Market Entry in Oligopolies under Uncertainty: Make or Buy?*

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Abstract

This paper extends the literature on market entry timing under uncertainty by accounting for the entrant's choice between a greenfield investment and an acquisition. We show that a large productivity advantage and high sunk costs favor acquisitions, whereas lower costs and moderate advantages make greenfield entry more appealing. Rising uncertainty delays both strategies but ultimately boosts the relative attractiveness of greenfield investments. We also highlight how market structure — specifically, the number of incumbents and the distribution of capital — alters the timing and viability of each entry mode.

Keywords: Market Entry; Competition; M&A; Real Options.
JEL codes: D43; D81; G31; G34

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1 Introduction

Mergers and acquisitions (M&A) have become defining features of modern markets, shaping industries through the consolidation of assets and competitive restructuring. A striking example is Facebook's acquisition of Instagram in 2012 for $1 billion. Though Instagram was relatively small at the time, the deal allowed Facebook to neutralize a prospective competitor in the social media space. Alike, biotech acquisitions such as AstraZeneca's $1.2 billion purchase of Gracell Biotechnologies highlight how large incumbents seek to secure emerging technologies and disrupt competitive landscapes. Finally, AI-driven acquisitions have surged lately as companies vie for dominance in this transformative field. A key example is Nvidia's acquisition of Israeli startup Habana Labs, a developer of AI inference processors, for $2 billion. These events raise fundamental questions about the circumstances under which firms opt to acquire competitors rather than engage in direct rivalry. As M&A activities have the potential to sustainably harm competition in particular innovative industries, understanding the driving forces are of central concern to researches, regulators and politicians alike.

To date, however, the question what determines the choice between organic growth and M&A has not yet generated a clear answer. The paper's motivation is to analyze the choice between the two pivotal modes by means of a dynamic industrial organization framework under uncertainty and will investigate how competition and uncertainty impact the decision to grow either internally or externally.

Over the years, empirical research has extensively investigated the factors influencing the choice between greenfield investment and M&A (e.g. Zejan, 1990; Hennart and Park, 1993; Anderson and Svensson, 1994; Brouthers and Brouthers, 2000, among others). However, a unified modeling framework that validates or contests these findings remains elusive. This gap is particularly evident in analyses of the choice between these two strategies under conditions of uncertainty and competition. Recently, the literature on investment under uncertainty has provided new perspectives on these issues, developing two distinct research streams.[1]

The first stream focuses on merger timing, examining bargaining processes under uncertainty between firms. These studies often disregard empirical evidence on the role of industry structure, emphasizing instead the dynamics of negotiation and the division of surplus during hostile takeovers or merger discussions. Key contributions in this area include e.g. Lambrecht (2004), Morellec and Zhdanov (2005), Lambrecht and Myers (2007), and Morellec and Schurhoff (2011) which primarily address how uncertainty affects takeover timing and surplus allocation. Alike, Alvarez and Stenbacka (2006), Hackbarth and Morellec (2008), and Lukas et al. (2019) contribute to the analysis subsequent growth option and serial acquisition while Thijssen (2008), Ebina et al. (2022) and Lukas et al. (2023)

[1] For a comprehensive overview on investment under uncertainty and real options (see e.g. Chevalier-Roignant et al., 2011; Huisman et al., 2004; Dixit and Pindyck, 1994; Huberts et al., 2015, among others).

analyzes the determinants that impact the choice between different forms of acquisitions.

The second stream examines greenfield investments, central to entry-timing models under competitive market conditions. This literature addresses whether competition accelerates market entry, how the threat of entry influences incumbents' strategic responses, and its role in fostering innovation. Notable studies include e.g. Huberts et al. (2015), Huisman and Kort (2015), Pawlina and Kort (2006), Armada et al. (2011), or Hagspiel et al. (2016).

The goal of this paper is to bridge these two streams of literature by incorporating the collectively held real option to merge into the dynamic entry timing literature under competition. Thus, the paper is closely related to a few recent works. Görg (2000) was among the first to address the choice between M&A and greenfield investment in a market entry context, showing that the firm's fixed costs of organic expansion are critical. As a result, M&A often emerges as the firm's preferred strategy due to higher immediate profits. Other studies examine the choice between these two strategies using real options frameworks. While Gilroy and Lukas (2006) mainly considers the timing decision and time-to-build aspects linked to greenfield investment, Margsiri et al. (2008) employs greenfield as a threat within the M&A negotiation process and explores its deterrent effect on M&A timing. However, Görg (2000) does not rigorously model the timing of M&A under uncertainty, and the latter two papers do not address the impact of competition.

