulate our model with more specific assumptions in order gain some leverage on the issue of how licenses and delay may affect entry.

Our framework is conceived to apply to developing economies because entry and regulatory barriers are more onerous than in developed ones (Djankov et al., 2002; Djankov, 2009). For example, in Latin America and the Caribbean, the average cost of entry (imposed by the government), including the payment license fees, is 36.6% of per capita income and the delay in being allowed to enter averages 61.7 days, while the corresponding figures for OECD countries are 4.7% of per capita income and 13 days (World Bank, 2008). There is also significant cross-country heterogeneity in developing economies. In Brazil, for example, entry costs are low (6.9% of per capita income) but delays high (120 days), while the opposite obtains in the Gambia (215% of per capita income but only 27 days of delay). We focus on the birth of a new industry to concentrate attention on the new firm entry (and exit) process. New industry creation takes a different form in a developing country because, rather than product or process innovation, it commonly takes the form of adaptation of foreign technologies to local circumstances. Hausmann and Rodrik (2003) provide examples such as information technology in India, the garment industry in Bangladesh and the cut-flower industry in Colombia.

While the assumptions of the model with respect to license fees and entry delays in a developing economy can be easily justified, there is less direct evidence on the existence of speculation. We are aware from developed economies that licenses for entry can lead to speculative purchases, for example in the auctioning of spectrum rights in the US telecommunications industry (Crampton et al., 1998), and licenses are more pervasive in developing economies (Djankov et al., 2002).
but the documentation on speculation is poor. Nonetheless, there is considerable
evidence of churning amongst new entrants, with simultaneously high rates of entry
and exit. In several Sub-Saharan African and Latin American countries around
20% of new entrants enter and leave in the same year (World Bank, 2013). Given
that ‘entry’ here is characterized as registration, with the acquisition of a license
as necessary, while ‘exit’ is measured as not being economically active for a certain
period, this evidence is consistent with speculative behaviour.

In Section 2 we specify the characteristics of the industry. In Section 3 we
examine equilibrium behaviour with and without license fees, and then in Section
4 we add bureaucratic delay into the model. Section 5 discusses some implications
of our results, considers the roles of some of our assumptions, and suggests some
extensions for future research.

2 The Industry

Consider a new industry, with no incumbent firms at time \( t = 0 \). The supply of
potential entrepreneurs is assumed large relative to the number that actually set
up firms in the industry. Entrepreneurs (and firms) are indexed \( i = 1, 2, \ldots \) Any
entrepreneur may innovate, setting up a firm to enter the industry and produce at
\( t = 1 \). This requires a sunk cost \( k \) and the payment of fee \( f \geq 0 \) for a license.\(^3\) If
\( k \) and \( f \) are incurred at \( t = 1 \), the firm will also need to employ a unit of skilled
labour in any period \( t \) in order to produce.

The output of any active firm \( i \) at time \( t \) is

\[
y_i^t = \theta, \quad t = 1, 2, \ldots
\]

where \( \theta \) is the realization, at \( t = 1 \), of a stochastic variable \( \Theta \) which is uniformly
distributed with support \([0, 2\tilde{\theta}]\). Given that at least one entrepreneur sinks cost
\( k \) at \( t = 1 \), the realization of \( \theta \) becomes common knowledge at \( t = 2 \). \( \Theta \) captures
the idea that, although the industry may exist in other countries, its suitability
to local conditions and institutions can only be discovered by experimentation;
it represents uncertainty related to the quality and reliability of inputs and their
productivity under local conditions, including the institutional and organizational
infrastructure. Note that \( \theta \) is not firm-specific. Unlike in Jovanovic (1982) or
Ericson and Pakes (1995), entrepreneurs do not learn about their own abilities;
rather, they learn about their environment. Apart from \( \theta \) at \( t = 1 \), the values of
all variables and parameters in the model are common knowledge.

We assume that (for a high enough \( \theta \)) a limit on the profitability of production
activity comes from an increasing supply price of skilled labour, rather than the
product demand side. Output demand is assumed to be perfectly elastic, with
price fixed at unity, so \( y_i^t \) can also be interpreted as revenue. In effect, the industry
produces a traded good in a small open economy. The wage \( w_t \) per unit of skilled labour at time \( t \) is

\[
w_t = \delta + \alpha n_t, \quad \delta, \alpha > 0, \quad t = 1, 2, \ldots
\]  

(2)

where \( n_t \) is the total number of firms in the industry at \( t \). Throughout, we approximate by treating the number of firms as continuous.

