THE CAUSES AND CONSEQUENCES OF OVER ENTRY: MODELING AND EMPIRICAL TESTING

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93-04-01

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This working paper reproduces in its entirety a dissertation of the same title presented to the Graduate Faculties of the University of Pennsylvania in partial fulfillment of the requirements for the Degree of Doctor of Philosophy

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A DISSERTATION
in
Decision Sciences

for the Graduate Group in Managerial Science
and Applied Economics

Presented to the Faculties of the University of Pennsylvania in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

1993

Supervisor of Dissertation

Graduate Group Chairperson

ABSTRACT

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In many industries, there is a repeated tendency for over entry (over building) which ultimately leads to some industry shakeout (exit). In some large fixed costs industries, shakeout is too costly leading some incumbent firms to "wait" for industry demand to increase as the entry rate of new firms subsides. The particular focus of this study will be explaining the causes and results of over entry brought about by an announced positive demand shock (a new development in the market that increases demand) in an industry that is otherwise characterized by relatively constant demand growth. Models are developed to describe over entry both as the result of demand uncertainty and firm behavior. To accomplish this, some concepts from the Industrial Organization and Strategic Management literature with some of the more behavioral (Decision Processes) literature are combined. These theoretical models were tested on data from the hotel markets of Philadelphia, Atlantic City, and Orlando.

Table of Contents

List of Figures

I. Introduction

In many industries, there is a repeated tendency for over entry (over building) which ultimately leads to some industry shakeout (exit).[1] These industries have at one time included hotels, restaurants, toys, beef and fishing (see Kilman; 1991 and Ingrassia; 1991 for examples of these situations).

Over entry is defined for the remainder of this work as a firm entering an industry where it loses money. Over entry will then lead to either shakeout or the sustaining of short-term losses. Firms in large fixed costs industries will find short-term losses (while demand increases to the supply) a less costly option than exit when faced with being an incumbent in an over entered industry. Previous studies (to be discussed later) have described other types of situations including over expansion and declining demand leading to shakeout, but this should be the first study explaining the causes and effects of over entry.

The particular focus of this study is to explain over entry and its consequences brought about by an announced positive demand shock (a new development in the market that increases demand) in an industry that otherwise sees relatively constant (increasing at a small percentage each

[1]In industries with large fixed costs or little salvage value, over entry may only lead to the sustaining of short term losses.

year) demand growth. These demand shocks could include new laws, change in weather and inventions.[2] As shown in Capone and Capone (1992), over entry is caused by both a smaller than expected realized demand and the seemingly irrational behavior of firms.

These theoretical models combine concepts from the Industrial Organization and Strategic Management literature with some of the more behavioral (Decision Processes) literature. This study of over entry and its results *does not include industries with a declining demand nor industries characterized by the over expansion of incumbents.* The only interest of this research is over supply caused exclusively by the entry process.

Specifically, two separate explanations are modelled and empirically tested using data from the hotel industries of Philadelphia (1983-1992), the Walt Disney World area of Orlando, Florida (1965-1992), and Atlantic City, New Jersey (1968-1992). These theoretical explanations each assume different levels of decision maker sophistication. By varying the sophistication of the decision makers, this work can appeal to many different fields with different assumptions about decision makers.[3]

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[2]In the hotel markets studied in this paper, the shocks are a new Convention Center, the legalization of gambling, and the building of a new amusement park.

[3]Including theoretical economics and psychology.

Economically rational decision makers are defined as those who understand the problem they face and the effect their actions will have on the industry. Myopic decision makers correctly understand their decision task, but they do not correctly infer (if they infer at all) the effects of their actions on the industry in the future. Behavioral fallacies including an overconfidence bias (Ross and Sicoly; 1979) and anchoring and adjustment (Slovic and Lichtenstein; 1971) force decision makers to incorrectly evaluate even the myopic problem they face.