Only recently has merger activity been studied within a real-options framework under competition. First, Bernile et al. (2012) examines how the threat of a potential entrant affects merger dynamics in an industry, showing that strategic considerations shape horizontal mergers. In particular, incumbents must balance the strategic benefit of increased market power against making entry more attractive. The authors conclude that horizontal mergers become more likely during periods of strong positive or negative demand shocks, since in those scenarios merger activity is less likely to spur new entry. By contrast, in periods of moderate growth or decline, incumbents may be better off not merging so as to delay outside entry. Second, Hackbarth and Miao (2012) analyzes merger dynamics in an oligopolistic industry using a real-options framework, allowing firm asymmetry and endogenous synergy gains arising from Cournot competition. The authors find that increased demand uncertainty and fiercer competition both delay merger activity, making mergers more likely in concentrated industries. Furthermore, higher dispersion in firm sizes stimulates more mergers. Third, Dimopoulos and Sacchetto (2017) studies how market entry shapes concentration trends in an industry. A foreign firm first installs capacity via greenfield investment, and subsequently may continue producing, join a merger contest, or exit. The findings show that M&A activity in the industry strongly stimulates new entry, raising productivity while inducing less productive incumbents to delay exit.

Although these studies offer valuable insights, they also have notable gaps. In particular, Hackbarth and Miao (2012) does not consider the threat of an entrant, whereas

Bernile et al. (2012) abstracts from the entrant's option to merge with an incumbent. Finally, in Dimopoulos and Sacchetto (2017), participating firms are chosen randomly, so entrants cannot directly choose with whom to merge, nor can they merge before entering the market by greenfield investment. Moreover, none of these studies includes alternative entry modes as a credible outside option within a bargaining process.

To address these limitations, we combine the main elements of the literature into a single model. We draw on the general Cournot-Nash equilibrium framework of Hackbarth and Miao (2012), while also allowing the entrant to choose whether to enter the market via greenfield investment (as in Bernile et al., 2012) or to acquire an incumbent by means of cooperative bargaining. Beyond that, our approach diverges from previous work in at least two ways. First, real options based industrial organization models of market entry usually assume that firms choose a perpetual quantity (i.e., capacity remains fixed if future conditions change). In our model, however, the firm can adjust its output to current conditions, which allows for more flexible production decisions. Second, while we let a firm choose between two entry modes, we also allow that firm to wield alternative options when bargaining over an acquisition. The entrant's default threat is to conduct greenfield investment if negotiations break down. Although this setup reflects plausible managerial actions, it has not yet been explored in the literature.

Our analysis shows that greenfield investment is favored when the entrant's sunk costs are relatively low or when its productivity advantage is only moderate, allowing it to compete effectively without acquiring an incumbent. By contrast, acquisitions become the dominant entry mode if the entrant's productivity advantage is sufficiently large or if the costs of building capacity from scratch are high. Under increasing uncertainty, both entry modes are delayed, yet greenfield eventually becomes more attractive. Finally, altering the market competitive structure — whether by increasing the number of incumbent firms or spreading capital among more competitors — affects both the timing and the relative attractiveness of each entry mode, highlighting the central role of market structure in strategic decision-making. Depending on how competition is defined, a more competitive environment may either accelerate or deter entry, thereby favoring one strategy over the other.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 provides a comparative statics analysis of the main results. Finally, Section 4 concludes and outlines avenues for future research.

2 Model

Our model is based on Hackbarth and Miao (2012). Consider an industry with $N \geqslant 2$ firms producing a homogeneous good, where each firm owns a capital stock $k_i > 0$. Let the industry's aggregate capital stock be $\sum_{i=1}^{N} k_i = K$. The industry's inverse demand at time t is

$$P(t) = aY(t) - bQ(t), \tag{1}$$

where $Y(t)$ is an industry-wide demand shock affecting all firms, $Q(t)$ is total output in the industry, and a and b are positive constants. We assume $Y(t)$ follows a geometric Brownian motion:

$$dY(t) = \alpha Y(t)\,dt + \sigma Y(t)\,dW(t), \quad Y(0) = y, \tag{2}$$

where $W(t \geqslant 0)$ is a standard Brownian motion, α is the risk-neutral drift, r is the risk-free interest rate, and σ the volatility. To ensure meaningful solutions, $2\alpha + \sigma^2 < r$. For simplicity, we omit the time index (t) hereafter.

Each firm i incurs costs according to

$$C_i(q_i, k_i) = \tfrac{1}{2}\frac{{q_i}^2}{k_i}, \tag{3}$$

implying that both average and marginal costs decrease with a larger capital stock.[2]

For tractability, assume the industry consists of N identical firms, each with capital k, and one entrant with capital λk. Under these conditions, the industry equilibrium follows Hackbarth and Miao (2012):

$$q_i^*(N, k, \lambda) = \frac{\theta(k, 1)}{1 + B(N, k, \lambda)}\frac{a}{b}Y \tag{4}$$

$$q_e^*(N, k, \lambda) = \frac{\theta(k, \lambda)}{1 + B(N, k, \lambda)}\frac{a}{b}Y \tag{5}$$

where $\theta(k, \lambda) = \frac{b}{b+(\lambda k)^{-1}}$ and $B(N, k, \lambda) = N\,\theta(k, 1) + \theta(k, \lambda)$. $q_i^*(N, k, 0)$ and $q_i^*(N, k, \lambda)$ represent the output of each of the N incumbent identical firms, respectively before and after entry, and $q_e^*(N, k, \lambda)$ represents the entrant's output. The total industry output is:

$$Q^*(N, k, \lambda) = \frac{B(N, k, \lambda)}{1 + B(N, k, \lambda)}\frac{a}{b}Y, \tag{6}$$

for a market price given by:

$$P^*(N, k, \lambda) = \frac{a}{1 + B(N, k, \lambda)}Y. \tag{7}$$

$Q^*(N, k, 0)$ and $P^*(N, k, 0)$ are the output and price before entry.