Any number of entrepreneurs can enter the industry at any time. For a first mover (that is, an entrant at \( t = 1 \)) \( \theta \) is stochastic. Then, for a potential second mover (that is, an entrant at \( t = 2 \)) the realization \( \theta \) is known. Since no information becomes available after \( \theta \) is revealed between \( t = 1 \) and \( t = 2 \), there will be no reason for a firm to prefer to enter or exit after the beginning of \( t = 2 \). Therefore, for \( t \geq 3 \), \( n_t = n_2 \), \( y_t = y_2 \), and \( w_t = w_2 \). Writing \( \pi_t^i \) and \( \pi_t^j \) for the respective profits at time \( t \) of a first mover \( i \) and a second mover \( j \), we have

\[
\begin{align*}
\pi_1^i &= \theta - \delta - \alpha n_1 - k - f; \quad \pi_1^j = \theta - \delta - \alpha n_2, \quad t = 2, 3, \ldots; \\
\pi_2^i &= \theta - \delta - \alpha n_2 - k - f; \quad \pi_2^j = \theta - \delta - \alpha n_2, \quad t = 3, 4, \ldots
\end{align*}
\]  

(3)

The present value, at \( t = 2 \), of first mover \( i \)'s profit stream, if it stays in production, is

\[
V_i^2 = \frac{1}{1 - \sigma} (\theta - \delta - \alpha n_2),
\]  

(4)

where \( \sigma \in (0, 1) \) is a discount factor. The present value, at \( t = 2 \), of second mover \( j \)'s profit stream is

\[
V_j^2 = \frac{1}{1 - \sigma} (\theta - \delta - \alpha n_2) - K,
\]  

(5)

where

\[
K = k + f.
\]  

(6)

In each case that follows, we examine the entry by first movers, the subsequent pattern of entry and exit, and the steady-state number of firms \( n^* \) in the industry. \( n^* \) is the number of firms in the industry after uncertainty has been resolved and any adjustments associated with license delay have played out.

### 3 Market Equilibrium

In this section we assume that although a license fee must be paid, there is no delay in receiving the license. Since there is no uncertainty after \( \theta \) is revealed (between \( t = 1 \) and \( t = 2 \)), the equilibrium number of firms is the same at \( t = 3, 4, \ldots \) as at \( t = 2 \). We therefore focus on the values of \( n_1 \) and \( n_2 \), and solve the model by backward induction from \( t = 2 \). At \( t = 2 \), each entrepreneur maximizes the
present value of his or her profit stream, given \( \theta \). Taking into account the behaviour that will obtain for each entrepreneur at \( t = 2 \) for all possible \( \theta \), at \( t = 1 \) each entrepreneur maximizes the expected present value of his or her profit stream. We assume that parameter values are such that there is positive entry at \( t = 1 \) in the solution.

The value of \( n_2 \) depends on the range of values within which \( \theta \) falls. Four cases can be distinguished.

**Case (a)** All \( n_1 \) first movers would exit because even one of them alone in the industry would make a loss at \( t = 2 \). From (3), this occurs if

\[
\theta < \delta + \alpha \equiv \theta_a.
\]

If (7) holds, all first movers exit; and since second movers are at a cost disadvantage relative to first movers (still having to incur a set-up cost), there is no entry by second movers.

**Case (b)** In this range some of the \( n_1 \) first movers remain in the industry at \( t = 2 \) (thus, \( \theta \geq \theta_a \)) but some exit. If all \( n_1 \) first movers were to remain in the industry the \( n_1 \)-th would make a loss, i.e., from (3),

\[
\theta < \delta + \alpha n_1 \equiv \theta_b(n_1).
\]

Thus, in this case \( \theta \in [\theta_a, \theta_b] \). Because, at \( t = 2 \), a potential second mover is at a cost disadvantage relative to any first mover, there is no entry by second movers. The number of firms \( n_2 \) is such that \( V^i_2 = 0 \), so that, from (4),

\[
n_2 = \frac{\theta - \delta}{\alpha} > 0 \quad \text{for} \quad \theta \in (\theta_a, \theta_b].
\]

**Case (c)** All first movers remain in the industry at \( t = 2 \) (thus, \( \theta \geq \theta_b \)) but \( \theta \) is not so great as to induce entry by second movers. From (5), \( V^j_2 \) is decreasing in \( n_2 \). Thus, if \( V^j_2 \leq 0 \) for \( n_2 = n_1 \), there will be no second movers. This condition can be written

\[
\theta \leq \delta + \alpha n_1 + (1 - \sigma)K \equiv \theta_c(n_1).
\]

Provided \( \theta \in [\theta_b, \theta_c] \), \( n_2 \) is independent of parameter values.