Industries other than hotels had been considered for this study and may be tested in later work, but the hotel industry has consistently over built in the United States and featured other points that makes it nearly practical for study. These reasons include data being available and demand for hotel rooms experiencing relatively steady growth. Because of the high fixed costs in this industry, this industry should experience, not exit, as a result of over entry. In fact, the data (and data from other over built cities like New Orleans and Houston) shows very little exit. Hotels change owners and file for bankruptcy, but only decreasing the supply of hotels on the market will be considered exit.

The models consider quantity (hotel size) and entry timings as the only strategic variables from which the firms make decisions. Many theoretical models consider price as a strategic variable. In fact, some economists consider price the only rational variable on which firms can actually compete. The hotel industry is difficult to get accurate prices, as different prices are quoted to businessmen, groups and conventioneers.

This study aims at explaining unprofitable entry. In a world of identical firms and *perfect information* among both firms and customers, one will never see this irrationality (over entry) even in response to a demand shock.

Firms with different efficiencies change this problem drastically. Intuitively, the more efficient (lower costs, better sales, etc.) firms can enter a saturated market because they know that they will eventually force out the less efficient firms. In this type of situation, the industry can only stabilize when each of the industry incumbents is at least as efficient as each of the potential entrants.

Similarly, in an industry with firms of different efficiency levels, the more efficient firms can expand (increase capacity) to force the less efficient firms from the industry. In this case, the less efficient types can also expand, but the more efficient firms will be able to *survive longer*. Games similar to this have been termed the War of Attrition (Maynard Smith; 1974). In the original model, two firms would stay in an industry that could only support one until one of the firms died.

If one does not allow myopia into the definition of rationality, it is still possible to get industry irrationality, but a different story needs to be told. One story could be a coordination failure. Experimenters and theorists (see Farrell and Saloner; 1985) have looked at problems of coordination. The firms' coordination problem is that many potential entrants want to enter a (expand) market that can only support a few.

Although the long entry process should make coordination easier in real industries, coordination failures for entrants have been seen in the hotel industry. In George Overstreet's (1989 a,b) study of the Charlottesville, Virginia, hotel market in the 1980s, two hotels began plans to build when most industry consultants (and the hotel builders) knew that Charlottesville could only support one more. Eventually both hotels opened, struggled and went through bankruptcy proceedings.[4]

Imperfect and asymmetric information about demand can also lead to irrational results for the industry as a whole. If firms have no correct way to compare their information with others, firms with high demand estimates (above the actual demand) will either enter or increase their capacity in a saturated market. Once again, these firms would be acting "rationally" as far as they knew, but their actions would not have been rational if they had access to perfect information.

Identical firms with perfect information always rationally stabilize an industry at the competitive equilibrium level in a price (Bertrand) game. In these situations, no firm is losing money nor gaining excess profits (most economic models account for operating profits of about 7%). In this game, the entire demand (or at least the firm's capacity) is given to the firm

[4]The Charlottesville hotel market is still very much over built.

with the lowest price before the remainder of industry demand is delegated.[5]

In a quantity setting game, there is room for positive profits with individually rational behavior. It will always be the case that the quantity setting (Cournot) price will be between the monopoly and competitive price. As in many industries, the individually irrational strategy of both players colluding will be preferred by both (collectively rational) to both being rational (collectively irrational) and acting non-cooperatively. The problem with collective rationality (that is individually irrational) is that each firm has an incentive to deviate from this strategy.

The only way to avoid this problem is by trust or using punishment for non-cooperation. Trust is possible in certain situations, but rarely with business competitors. There have been cases where this trust has worked in the business world; notably among the railroad barons of the late nineteenth century in the United States. Experimental economists have seen subjects play cooperatively more often when playing against friends than against someone anonymous. Trust, however, is not something considered by a rational economic actor when competing against other rational actors.

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[5]The equilibrium sees the lowest priced firm(s) taking (sharing) the entire market.

A cooperative outcome can be sustained if a game is repeated infinitely (a supergame) and the players adopt a strong enough punishment strategy for deviating. Examples of punishment strategies are to play non-cooperatively forever or only in the following period (tit-for-tat).