[2] As Hackbarth and Miao (2012) note, this can result from a Cobb–Douglas production function with output elasticities of 0.5, i.e. $q_i = \sqrt{k_i l_i}$, where l_i is the labor input.

Instantaneous profits for the incumbents and the entrant are respectively:

$$\pi_i^*(N,k,\lambda) = \phi_i(N,k,\lambda)Y^2 \tag{8}$$
$$\pi_e^*(N,k,\lambda) = \phi_e(N,k,\lambda)Y^2 \tag{9}$$

where

$$\phi_i(N,k,\lambda) = \left(b + \frac{1}{2}k^{-1}\right)\left(\frac{\theta(k,1)}{1+B(N,k,\lambda)}\frac{a}{b}\right)^2 \tag{10}$$
$$\phi_e(N,k,\lambda) = \left(b + \frac{1}{2}(\lambda k)^{-1}\right)\left(\frac{\theta(k,\lambda)}{1+B(N,k,\lambda)}\frac{a}{b}\right)^2 \tag{11}$$

with $\pi_i^*(N,k,0)$ being yhe profit of the incumbent firms before entry.

Suppose N incumbent firms face the threat of a new firm entering by either a *greenfield* investment or by *acquiring* an incumbent. We assume that mergers among incumbents are ruled out by antitrust constraints.

2.1 Greenfield investment

Assume the entrant e has a more productive capital stock, $\lambda > 1$, that is,

$$C_e(q_e,k) = \frac{1}{2}\frac{{q_e}^2}{\lambda k} \tag{12}$$

yielding a cost advantage over incumbents.

After entry, the incumbents' and entrant's instantaneous profits become

$$\pi_i^g(N,k,\lambda) = \phi_i(N,k,\lambda)\,Y^2 \;=\; \phi_i^g\,Y^2, \tag{13}$$
$$\pi_e^g(N,k,\lambda) = \phi_e(N,k,\lambda)\,Y^2 \;=\; \phi_e^g\,Y^2, \tag{14}$$

respectively, where the greenfield investment requires a sunk cost $\delta^g\lambda k$, with δ^g the per-unit of capital entry cost, which increases with λ.

Greenfield investment is analogous to a call option that the entrant exercises once Y reaches a threshold. The value and threshold come from standard value-matching and smooth-pasting conditions.[3]

Proposition 1. *In the case of greenfield investment, the entrant's optimal strategy is to invest at the threshold*

$$Y^g = \left(\frac{\beta_1}{\beta_1 - 2}\frac{r-(2\alpha+\sigma^2)}{\phi_e^g}\delta^g\lambda k\right)^{1/2} \tag{15}$$

[3]See Dixit and Pindyck (1994) for an overview.

where

$$\beta_1 = \frac{1}{2} - \frac{\alpha}{\sigma^2} + \left(\left(-\frac{1}{2} + \frac{\alpha}{\sigma^2} \right)^2 + \frac{2r}{\sigma^2} \right)^{1/2} \quad > \; 2 \tag{16}$$

The value of the greenfield investment strategy for the entrant is

$$F_e^g(Y) = \begin{cases} \left(\phi_e^g \dfrac{(Y^g)^2}{r - (2\alpha + \sigma^2)} - \delta^g \lambda k \right) \left(\dfrac{Y}{Y^g} \right)^{\beta_1} & Y < Y^g \\ \phi_e^g \dfrac{Y^2}{r - (2\alpha + \sigma^2)} - \delta^g \lambda k & Y \geqslant Y^g \end{cases} \tag{17}$$

For $Y < Y^g$, the entrant waits and holds the option; once Y crosses Y^g, the entrant immediately invests and earns the net payoff.

From the incumbents' perspective, profit before entry is

$$\pi_o(N,k) = \phi_i(N,k,0)Y^2 = \phi_o Y^2, \tag{18}$$

which drops to $\phi_i^g Y^2$ once the new firm enters (Equations 13 and 18).

Proposition 2. *The value of an incumbent facing the threat of greenfield entry is*

$$F_i^g(Y) = \begin{cases} \phi_o \dfrac{Y^2}{r - (2\alpha + \sigma^2)} + (\phi_i^g - \phi_o) \dfrac{(Y^g)^2}{r - (2\alpha + \sigma^2)} \left(\dfrac{Y}{Y^g} \right)^{\beta_1} & Y < Y^g \\ \phi_i^g \dfrac{Y^2}{r - (2\alpha + \sigma^2)} & Y \geqslant Y^g \end{cases} \tag{19}$$

Here, the first term in the upper branch is the *status-quo* value, and the second term is the expected loss from new entry once $Y = Y^g$ (note that $\phi_i^g - \phi_o < 0$).

2.2 Acquisition of one incumbent firm

We now consider an alternative strategy: acquiring one incumbent. For simplicity, assume incumbents are passive and, because they are identical, the entrant chooses among them randomly.