**Case (d)** If \( \theta \in (\theta_c, 2\theta] \) the first movers will all remain in the industry at \( t = 2 \) and there will be entry by second movers until \( V^j_2 = 0 \). Hence, from (5),

\[
n_2 = \frac{1}{\alpha} [\theta - \delta - (1 - \sigma)K] \equiv \hat{n}_2.
\]

At \( t = 1 \) firm \( n_1 \) is the marginal firm among those that enter. Writing \( \pi^n_t \) for its profit at time \( t \), and taking into account the four cases for possible draws of \( \theta \),
the expected present value of this firm’s profit stream is

\[ V_{1}^{n_1}(n_1) = \frac{1}{2\theta} \left\{ \int_{0}^{\theta_c} \pi_1^{n_1}(n_1) d\theta + \frac{\sigma}{1-\sigma} \left[ \int_{\theta_c}^{\theta} \pi_2^{n_1}(n_1) d\theta + \int_{\theta_c}^{2\theta} \pi_2^{n_1}(\tilde{n}_2) d\theta \right] \right\}. \] (12)

Here, the term in parentheses (.) after each \( \pi_i^{n_1} \) denotes the number of firms in the industry in the time period considered. The first integral covers profit at \( t = 1 \), while the second and third integrals relate to profit at \( t = 2 \) in Cases (c) and (d) respectively. (If Case (a) or (b) applied, firm \( n_1 \) would exit, and so no term is specified.) For (12) to hold we assume that \( 2\theta > \theta_c \); i.e., we assume that the realization of \( \theta \) may be sufficiently large for there to be second-mover entry. For simplicity, we do not consider other cases. \( \pi_1^{n_1}(\cdot) \) and \( \pi_2^{n_1}(\cdot) \) are given by (3), while \( \tilde{n}_1 \) is given by (11). Thus,

\[ V_{1}^{n_1}(n_1) = (\bar{\theta} - \delta - \alpha n_1 - k - f) - \frac{1}{4\theta} \sigma (1-\sigma) K^2 + \sigma K \left( 1 - \frac{\delta + \alpha n_1}{2\theta} \right). \] (13)

From (13), \( dV_{1}^{n_1}(n_1)/dn_1 < 0. \) \( n_1 \) adjusts such that, in equilibrium, \( V_{1}^{n_1}(n_1) = 0 \), the solution being \( n_1 = \hat{n}_1(f) \), where

\[ \hat{n}_1(f) = \frac{2\bar{\theta} - \delta}{\alpha} - \frac{4\bar{\theta}(\bar{\theta} + K) + \sigma (1-\sigma) K^2}{2\alpha(2\bar{\theta} + \sigma K)} \equiv \frac{2\bar{\theta} - \delta}{\alpha} - z. \] (14)

We assume that the configuration of parameter values is such that \( \hat{n}_1(f) > 0 \). Combined with our assumption that \( 2\bar{\theta} > \theta_c \), using (10) and (14), this implies that

\[ 2\bar{\theta} - \delta > \alpha z > \alpha(1 - \sigma)K. \] (15)

From (11) and (14), we can find, for Case (d), how many second movers will enter. Denoting this number by \( \hat{m}_2(f) = \hat{n}_2(f) - \hat{n}_1(f) \), we obtain

\[ \hat{m}_2(f) = \frac{4\bar{\theta}(\theta - \bar{\theta}) + \sigma K [2\theta - (1-\sigma)K]}{2\alpha(2\bar{\theta} + \sigma K)} \text{ for } \theta \in (\theta_c, 2\bar{\theta}); \] (16)

\[ \hat{m}_2(f) = 0 \text{ for } \theta \leq \theta_c. \]

Let \( n^{*m}(f) \) denote the steady-state number of firms in the solution for license fee \( f \). Since by \( t = 2 \) all uncertainty is resolved, \( n^{*m}(f) = n_2 \). The value of \( n^{*m}(f) \) depends on which of Cases (a)-(d) obtains.

Our first proposition gives the comparative statics of the model.

**Proposition 1** \( \hat{n}_1 \) is decreasing in \( \alpha, \delta, k \) and \( f \), and increasing in \( \sigma \). In Case (a) \( n^{*m} = 0 \). In Case (b) \( n^{*m} \) is decreasing in \( \alpha \) and \( \delta \), and independent of \( \sigma, k \) and \( f \). In Case (c) \( n^{*m} = \hat{n}_1 \). In Case (d), \( n^{*m} \) is decreasing in \( \alpha, \delta, k \) and \( f \), and increasing in \( \sigma \).
As might be have been expected intuitively, the initial number of entrants $n_1$ is decreasing in all cost parameters. Also, because costs $k$ and $f$ are incurred only at $t = 1$, a higher discount factor $\sigma$ diminishes their relative importance in the present value of the expected profit stream and so is associated with a greater number of initial entrants.