In any finite repetition of this game, punishments should not work because in the last game both firms will act non-cooperatively. By backwards induction one can see that in the penultimate game, both firms realize no punishment can follow, so they both play non-cooperatively. This reasoning can continue all of the way back to the first game.

Industry can be thought of as a repeated game with an uncertain length. That is, firms in the same industry will usually compete for many years and may realize that it is mutually beneficial not to act so aggressively (price low or expand). These firms can act non-aggressively with or without communicating explicitly. Communication allows the threats of punishment to be stated and usually these meetings help to establish trust. With perfect trust, the firms can collectively act as a monopoly and divide the monopoly profits or discuss "exclusive" territories where single firms can act monopolistically. Communication can also aid in entry deterring strategies as Torres (1983) showed in a study of independent funeral homes banning together to keep out national funeral chains. Legislation (most notably the Sherman Anti-trust act of 1890) has been aimed at breaking up this type of communication and other collusive behavior.

Firms can establish trust by other methods including infiltrating their rivals with their "own people". Large American companies practiced this during the late 1800s. Without signing contracts or having strong enough punishment strategies, these communications (cheap talk) are non-credible. Communication can serve as a signal to the other firms of one firm's intentions, but no firm is legally bound to follow this type of signal. Although these signals are not always valid, they can give the other players (firms) a positive probability estimate of one's "trustworthiness". In some situations, only a small probability of trust is needed to sustain collectively rational (collusive) outcomes.

The remainder of this thesis describes individual behavior (both rational and irrational) leading to a state of collective irrationality (over entry).[6] As a best case scenario, this research describes over entry accurately in industries. If this happens, managers in the typically over entered industries can use these models (and implied strategies) as a basis for deciding both when to enter (exit) and at what size. Realistically, this research should provide models of market behavior that (theoretically) explain a previously unexplained phenomenon in the academic literature.

[6]Over entry is ex-post both individually and collectively irrational.

II. Literature Review

II.1 Relationship Between the Literature

This study's main concern is with the Industrial Organization (also referred to as neoclassical) and the Organizational Ecology literature. Although the two schools are quite distinct, similarities do exist. Organizational Ecologists attempt to explain how social conditions affect both the entry and exit rates within an industry, the entry and exit rates of new industries, the results of new technologies, and the rate at which industries change form. Also of importance to ecologists are the dynamics of change within industries. The results of ecological models are probabilistic while those of the neoclassical models are deterministic.

The neoclassical school assumes that all firm behavior can be explained by competitive profit seeking which will eventually drive down rents (profits) to normal levels. Ecologists still debate the degree to which organizations either affect or respond to their environments (McKelvey; 1982), while there is nothing in neoclassical theory suggesting that organizations can exert any control over their environment (Robins; 1985). The focus of neoclassical research, unlike organizational ecology, has almost exclusively been theoretical, with little regard for empirical work.

It is easier to compare the two fields by their two basic elements. The neoclassical school defines efficiency as the satisfaction of demand and treats demand as exogenous to the model. Combined with these two ideas, the principle of competition for profits will produce a solution (equilibrium) to the problem prescribed by theorists. Organizational Ecologists consider both natural selection and resource scarcity. By considering the inertia of firms, ecologists can predict entry and exit.[7]

The remainder of this comparison will first describe a brief history of both the neoclassical and organizational ecology school, then some differences between the two schools concerning entry, expansion and technological innovations, and finally, some specific literature from both fields relating to over entry.

II.1.1 History of NeoClassicalism

The neoclassicalists of today consider the classic "theory of the firm" when modelling problems. Although there is some disagreement about the exact definition of this theory, there are some general ideas on which most neoclassicalists would agree.

The theory of firms can really be considered a market theory explaining how resources are allocated in a price system (Cyert and March; 1963). A firm maximizes profits subject to its choices (prices, quantity, etc.) and leaves the environment as given. When the choice of inputs (capital, labor) is considered, the production function is taken as given (recently production functions have sometimes been considered endogenous resulting from past behavior). By methods of differential

[7]The more efficient firms will acquire more of the scarce resources.

calculus and the Lagrangean multiplier,[8] neoclassicalists can solve for the firm's optimal levels for both inputs and outputs. In equilibrium, no firm will have an incentive to change its strategy after witnessing the strategies of all other firms and (in competitive markets) demand should balance with supply.