We treat acquisitions as cooperative deals, where two firms negotiate both the premium and timing.[4] Importantly, greenfield investment serves as a credible outside option in case negotiations fail.

Because the entrant is more productive ($\lambda > 1$), it transfers this efficiency gain to the acquired incumbent, turning its capital into λk and thereby reducing production costs. After acquisition, the instantaneous profits for the acquired firm and each remaining in-

[4]A non-cooperative approach is also possible but typically yields time inefficiencies in reaching an agreement (Lukas and Welling, 2012).

cumbent are

$$\pi_e^a(N,k,\lambda) = \phi_e(N-1,k,\lambda)\,Y^2 \;=\; \phi_e^a\,Y^2, \tag{20}$$
$$\pi_i^a(N,k,\lambda) = \phi_i(N-1,k,\lambda)\,Y^2 \;=\; \phi_i^a\,Y^2, \tag{21}$$

respectively. The entrant must invest $\delta^a\lambda k$, with $\delta^a < \delta^g$.

The acquisition surplus is shared via an asymmetric Nash bargaining problem:

$$\sup_P \left[(V_a(Y) - P - \delta^a\lambda k - F_e^g(Y))^\eta \, (P - F_i^g(Y))^{1-\eta} \right], \tag{22}$$

where η is the entrant's bargaining power, $V_a(Y) = \frac{\phi_e^a Y^2}{r-(2\alpha+\sigma^2)}$ is the acquired incumbent's value to the entrant, net of the premium P and the investment cost, minus the entrant's outside option $F_e^g(Y)$; the target's payoff is P minus its outside option $F_i^g(Y)$.

Proposition 3. *When the entrant enters by acquiring an incumbent, the equilibrium deal price is:*

$$P^*(Y) = F_e^g(Y) + \eta S(Y) \tag{23}$$

where

$$\begin{aligned} S(Y) &= V_a(Y) - (F_i^g(Y) + F_e^g(Y)) - \delta^a\lambda k \\ &= \begin{cases} (\phi_e^a - \phi_o)\dfrac{Y^2}{r-(2\alpha+\sigma^2)} - \delta^a\lambda k \\ \qquad - \left[(\phi_e^g + \phi_i^g - \phi_o)\dfrac{(Y^g)^2}{r-(2\alpha+\sigma^2)} - \delta^g\lambda k \right] \left(\dfrac{Y}{Y^g}\right)^{\beta_1} & Y < Y^g \\ (\phi_e^a - \phi_e^g - \phi_i^g)\dfrac{Y^2}{r-(2\alpha+\sigma^2)} - (\delta^a - \delta^g)\lambda k & Y \geqslant Y^g \end{cases} \end{aligned} \tag{24}$$

and the agreement on $P^*(Y)$ implies the acquisition threshold:

$$Y^a = \left(\frac{\beta_1}{\beta_1 - 2} \frac{r-(2\alpha+\sigma^2)}{\phi_e^a - \phi_o} \delta^a\lambda k \right)^{1/2} \tag{25}$$

The target's value is

$$F_i^a(Y) = \begin{cases} F_i^g(Y) + (1-\eta)S(Y^a)\left(\dfrac{Y}{Y^a}\right)^{\beta_1} & Y < Y^a \\ F_i^g(Y) + (1-\eta)S(Y) & Y \geqslant Y^a \end{cases} \tag{26}$$

and the entrant's value is

$$F_e^a(Y) = \begin{cases} F_e^g(Y) + \eta S(Y^a)\left(\dfrac{Y}{Y^a}\right)^{\beta_1} & Y < Y^a \\[2ex] F_e^g(Y) + \eta S(Y) & Y \geqslant Y^a \end{cases} \tag{27}$$

For Y^a to be finite, $\phi_e^a > \phi_o$ (i.e., $\lambda > 1$), ensuring synergy is produced via acquisition.

2.3 Free-riding

When $N \geqslant 2$ incumbents are present, they might prefer to be acquired or to free-ride on another firm being acquired. With symmetric incumbents,

Proposition 4. *Symmetric firms prefer free-riding to a greenfield investment.*

A potential target must balance any benefits of being acquired against free-riding on another firm's acquisition attempt — unless greenfield investment yields a larger payoff. If the entrant's bargaining power (η) is very low and λ very large, symmetric firms prefer being acquired. If η and λ are both very high, incumbents might compete for being acquired, but that erodes their bargaining power, so they choose to free-ride instead.

Proposition 5. *Symmetric firms prefer free-riding to being acquired.*

Thus, each incumbent firm prefers to see another firm get acquired, leading to potential circularity in outside options, If we model the scenario as a sequential negotiation game with no negotiation costs, the entrant may eventually acquire the last firm only, when greenfield is the sole credible threat:

Proposition 6. *The only viable acquisition is of the last target N, once no other targets remain.*

2.4 Optimal entry strategy

The choice between greenfield and acquisition depends on their relative values. Acquisition is cooperative, so it must generate a positive surplus $S(Y^a)$ for both the entrant and the target, where the relevant threshold is Y^a. This comparison also depends on Y^g (Equation 15).