The steady-state number of firms $n^{*m}$ is non-increasing in cost parameters, with results depending on which of the Cases (a)-(d) obtains. In Case (a) there is no production in steady state. In Case (b) some, but not all, of the first movers remain in the industry in steady state. The number of these remaining firms is decreasing in the cost parameters $\alpha$ and $\delta$ that apply every period. However, these firms do not need to incur costs $k$ and $f$ at $t = 2, 3, \ldots$, and, because they are intra-marginal first movers, a marginal variation in $k$ or $f$ does not affect their entry decision at $t = 1$. Hence, their number is independent of $k$ and $f$. Similarly, because these firms are intra-marginal among first movers, their number is not affected by a marginal variation in the discount factor $\sigma$. In Case (c) the steady-state number of firms $n^{*m}$ equals the number of first movers $\hat{n}_1$, and the comparative statics are as already discussed. Finally, in Case (d) the steady-state number of firms includes both first- and second-movers. This number is decreasing in all cost parameters, and, because costs $k$ and $f$ are only incurred up-front when a firm enters, it is increasing in $\sigma$, as already explained with respect to $\hat{n}_1$.

Setting $f = 0$, we obtain the laissez-faire solution, which is depicted in Figure 1, where period-1 entry is labelled $n_1^m(0)$ and the steady-state solution is labelled $n^{*m}(0)$. For at least one firm to stay in the industry we must have $\theta \geq \delta + \alpha$. $n_1^m(0)$ is independent of $\theta$ because it is determined before $\theta$ is revealed. The vertical distance between $n^{*m}(0)$ and $n_1^m(0)$ shows the amount of entry at $t = 2$. For low values of $\theta$ this is negative, i.e., there is exit.

[Figure 1]

Figure 2 illustrates the effect of a positive license fee on the market solution. The zero-license fee case is shown by the broken line, and the positive-license fee case is shown by the thick line. The existence of the license fee reduces the number of first movers, and so the horizontal section of $n^{*m}(f)$ is below that of $n^{*m}(0)$. Also, provided $\theta > \theta_b(\hat{n}_1)$, the license fee reduces the steady-state number of firms.

[Figure 2]

4 Delay and Speculation

In the formulation above, the license fee $f$ plays the same role as the sunk cost $k$. We now suppose, however, that there is a one-period delay between paying the fee
and getting the license.⁷ Thus, we suppose that first movers pay the license fee at 
\( t = 0 \) and begin production at \( t = 1 \). As above, \( \theta \) is observed between \( t = 1 \) and 
\( t = 2 \). With this amendment to the model, one possibility is for other firms to wait 
to observe \( \theta \) and, if this realization is favourable, pay the fee \( f \) at the beginning 
of \( t = 2 \). Any entry by second movers would occur at the beginning of \( t = 3 \), with 
the set-up cost \( k \) then being incurred.

However, entry may take a different form. An entrepreneur may decide to ‘speculate,’ applying for a license, but not producing before \( \theta \) is realized, and then only going into production if the realization is sufficiently favourable. Thus, the 
entrepreneur may pay the fee at the beginning of \( t = 1 \), and then either begin 
production at the start of \( t = 2 \) or not begin production at all. We can therefore 
distinguish three types of entry: by first movers, by speculators and by ‘late movers’ 
(entrepreneurs who wait to see the realization \( \theta \) before possibly paying \( f \)).⁸

At \( t = 2 \) a first mover has a cost advantage \( k \) over a speculator, and so, if a 
speculator enters, we know that all first movers remain in the industry. At \( t = 2 \) and 
\( t = 3 \) a speculator has the cost advantages of \( f \) and \( k \) over a late mover, and 
so, if any late movers enter, we know that all speculators stay in. To solve the 
model, we begin by disregarding late movers entirely, considering only first movers 
and speculators. We shall then show that in the solution we may have speculators, 
or we may have late movers, but not both at the same time.

Suppose that \( s_1 \) entrepreneurs buy licenses at \( t = 1 \). For any one of these 
speculators, \( h \), entry at \( t = 2 \), yields profit
\[
\pi_h^2 = \theta - \delta - \alpha n_2 - k; \\
\pi_t^h = \theta - \delta - \alpha n_3, \quad t = 3, 4, ... \tag{17}
\]

And, at \( t = 2 \), the present value of its profit stream is
\[
V_h^2 = \theta - \delta - \alpha n_2 - k + \frac{\sigma}{1 - \sigma} (\theta - \delta - \alpha n_3). \tag{18}
\]

The number of speculators that then enter at \( t = 2 \) depends on what realization 
of \( \theta \) occurs. The realizations can be divided into three cases.