Neoclassical theory in its standard form does not address the fact that decisions are made in large scale organizations. Neoclassicalist scholars consider the entire firm acting as a rational individual maximizing firm profits and each rational individual behaving exactly the same as the others. Friedman explained (1957) that all firms do not act rationally, but neoclassicalists assume that those irrational firms will lose profits and eventually be forced from the market.

II.1.1 History of Organizational Ecology

Much of the Organizational Ecology roots can be traced back to political sociology, macrosociology, and Darwin's theory of evolution. The sociology concepts of Marz, Weber, Michels and others questioned the role of social and historical transformation on organizations (including industries) and how organizational diversity can shape social change (Hannan and Freeman; 1989). Darwin's "survival of the fittest" is one measure applied to the efficiency (or some other measure of firm heterogeneity) of firms by the ecologists. Some ecologists rationalize that

[8]Taking the first derivative with respect to constraints.

eventually the most efficient firms will survive (although inefficient firms may still earn positive rents by entering early) while others consider measures other than efficiency[9] as selection criteria.

Ecologists considered both the theory of the firm in competitive markets and models of community ecology when developing their theory. More was taken from the community ecology literature which explains how selection processes shape adaptation at the population level in response to environmental variations. The ecologists were influenced by Hawley (1950, 1968) whose principle of isomorphism explained that units subjected to the same environmental conditions will acquire a similar form of organization. Also influencing the ecologists was Stinchombe (1965) who assumed that cohorts of organizations are "imprinted" with the features that are common in the environment when the cohort is founded. He also felt that these features were highly resistant to change.

II.1.3 Behavioral Theory of the Firm

The literature on the behavioral theory of the firm (Cyert and March; 1963) which revised the classical theory of the firm considers both the ideas of the Neoclassicalists and the Organizational Ecologists. Scott (1987) gives a good history of the work done at Carnegie-Mellon University in the 1950s and 1960s by colleagues and students of Simon and March. They developed some general theories of decision-making within organizations connecting

[9]These criteria include luck, timing, and response to technical change.

to work in sociology, political science, and economics. They also reasoned that the assumptions of the classical theory of the firm appeared unrealistic with few characteristics of actual business firms (Cyert and March; 1963). "Behavioralists" have since devised a theory that takes the firm as its basic unit, attempts to predict firm behavior, and emphasizes the actual process of organizational decision making.

Behavioralists consider the organizational politics affecting the decisions of firms and consider the different problems facing the subunits within an industry. Often, these internal political debates create suboptimal decisions for the firm as a whole as there is a "quasi-resolution" to this conflict by satisfying minimum goals of the subunits.[10] Cyert and March (1963) believed that the objectives of organizations grow out of the interaction of the various participants (groups) within the organization. To solve these problems, Cyert and March use a flow chart and a computer program. Recently, behavioralists like Nelson and Winter (1982) have looked at behavioral theory at the market (industry) level.

II.1.4 Dynamics and Equilibrium

Ecologists feel that the entry of firms into an industry can be explained from an industry's inception until its maturity. As the ecologist, Hannan, (1986) explains, the density of an industry first has a positive (legitimizing) effect on the founding rates of organizations. Later, as the

[10]Negotiation experts call these minimum goals BATNAs.

density becomes so great as to make the industry competitive, the founding rate declines and the hazard rate increases. In fact, Klepper and Grady (1990) have shown empirically that industries stabilize only after losing an average of 40% of the firms. Hannan and Freeman's (1988 and 1989) work discovered that a U-shaped relationship between population density and hazard rate.

It is important to realize that the ecologists consider the assumption of an equilibrium to rarely be plausible for industries exposed to continuous social change (Hannan and Freeman; 1989). Both the theory and empirical research in organizational ecology, however, is broadly consistent with a "punctuated equilibrium" which sees firms entering and exiting rapidly over very short time periods.