The acquisition occurs earlier than greenfield ($Y^a < Y^g$) if

$$\delta^g > \delta^t = \frac{\phi_e^g}{\phi_e^a - \phi_o}\delta^a \tag{28}$$

and the surplus $S(Y^a)$ (first branch of Equation 24) must be positive, implying $\delta^g > \delta^{va}$, where δ^{va} solves

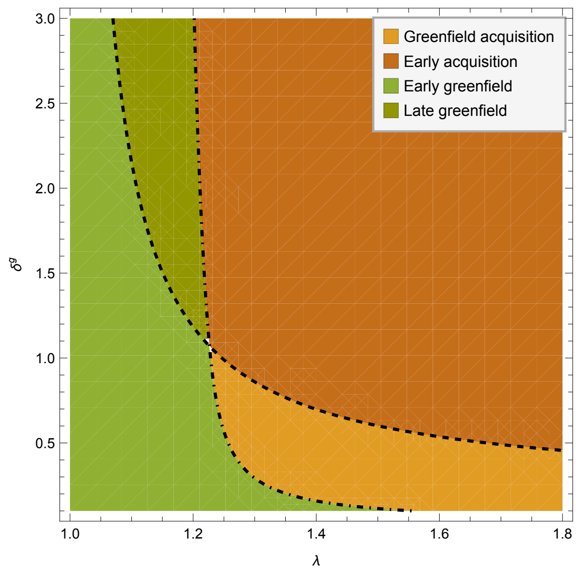
$$(\phi_e^a - \phi_o)\frac{(Y^a)^2}{r-(2\alpha+\sigma^2)} - \delta^a\lambda k - \left[(\phi_e^g + \phi_i^g - \phi_o)\frac{(Y^g)^2}{r-(2\alpha+\sigma^2)} - \delta^{va}\lambda k\right]\left(\frac{Y^a}{Y^g}\right)^{\beta_1} = 0 \tag{29}$$

Proposition 7. *An* ***early acquisition*** *occurs if* $\delta^g > \max(\delta^t, \delta^{va})$. *A* ***late greenfield*** *arises if* $\delta^{va} > \delta^g > \delta^t$.

When $Y^g < Y^a$, it can be shown that the acquisition is optimally anticipated to Y^g, and the decision depends on $S(Y^g)$ (second branch of Equation 24), which is positive if

$$\delta^g > \delta^{vg} = \frac{(\beta_1 - 2)\phi_e^g}{\beta_1(\phi_e^a - \phi_i^g - \phi_e^g) + (\beta_1 - 2)\phi_e^g}\delta^a \tag{30}$$

Proposition 8. *A* ***greenfield (timed) acquisition*** *arises if* $\delta^t > \delta^g > \delta^{vg}$. *An* ***early greenfield*** *occurs if* $\delta^g < \min(\delta^t, \delta^{vg})$.



Parameter values as in Table 1.

Figure 1: Entry strategies

Figure 1 shows how these four strategies arise for combinations of λ and δ^g when $N = 1$. Acquisitions become more likely when the productivity advantage (λ) is larger and the cost of greenfield entry (δ^g) is higher. As δ^g approaches δ^a, the model becomes more sensitive to differences in cost and synergy, so a higher λ is needed for acquisitions to prevail. Above a certain λ, a greenfield strategy is no longer optimal when $\delta^g > \delta^a$.

3 Comparative statics

Equipped with the condition governing the choice between the two strategies ($S(\tilde{Y}^a)$ from Equation 24), alongside Y^g (Equation 15) and the fact that the acquisition threshold is given by $\tilde{Y}^a = \min(Y^a, Y^g)$ (where Y^a is in Equation 25), we now conduct a comparative statics analysis. The base-case parameter values are shown in Table 1.

Table 1: The base-case parameter values.

Parameter	Description	Value
σ	Volatility	0.15
r	Risk-free interest rate	0.06
α	Risk-neutral drift rate	0.05
a	Origin of the linear demand function	2
b	Slope of the linear demand function	1.3
δ^a	Unit acquisition cost	0.1
δ^g	Unit greenfield investment cost	1
k	Firms' capital stock	1
λ	Productivity shock factor	1.3
η	Entrant bargaining power	$\lambda k/(k+\lambda k) = 1.3/2.3$

3.1 The effect of the productivity shock and greenfield entry cost

Figure 1 above shows how different combinations of the productivity shock and greenfield entry cost determine the entry strategies. Additionally, we can state the following:

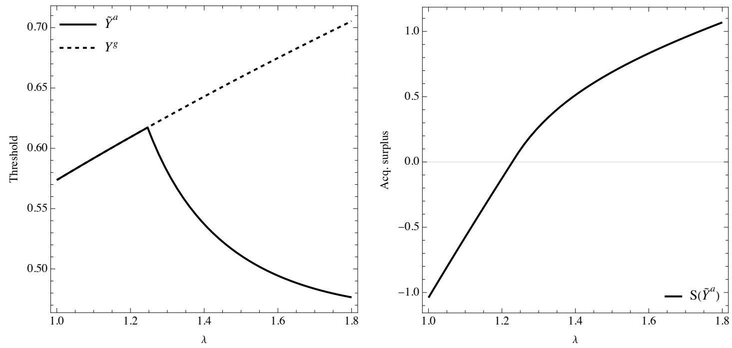
Proposition 9. *A higher productivity shock λ deters greenfield investments ($\partial Y^g/\partial\lambda > 0$), accelerates early acquisitions ($\partial Y^a/\partial\lambda < 0$), and promotes acquisitions.*