*Case (Sa)* If \( \theta \) is low enough, \( V_h^2 < 0 \) for all \( h \in (n_1, n_1 + s_1) \), so that none of 
the speculators enter. Since, at \( t = 2 \), a speculator has a cost disadvantage relative 
to a first-mover, the highest value of \( \theta \) at which this case obtains is when all \( n_1 \) 
first movers would nonetheless remain in the industry. Hence, Case (Sa) is defined 
by writing \( n_2 = n_3 = n_1 \) in (18) and finding the values of \( \theta \) for which \( V_h^2 < 0 \), i.e.,
\[
\theta < \delta + \alpha n_1 + (1 - \sigma)k \equiv \theta_{SA}(n_1). \tag{19}
\]

*Case (Sb)* In this range (19) is violated, and some, but not all, \( s_1 \) speculators 
enter. If all speculators were to enter, the least efficient would make a loss in
present value terms; i.e., from (18),
\[ \theta < \delta + \alpha(n_1 + s_1) + (1 - \sigma)k \equiv \theta_{SB}(n_1 + s_1). \]  
(20)

The number of firms adjusts such that in (18), \( V^h_2 = 0 \) for \( h = n_2, \) i.e.,
\[ n_2 = \frac{1}{\alpha} [\theta - \delta - (1 - \sigma)k] \equiv \bar{n}_2^s. \]  
(21)

Case (Sc) Here, all \( s_1 \) speculators enter; i.e., (20) is violated.

Moving back to \( t = 1, \) we can now consider the payoff from speculation. The expected present value for the marginal speculator (the \( s_1\)-th) is
\[ V^{s_1}_{1}(n_1 + s_1) = -f + \frac{\sigma}{2\bar{\theta}} \int_{\theta_{SB}}^{2\bar{\theta}} \left[ \sigma \pi_{2}^{n_1+s_1}(n_1 + s_1) + \frac{\sigma}{1 - \sigma} \pi_{3}^{n_1+s_1}(n_1 + s_1) \right] d\theta, \]
where it is assumed that \( 2\bar{\theta} > \theta_{SB} \). The first term in [.] is profit including set-up cost \( k, \) while the second is the stream of discounted profits after the set-up cost has been incurred. Hence,
\[ V^{s_1}_{1}(n_1 + s_1) = -f + \frac{\sigma}{\theta(1 - \sigma)} \left( \bar{\theta} - \frac{\theta_{SB}}{2} \right)^2. \]  
(22)

From (20) and (22), \( dV^{s_1}_{1}(n_1 + s_1)/ds_1 < 0. \) \( s_1 \) adjusts such that, in equilibrium, \( V^{s_1}_{1}(n_1 + s_1) = 0; \) that is, assuming an interior solution,
\[ n_1 + s_1 = \frac{1}{\alpha} \left\{ 2\bar{\theta} - \delta - (1 - \sigma)k - 2 \left[ \frac{\bar{\theta}(1 - \sigma)f}{\sigma} \right]^{\frac{1}{2}} \right\}. \]  
(23)

The ranges of \( \theta \) relevant to the behaviour of a first mover follow immediately from the cases already specified in this and the previous section.

Case (Fa) All first movers exit (and no speculators enter). They do this if \( \theta < \theta_a, \) as specified in (7).

Case (Fb) Some, but not all, first movers exit (and no speculators enter). This occurs if \( \theta \geq \theta_a, \) but \( \theta < \theta_b(n_1), \) as specified in (8). Note that since the value of \( n_1 \) will now be different to the value taken in the absence of delay, the value of \( \theta_b(n_1) \) will also differ. \( n_2 \) is now given by (9).

Case (Fc) All first movers stay in production, but still no speculators enter. In this case \( \theta \geq \theta_b(n_1), \) but \( \theta < \theta_{SA}(n_1), \) where \( \theta_{SA}(n_1) \) is given by (19).

Case (Fd) All first movers stay in production and some, but not all, speculators enter. This occurs if \( \theta \geq \theta_{SA}(n_1), \) but \( \theta < \theta_{SB}(n_1), \) where \( \theta_{SB}(n_1) \) is given by (20). \( n_2 \) is now given by (21).
Case (Fe) All speculators enter. This happens if $\theta \geq \theta_{SB}(n_1)$, the number of firms $n_1 + s_1$ being given by (23).