Neoclassicalists merely consider the entry and exit rates of firms as a function of the residual demand in the market. Entry and exit is assumed to be instantaneous and identical among firms merely as a response to acquire profits as described by Ekelund and Tollison (1981: 18):

> Rent seeking or profit seeking in a competitive market order is therefore a normal, healthy feature of economic life. Over time the returns of resource owners will be dissipated or driven to normal levels by competitive profit seeking as some resource owners earn positive rents, which promote entry by competitors into their activities and others earn negative rents, which cause them to exit from their present undertakings.

There is little literature on timing of entry and exit rates with neoclassical ideas. Timing is confined mostly to literature on exit, (see Whinston; 1988) patent races, and preemption (see Fudenberg and Tirole; 1985).[11]

II.1.5 Entry (Founding Rates)

Ecologists have offered many explanations for the variation in founding rates over time. Delacroix and Carroll (1983) felt that the founding rates were cyclical resulting from prior failures on the availabilities of resources. Recently, most of this work on organizational foundings (entry) has concentrated on density dependence and population dynamics with the time intervals between foundings considered independent. Hannan (1986) showed that the density of firms in an industry has a non-monotonic (initially positive, then negative) effect on founding rates.

On the other hand, the neoclassical school usually proposes a specific model with assumptions about information, firm size, demand, and firm expansion capabilities. Entry rates in their models are merely a function of changes in demand. As Porter and Spence (1982) show in their study of the Corn Wet Milling industry, industry capacity expansion is a function of demand uncertainty subject to assumptions about rivals' behavior (capacity expansion paths). This work stems from the textbook economic theory that

[11]The equilibria of these models defines the entry and exit of different sized firms.

firms will continue to enter or expand an industry until that industry has reached a competitive equilibrium. Extensions to the neoclassical entry literature include entry deterrence, preemptive timing (see Reynolds; 1987), and capacity expansion games (see Spence; 1979).

Much of the industry evolution is explained by expansion (strategic and otherwise) in the neoclassical literature. In an industry with large fixed costs, incumbents are often able to expand and establish a large market share because they can continue to expand in small increments before enough residual demand appears to justify the fixed cost of another firm. Spence's (1979) work on capacity expansion considered a classical duopoly with linear demand. In his paper, both firms would expand as quickly as possibly until reaching the reaction function of the initially disadvantaged firm (one firm was given an initial capacity advantage).[12]

The Ecology literature explains that most change within an industry is a direct result of founding and mortality, not expansion. Singh and Lumsden (1990) explain that these scholars pay too little attention to organizational change because (1.) they feel that organizations are subject to much inertia, (2). the focus of organizational change is only of secondary concern to these researchers, and (3). data is typically difficult to obtain.

[12]Fudenberg and Tirole (1983b) reworked this problem to show an "early-stopping" equilibrium. In 1991, I ran experiments to show a third equilibrium where the difference in speed of expansion between firms was a negative function of the differences in initial endowment.

II.1.6 Diversity of Firms

The Ecologists, typified by Brittain and Freeman (1981), more often consider firms of different types (efficiency, size, speed, etc.) that are prone to enter or expand in different situations. The attributes which distinguish organizations (organizational inertia) are also assumed to be stable over time (Hannan and Freeman; 1984). Implicit in all ecological analyses is the assumption that there is some heterogeneity among the firms' efficiencies. For instance, Miles and Snow (1990) classify firms into prospectors, defenders, and analyzers. These authors describe situations in which each of the different firm types are most likely to flourish.

With few exceptions, the neoclassicalists usually consider firms within an industry to be identical. Even when the neoclassicalists allow some difference between firms, it is merely an informational, size or timing advantage.

Another distinction made by ecologists is generalist and specialist firms. Freeman and Hannan (1983) have shown empirically that specialist firms outperform generalists in uncertain, concave, and fine-grained environments. Carroll got similar results in highly concentrated industries where the specialist firms could serve a niche segment.