Proposition 10. *A higher greenfield entry unit cost δ^g deters greenfield investments ($\partial Y^g/\partial\lambda$) and promotes acquisitions.*

Both the productivity shock and the greenfield entry cost affect the total investment cost of greenfield expansion, explaining the deterrent effect on entry (Figures 2(a) and 3(a)). In both cases, a higher value enlarges the wedge between the two entry thresholds. When acquisition is timed by the greenfield investment ($\tilde{Y}^a = Y^g$) and it is not too early, it provides higher value (Figures 2(b) and 3(b)). However, if greenfield entry occurs early enough, it may be the preferred strategy because its cost is closer to the acquisition cost and, in that scenario, the entrant's cost advantage is smaller.

3.2 The effect of uncertainty

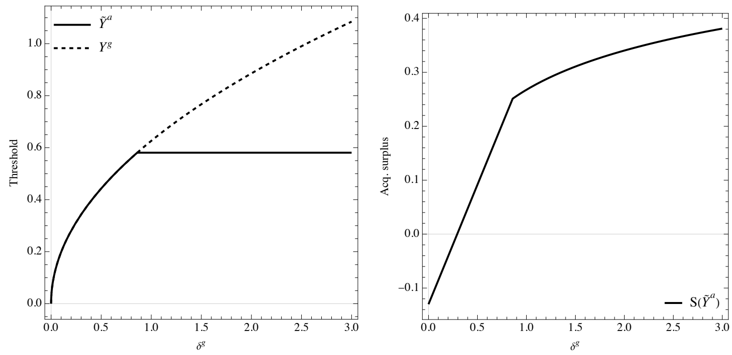
Uncertainty typically deters the exercise of real options such as those in this model. We are also interested in how it affects the entry strategy and surplus.



(a) Thresholds (b) Acq. surplus

Parameter values as in Table 1.

Figure 2: The effect of the productivity shock (λ)



(a) Thresholds (b) Acq. surplus

Parameter values as in Table 1.

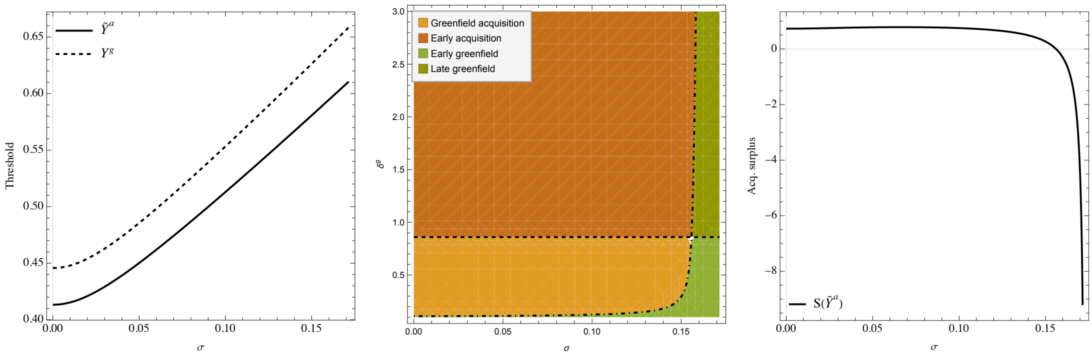
Figure 3: The effect of the greenfield unit entry cost (δ^g)

Proposition 11. *A higher market uncertainty deters entry ($\partial Y^a/\partial\sigma > 0$, $\partial Y^g/\partial\sigma > 0$) and promotes greenfield investments.*

Figure 4(a) shows the effect on the thresholds. By discouraging both strategies, higher uncertainty has a non-monotonic impact on the advantage of acquisition: it initially increases but eventually becomes negative (Figure 4(c)), making greenfield entry more appealing (Figure 4(b)).

3.3 The effect of competition

The impact of competition depends on how it is defined. If competition implies a market with more symmetric firms, leading to an increase in the industry's total capital stock ($K = Nk$), then the same demand is shared among more firms of identical size. Because competition reduces individual firms' output, the following proposition describes the effect



(a) Thresholds (b) Strategies (c) Acq. surplus

Figure 4: The effect of uncertainty (σ)

on entry timing and strategy:

Proposition 12. *A more competitive market, comprised of a larger number (N) of symmetric incumbent firms, deters market entry ($\partial Y^a/\partial N > 0$, $\partial Y^g/\partial N > 0$) and promotes greenfield investments ($\partial S(Y^a)/\partial N < 0$).*

Figure 5 illustrates the above proposition. When the productivity shock is small ($\lambda = 1.3$), acquiring an incumbent is only attractive if the industry is a monopoly ($N = 1$), and it may not be appealing for an even smaller λ or a higher greenfield entry cost δ_g (Figure 5(c)). For a larger λ, acquisition is preferred up to $N = 3$ (Figure 5(d)). This partially reflects the wider gap between the two thresholds (Figure 5(b)).