Given these ranges, the present value, measured from $t = 0$, of the expected profit stream for the marginal first mover is

$$V_{0}^{n_1}(n_1) = -f + \frac{\sigma}{2\theta} \int_{0}^{2\theta} \pi_1^{n_1}(n_1) d\theta +$$

$$\frac{\sigma^2}{1-\sigma} \int_{\theta_0}^{\theta_{SB}} \pi_2^{n_1}(n_1) d\theta + \int_{\theta_{SA}}^{\theta_{SB}} \pi_2^{n_1}(\tilde{n}_2^*) d\theta + \int_{\theta_{SB}}^{2\theta} \pi_2^{n_1}(n_1 + s_1) d\theta,$$

where the profit equations (3) apply, but with $f$ deleted. Using (20) and (23), it is found that $2\bar{\theta} > \theta_{SB}$, and so the final integral is valid. The first integral covers profit at $t = 1$; the others cover profit at $t = 2, 3, \ldots$ for Cases (Fc-Fe), i.e., when $\theta$ is large enough for the marginal first mover to stay in production.

We thus find, after substituting from (23) to eliminate $s_1$, that

$$V_{0}^{n_1}(n_1) = -(1-\sigma)f + \sigma(\bar{\theta} - \delta - \alpha n_1 - k) - \frac{1}{4\theta} (1-\sigma)\sigma^2 k^2$$

$$+ \sigma^2 k \left( 1 - \frac{\delta + \alpha n_1}{2\theta} \right). \quad (24)$$

From (24), $dV_{0}^{n_1}(n_1)/dn_1 < 0$. $n_1$ adjusts so that, for an interior solution, $V_{0}^{n_1}(n_1) = 0$. The solution is $n_1 = \tilde{n}_1^*$, where, from (24),

$$\tilde{n}_1^* = \frac{2\bar{\theta} - \delta}{\alpha} - \frac{4\theta [(\bar{\theta} + k) + (1-\sigma)f/\sigma] + (1-\sigma)\sigma k^2}{2\alpha [2\theta + \sigma k]} \quad (25)$$

We now add the possibility of late entry into the model, while still allowing for speculation. If entrepreneur $j$ pays at $t = 2$ for a license in order to begin production at $t = 3$, the present value of his or her profit stream is

$$V_{2}^{j} = \frac{\sigma}{1-\sigma} (\theta - \delta - \alpha n_3) - \sigma k - f, \quad (26)$$

where $n_3$ is the number of firms at $t = 3$. This parallels equation (5), but incorporates additional discounting because of the time lag in receiving the license. If $\theta$ were to be sufficiently high for such late entry to occur, an interior solution for $n_3$ would be characterized by $V_{2}^{n_3} = 0$; and hence,

$$n_3 = \frac{1}{\alpha} \left\{ \theta - \delta - (1-\sigma) \left[ k + \frac{f}{\sigma} \right] \right\}. \quad (27)$$

However, $n_3$ is the total number of firms in this case; that is, it includes the first movers and speculators, as well as late movers. Now compare (27) with (21), which
gives the total number of firms in Case (Sb), i.e., when the marginal speculator
does not enter, though some speculators do. Because of the appearance of the
term $f/\sigma$, $n_3$ in (27) is less than $n_2$ in (21). But when there is any late entry, our
assumptions imply that all first movers have stayed in and all speculators have
entered. Thus, the total number of first movers and speculators must be at least
as large as in (21). We have a contradiction: (27) could only apply if the number
of late movers were negative. This yields the following result.

**Lemma 1** When there is speculation there is no late entry.

By speculating, a firm gets a chance to produce before late movers do. Thus,
speculators exploit all business opportunities, making entry by late movers unprof-
itable.

Now consider whether in the absence of speculation there may be late entry. From (23), for any value of $n_1$ a corresponding value for $s_1$ is found. The particular value that $n_1$ takes in the solution to the model is $\hat{n}_1^*$, as given by (25). Suppose that the interior solution for $s_1$ found in this way is $s_1 = 0$. (We return below to whether there exist parameter values such that this interior solution can occur.) Then there would be entry by late movers in the solution if $n_3$, as given by (27), exceeds $n_1$. For a given set of parameter values, once we reach $t = 3$, if late mover entry is to occur at all, it would occur if the realization of $\theta$ were at the maximum value $2\tilde{\theta}$. Assume this realization occurs. Then late mover entry occurs if $n_3$ as given by (27) exceeds $n_1$ as given by (23) with $s_1 = 0$. This inequality reduces to

$$\tilde{\theta} > \frac{(1 - \sigma)f}{8\sigma}. \quad (28)$$

If we can show that there exist parameter values for which the interior solution $s_1 = 0$ is obtained, and also (28) holds, then we have shown that late mover entry may occur when speculation does not. This interior solution holds if $\hat{n}_1^* = n_1 + s_1$ when $s_1 = 0$. From (23) and (25), this condition reduces to

$$\tilde{\theta} = \frac{k}{2(g - 1)} \left( \sigma \pm \sqrt{\sigma} \right), \quad (29)$$

where $g = [(1 - \sigma)h/\sigma]^{1/2}$ and $h = f/\tilde{\theta}$. For the values of $\tilde{\theta}$ in (29) to be positive, we must have $g > 1$, i.e., $(1 - \sigma)f/\sigma > \tilde{\theta}$. Combining this inequality with (28), we have