II.1.7 Institutional Variables Relating to Entry

Unlike the neoclassical scholars, the ecologists feel that the founding rates are related to institutional variables like political turmoil (see Carroll and Huo; 1986), legal constraints (see Barnett and Carroll; 1989), or by the presence of similar industries (see Marrett; 1980 and Lincoln; 1977). Other

Ecologists (see Nelson; 1975 or Burns and Stalker; 1961) look at the historical record of innovation in the United States, pointing to the turn of the century and post World War II periods as times of great innovation. These ecological studies also show that innovation has been concentrated in periods of industrialization and modernization. McKelvey (1982) pointed out that institutional variables may not be globally conducive to innovation; they may only be conducive to certain types of industry innovations.

Neoclassical scholars consider the problem of founding (entry) more simply as n firms in a game trying to maximize profits by pricing or quantity setting subject to a specific demand function. Outside factors that ecologists consider are not modeled by neoclassicalists unless they have a specific effect on some inherent part of their model. For instance, a neoclassicalist might consider the political turmoil of an area by increasing the variability of demand.

The entry models of the neoclassicalists have historically considered identical firms entering into an industry with known demand. A Cournot quantity game is played until no other firm can profitably enter. As the fixed costs in these models approach zero, the industry equilibrium approaches the competitive equilibrium.

II.1.8 Speed, First Mover Advantages, and Technical Change

A first mover advantage can be seen in the neoclassical model developed by von Stackleberg (1934). In this duopoly model, the first mover acts as a monopolist to acquire more than the Cournot duopoly profits.

Depending on the fixed costs, the Stackleberg model can have the first mover deter entry of a second firm (Caves and Porter; 1977 describe this process in more detail). Neoclassicalists are quick to point out that this type of entry barrier is only credible when the capital investment of the first mover is difficult to reverse. A first mover advantage is not seen in the Ecology related literature. In fact, Anderson and Tushman (1990) feel that the innovating firm will not enjoy the industry standard and often will not be a strong force in the industry in its maturity. Lambkin and Day (1989) claim that the pioneer rarely outperforms later entrants.

Although there are many strengths to the neoclassical model, it lacks an adequate analysis for technical *change*. Neoclassicalists including Harris and Vickers (1985) model innovation in terms of a patent race. This literature explores the strategies of firms leading to an innovation. The post-innovation world in these models is understood by all firms to protect the innovator to some degree. Unlike the ecologists, the neoclassicalists only consider the strategy leading toward an innovation. The effects of technological change are more thoroughly considered in the ecology related literature. Anderson and Tushman (1990) have recently considered technology change and break the types of changes into competence destroying and competence enhancing. The former type generally brings many new firms into the industry and sees the demise of many old firms. The latter type of technology change makes the incumbent firms stronger and weakens the potential for entry.

II.1.9 Entry Deterrence

Other neoclassicalists including Bulow, Geankopolos, and Klemperer (1985) and Dixit (1980) have shown that incumbent firms can hold idle capacity to rationally deter entry. Dixit's result rests on the entrant's assumption that the incumbent will produce at the same post entry level as his pre-entry level. Ecologists, who do not consider the firms' decision makers as strategic, have apparently not done much research on this type of strategic entry deterrence. Entry is deterred in their models by density and institutional factors.

Comparisons between the two schools could continue, but the previous analysis highlights the major differences among entrants in the entry process. Some major differences between the two schools of thought are:

1. Entry: The ecologists feel that the founding (entry) rate is a function of the industry's density. A neoclassicalist would claim that entry is solely explained by the availability of demand.

2. Inner expansion: Ecologists feel that most industry change is due to foundings and mortality (this theory has come under criticism recently by Singh and Lumsden; 1990). Although some of this expansion involves changing forms, there is still little discussion of capacity expansion. Capacity expansion models are frequently seen in the neoclassical literature.

3. Types of firms: Neoclassicalists most often consider all firms in a model to be identical. Ecologists distinguish firms by efficiency, generalist versus specialist, and more subjective classifications.