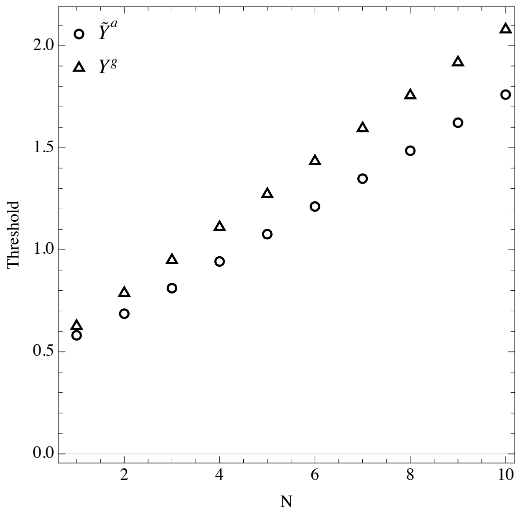
However, if we compare two markets with the same total stock of capital but differing numbers of incumbent firms, we see completely different results:

Proposition 13. *A more competitive market, comprised of a larger number (N) of symmetric firms but with the same total stock of capital, accelerates market entry ($\partial Y^a/\partial N < 0$, $\partial Y^g/\partial N < 0$) and has a non-monotonic effect on the entry strategy: for smaller N, greenfield investment may be chosen, whereas for larger N, acquisition becomes the choice, albeit with diminishing attractiveness.*

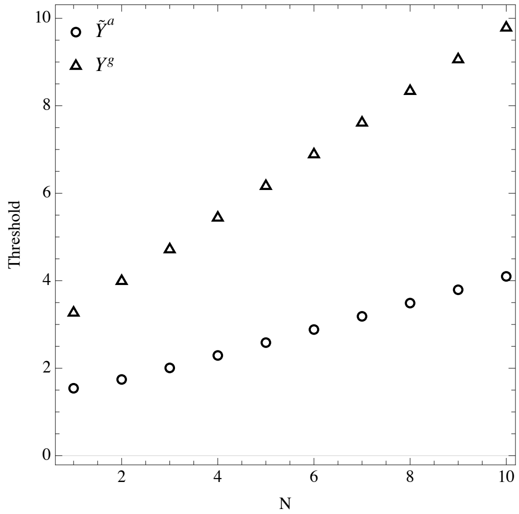
Figure 6 illustrates this point. In the left panel, when $N = 1$ (Figure 6(c)), greenfield investment is chosen. In that case, the alternative acquisition is timed by the greenfield entry, i.e., $\tilde{Y}^a = Y^g$ (Figure 6(a)). As N increases, the acquisition surplus declines, yet acquisition still prevails over greenfield (Figures 6(c) and 6(d)).

4 Conclusion

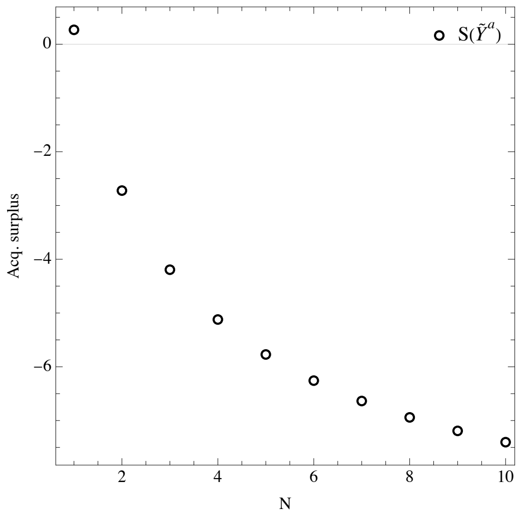
This paper studies the choice between greenfield investment and M&A as alternative entry modes under uncertainty and competition. By building on a real options framework, it



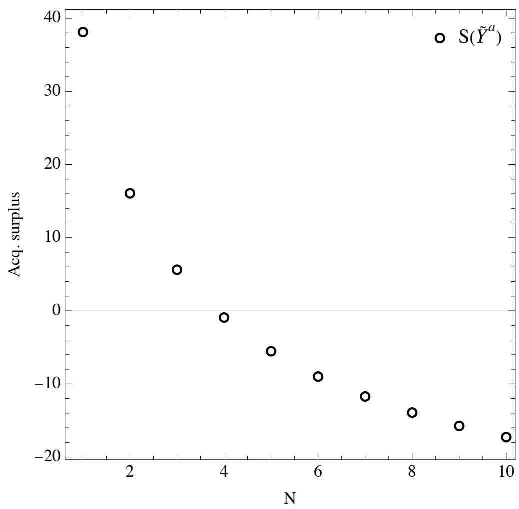
(a) Thresholds ($\lambda = 1.3$)



(b) Thresholds ($\lambda = 50$)



(c) Acq. surplus ($\lambda = 1.3$)