**Lemma 2** An interior solution $s_1 = 0$ holds and there is late entry if $\theta = 2\Theta$ and

$$\frac{(1 - \sigma)f}{\sigma} > \tilde{\theta} > \frac{(1 - \sigma)f}{8\sigma}. \quad 11$$
The *ex ante* prospects for the industry can be good enough to induce entry by some first movers, but insufficiently good to induce other firms to purchase a license speculatively. Nonetheless, it may turn out *ex post*, when the value of $\theta$ is realized, that the industry is profitable enough to attract entry by late movers. Indeed, under these conditions it is partly the prospect of entry by late movers that inhibits the initial speculative purchase of licenses.

Putting Lemmas 1 and 2 together, the following proposition obtains.

**Proposition 2** With a positive license fee, if it is necessary to wait to be granted a license, speculative purchase of licenses may occur, or there may be late (non-speculative) purchase of licenses, but not both.

The up-front payment of the license fee by speculators can give a strategic advantage over late entrants that is so strong that all late entry is squeezed out. If it is not this strong, then speculation is eschewed by all entrepreneurs, with late entry then taking place if the realization of $\theta$ is sufficiently large. In the latter case, even though prospects, *ex ante*, are on average so poor as to prevent speculation, a realization of $\theta$ may then occur that is sufficiently favourable for late entry to be profitable.

It might be supposed that bureaucratic delay would decrease the number of firms in steady state, for it increases entry costs for all entrants, reducing expected profits relative to the outside option of staying away from the industry altogether and earning zero profits. However, delay imposes some expected costs on late movers and speculators that are not imposed on first movers.\(^{10}\) Whereas first movers must wait only one period before entering, late movers suffer a two period delay before they may enter, meanwhile forgoing any potential profits; and while first movers pay for a license fee that they then use for entry and potentially to earn profits, speculators pay a fee for a license that they may not use. These costs have a negative effect on entry by late movers/speculators, and this boosts the expected profits, and numbers, of first movers. It is the interplay of these various factors that prevents us from coming to clear-cut conclusions regarding the effect of delay on the steady-state number of firms.

If there is late entry (with no speculation) the pattern of entry is broadly similar to that shown in Figure 2. If there is speculation (but no late entry) the pattern of entry is shown in Figure 3, where $n^*_2(f)$ is period-1 entry in the delay-case. This differs significantly from the previous figures in that, for the highest range of $\theta$ ($\theta \in [\theta_{SB}(n_1), 2\theta]$) the line depicting the steady-state number of firms $n^*$ is horizontal. This is because, for such high $\theta$ all the entrepreneurs that have speculatively bought a license will enter, and, as we have seen, the solution to the model is such that there is no entry by late movers.

[Figure 3]
5 Concluding Comments

We have analyzed how license fees and bureaucratic delays affect entry into a new industry in a developing economy. License fees alone have a negative effect on entry and may lead to later entry by some firms. This may exacerbate the deficiencies in the process of creative destruction that are emphasized by the World Bank in its latest World Development Report.\textsuperscript{11} We also show that bureaucratic delays may result in some entrepreneurs purchasing licenses speculatively, only using them to enter production late if the profitability of the industry is revealed to be sufficiently favourable. In equilibrium, some entrepreneurs may speculate or some may wait, not deciding whether to purchase a license until after profitability is revealed; but it is never found that some entrepreneurs adopt one of these strategies and some the other. This suggest that official statistics about new firm entry, which derive from the new company registration data, may over-estimate actual entry.\textsuperscript{12} With currently available data, it is not possible to explore this proposition empirically because there is no publicly available information tracing economic activity post-registration. To build such a data set would require a major collection effort, but if we are correct in predicting that entry rates will be over-estimated in weak institutional environments, this may be a valuable research activity.

Two of our simplifying assumptions bear further comment. The first, the assumption of a uniform distribution of potential outcomes, is a common simplification in related literature (see, e.g., Hausmann and Rodrik, 2003; Hausmann \textit{et al.}, 2007). In our model we would not expect the use of other distributions to affect Proposition 1 significantly, provided the analysis is tractable. However, we conjecture that Proposition 2 might not hold. In particular, suppose that a distribution has a small probability of very high values of $\theta$, above $2\theta$ in the current model, but that the mean of $\theta$ is still $\bar{\theta}$. Then the average prospects of the industry are the same as in the current model, but there is now the possibility of a very high realization of $\theta$. This favours potential late entry, rather than speculation. We conjecture, therefore, that late entry may occur in this case even in the presence of speculation.