4. Institutional variables: Neoclassicalists assume that all of the institutional variables are implicit in other parts of the model (demand functions, profit functions, etc.). Founding rates are affected by institutional variables both positively and negatively in the ecology literature.

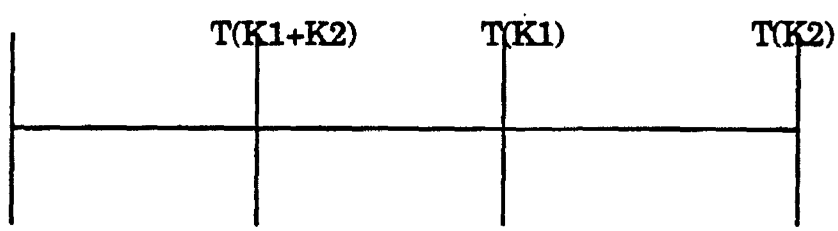
5. First-Mover or Innovator Advantage: The neoclassical models give the first movers an advantage because they can acquire demand before later firms are able to compete with them. Innovators are generally not seen to perform well both in the empirical and theoretical ecology literature.

II.2 Industrial Organization Literature

There is considerable literature *relating to* the study of over entry and shakeout in the Industrial Organization field. At this time, shakeout (exit) has primarily been researched in declining industries in the Industrial Organization literature. This literature can begin with the consideration of exit.

After some earlier work, a classic paper by Ghemawat and Nalebuff (1985) proposed a model with two firms remaining in a declining market. Firm 1 owned a larger plant than firm 2 and there was complete information as to the industry's rate of decline and each firm's plant size.

The only perfect equilibrium is reached when firm 1 exits at time T(K1+K2) and firm 2 exits at time T(K2) as shown in the timeline below. Backward induction leads to this solution as it is intuitive to realize that firm 1 must exit before firm 2. In fact, firm 1 realizes that firm 2 can operate alone in the market until T(K2), so firm 1 exits at the latest time in which the industry can profitably support both firms:



T(i): final time in which the industry can profitably support a firm of size i
Figure II.2.1

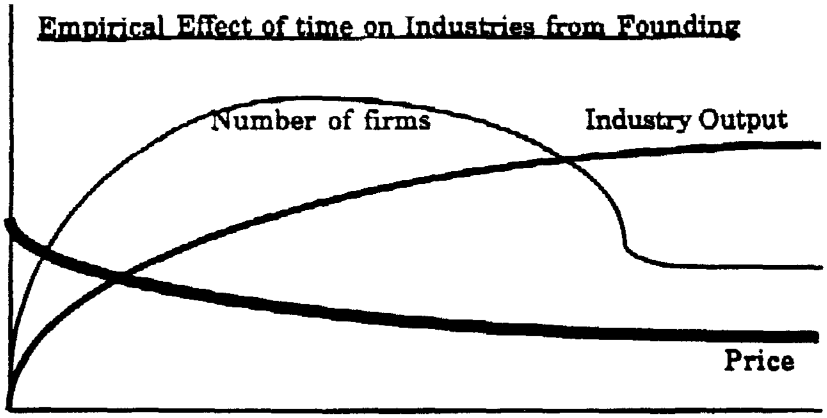
Fudenberg and Tirole (1986) have a similar model with open loop strategies of when to exit if opposed and unopposed. Their perfect equilibrium is the same type as Ghemawat and Nalebuff.

Whinston (1988) added multi-plant firms and discrete time to the Ghemawat and Nalebuff model. His results do not add much to the earlier results; the larger plants exit first, leaving the smaller plants to make short-term profits. All of these Industrial Organization models differ slightly in their strategies, number of firms, or plant sizes; but they all consider known declining industries and their results always have the larger plants exiting incrementally before the small plants.