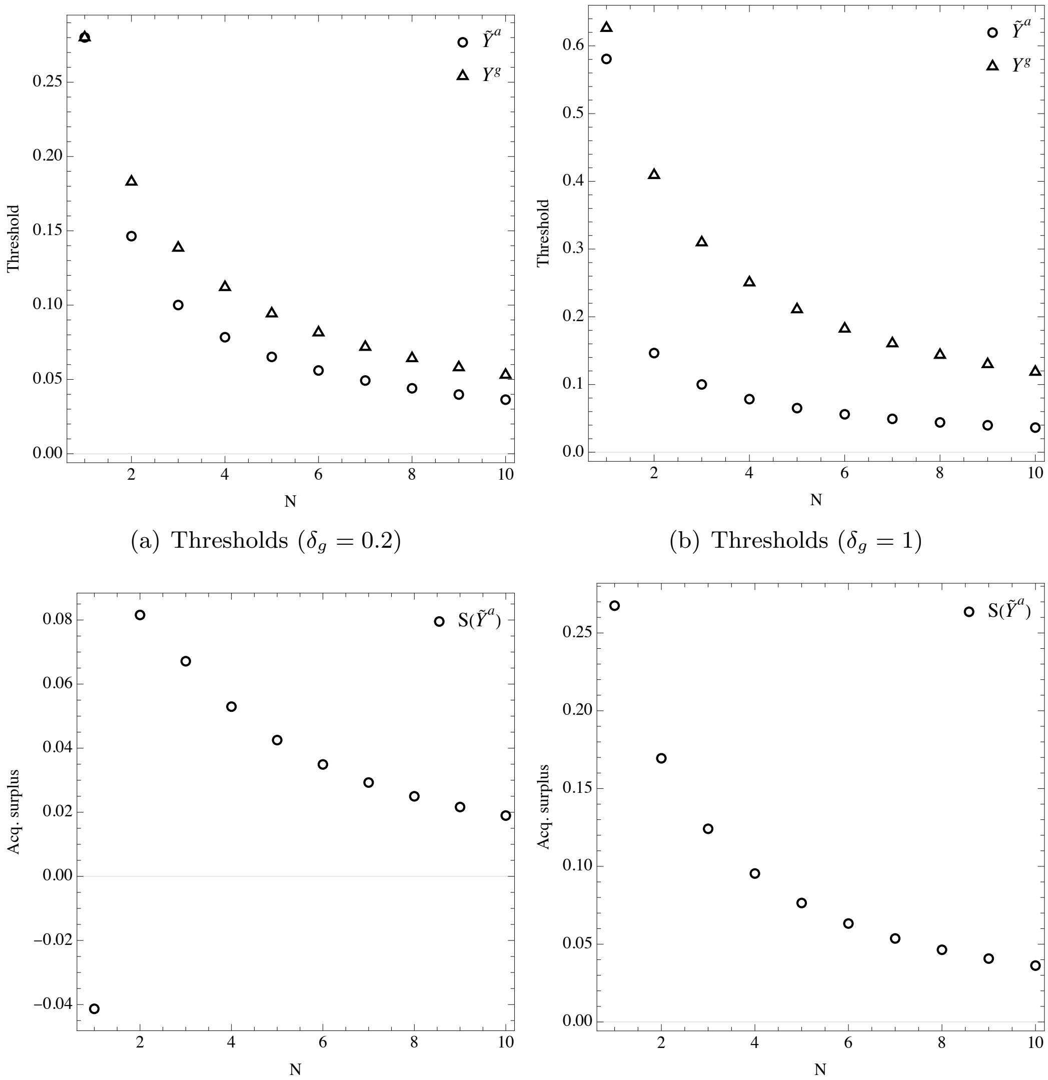


(d) Acq. surplus ($\lambda = 50$)

Figure 5: The effect of N with increasing total stock of capital

shows how the timing of these strategic choices depends on core parameters such as the entrant's productivity advantage, the sunk costs associated with greenfield entry, and the structure of the incumbent market. When the productivity shock is sufficiently large or greenfield costs are comparatively high, acquisition emerges as the dominant strategy. Conversely, if greenfield investment can be undertaken early because of a relatively low cost, it is often preferred, despite the initial competitive disadvantage of building capacity from scratch.

We also find that heightened uncertainty tends to deter entry overall but eventually favors greenfield investments over acquisitions. Furthermore, the changing the competitive



(a) Thresholds ($\delta_g = 0.2$)
(b) Thresholds ($\delta_g = 1$)
(c) Acq. surplus ($\delta_g = 0.2$)
(d) Acq. surplus ($\delta_g = 1$)

Figure 6: The effect of N with fixed total stock of capital

structure of the market, increasing the number of incumbent firms or distributing capital among a larger group of competitors alters both the timing and the attractiveness of each entry mode, underscoring the importance of market structure in strategic decision-making. Depending on how competition is defined, a more competitive market may accelerate our deter market entry and favor one of the strategies.

Future research might incorporate asymmetry of incumbents, search costs incurred by the entrant when finding a target, and strategic behavior of the incumbents, both pre- and post-entry.

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Appendices

A Proofs

TO BE ADDED.