Secondly, consider the assumption of linearity of the wage equation. Suppose, for example, that we amended the wage equation (2) so that $dw_t/dn_t$ were increasing in $n_t$, rather than constant. The qualitative effect on our diagrams would be that the upward-sloping lines would have a diminishing slope as $\theta$ is increased, for the entry of each firm would drive up costs for the next firm. Although the parametric specification would be affected, the general nature of Proposition 1 would still obtain. However, because the analysis would be more complicated the implications for our speculation/delay result are unclear.

A weakness of our analysis is that it does not address the issue of why the government requires licenses for entry and delays issuing them. In principle, the
government might be welfare-maximizing, erecting barriers to entry to limit the duplication of fixed costs (Bennett and Estrin, 2006). In this context, our framework could be extended to explore formally how time delays affect welfare, for example through effects on market concentration. However, in practice, as stressed by public choice theory, the rationale for imposing entry barriers may instead be to generate private benefits to politicians and the bureaucracy (Djankov et al., 2002). According to the “tollbooth” theory, the motivation for introducing licensing would be in order to refuse to issue a license, or to delay its issue further, unless a bribe is given (Shleifer and Vishny, 1993). Thus, the license fee \( f \) in our model might be interpreted as including a bribe component. With this interpretation, the model might be developed to explore the interplay between politicians’ desire to generate bribes, exhibited through endogenously determined levels of the license fee and the associated delay, and entrepreneurial entry behaviour. The possibility that, after they have entered, first movers would bribe politicians to raise the license fee that other entrants would then have to pay, could also be examined.

References
Notes

1 Since the licenses are non-tradeable, the down-side of a speculative purchase is that the license will be unused. We do not consider tradeable licenses, which (in a model with heterogeneous entrepreneurs) might be purchased speculatively for potential later resale.

2 At any time $t$ there are more potential entrants than the market can sustain. The question therefore arises of how the entry of only some of these potential entrants is coordinated. We assume that there is some small exogenous asymmetry between potential entrants that allows entry to take place only up to the point at which the present value of the expected profit stream for the marginal entrant is zero. (It is not necessary to assume that entry up to this point is sequential; all that is required is that this present value condition holds. We speak in terms of sequential entry for expositional convenience.) An alternative approach would be to model a mixed-strategy equilibrium, but this would add complexity, and Levin and Peck (2003) have shown that this approach can generate some rather implausible results.

3 In this and the next section $k$ and $f$ play the same roles and so one could be excluded; but when we introduce delay in Section 4 the distinction between $k$ and $f$ becomes important.
4 A more general formulation would allow for the magnitude of the externality to second movers to depend on the number \( n_1 \) of first movers (as in Jovanovic and Lach, 1989).

5 If all firms find it unprofitable to enter at \( t = 1 \), there will be no realization of \( \theta \) and the industry will not be established.

6 The two assumptions are required for the number of first movers to be positive (otherwise there is no industry) and for the possibility that profitability can turn out sufficiently high for second movers to enter.

7 The arguments in this section are based on license delays when a positive fee exists. In the absence of a such fee all firms would procure a licence at \( t = 0 \) and we would effectively be back in the laissez-faire solution.

8 It is worth noting that there is no such scope for speculation in the first version of the model, where there is no delay between purchase of a license and entry. It would not be rational for a firm to speculate by purchasing a license at \( t = 1 \) because, instead, it can just wait to observe the realization of \( \theta \) between \( t = 1 \) and \( t = 2 \) and then, if \( \theta \) is sufficiently favourable, buy the license and produce immediately.

9 We might alternatively look for cases in which no speculation occurs as a corner solution to (23). However, since (25) is derived using the interior solution to (23), we would not then be able to use (25) and the derivation is more complicated. We can focus on the interior solution \( s_1 = 0 \) to (23) because it is only necessary to find an example in which there is no speculation, but positive late entry, to arrive at Proposition 2.

10 Of course, first movers also suffer, relative to others, from having to make up-front payments to enter an industry that may turn out unprofitable.

11 “The wide dispersion of productivity among businesses, the large number of unsustainable micro-enterprises and the stagnation of larger firms all suggest that the process of market selection and creative destruction...is weak in most developing countries” (World Bank, 2013, page 112).

12 Although our analysis suggests that entry rates might be lower in developing than developed economies because regulatory barriers are higher, the available suggests quite high rates of entry in developing economies (Roberts and Tybout, 1996; Campos and Estrin, 2008). This contradiction may be explained by this potential problem with the data.
Figure 1. Laissez Faire ($f = 0$)
Figure 2. A Positive License Fee
Figure 3. Speculation