The biologist John Maynard Smith (1974) proposed a different type of exit situation; the war of attrition. This game involves one firm trying to outlast its opponent in an unprofitable industry. The simplest games involve two players producing at an unprofitable level until one firm exits. At that time, the remaining firm becomes a profitable monopolist. Ex-ante, no firm is profitable; but ex-post the surviving monopolist acquires positive profits. Recently, Hendricks, Weiss, and Wilson (1988) review earlier work on the War of Attrition and consider asymmetry between the players for the first time. They show different types of equilibria for different assumptions.

In more recent Industrial Organization literature, Londregan (1990) combines the study of both entry and exit. He considers two firms competing over an industry life cycle. During the growth stage, a commitment advantage can even allow the higher cost firm to preempt the lower cost firm. He also shows that reentry barriers can have the effect of entry barriers. Brown (1980) concluded that over entry would occur in industries with large variations in returns because entrants could not assess their own abilities correctly. Rob (1990) describes potential behavior in response to a positive demand shock of unknown size. The behavior (strategy) in this model is only entry or exit as full capacity is used and the industry price is determined by the marketplace.

It is important to distinguish the topic of this thesis from the results of Klepper and Graddy (1990) who built on work of Gort and Klepper (1982). The later research consisted of an empirical study focusing on industry concentration. Their general results are summarized in Figure II.2.2:



Time
Figure II.2.2

The shakeout was typically about 40% of the maximum number of firms in the industry. Although shakeout occurs in their work, the total industry output increases throughout time (any shakeout in these models will permanently decrease industry output). Their research concerned industry growth as a result of entry and internal growth of firms. This research will focus only on industry growth due to entry.

The school of research closest to the proposed models is the school of socially inefficient entry seen in von Weizsacker (1980). The original work by von Weizsacker (1980) showed that more than the social welfare maximizing number of firms would enter an industry with set-up costs.[13] Although no entering firms lose money under his scenario, he argues that social welfare could actually be increased by increasing the protection of incumbents from the competition of entrants.

[13]The set-up costs can be thought of a "dead weight" loss.

Since that first paper, a number of others have written on the subject including Mankiw and Whinston (1986) and Mills (1991). The former paper tried to analyze the forces behind this result and also to compare homogenous with heterogeneous product markets. Mills (1991) showed that not only is entry socially excessive in these models, but entry also occurs too quickly. Although this literature seems closely tied to over entry, it is important to realize that firms here earn *positive profits*.

II.3 Organizational Ecology Literature

Organizational Ecology deals with how social conditions as well as competitive forces affect the rates of entry and exit of new organizational forms and new organizations as well as the rates of change in organizational forms. Unlike Industrial Organization scholars, most Organizational Ecology researchers have focused on exit, not entry.

Recently, most of this work on organizational foundings (entry) has concentrated on density dependence and population dynamics. Carroll and Swarminathan (1989) and Hannan and Freeman (1987) have shown non-monotonic founding rates in the brewing industry and among labor unions respectively. Recently, Levinthal's (1991) research has shown that these findings are largely consistent with a competitive process among firms.

The Population Ecology (a subset of Organizational Ecology) literature reviewed by Singh and Lumsden (1990) focuses on six methods to study exit (mortality rates): fitness set theory, the liability of newness, density dependence and population dynamics, resource partitioning theory, the liability of smallness, and the impact of founding conditions. This literature also distinguishes generalist from specialist entry which is not discussed at all in the Industrial Organization literature. Generalists attempt to enter the entire existing market, while the specialists look for a specific niche to serve.

Fitness set theory which focuses on the level of environmental variability and grain (patchiness of the variation) is still in its infancy. Freeman and Hannan (1983) consider strategy of generalists or specialists in different environments. The liability of newness presumes young firms to have a higher failure rate than their older counterparts. Stinchcombe (1965) proposed that the liability of newness could be caused by learning time for firms to realize their role in the market, coordinating this role within their organization, and the difficulty in diverting business from established firms. Most empirical evidence supports this idea, but as Singh and Lumsden (1990) point out, there may be some confounds acting here.[14]

Resource partitioning is the prediction that a high concentration of generalist firms in the mass market implies a higher mortality rate for generalists and a lower mortality rate for specialists. There is some current empirical evidence to support this theory. The liability of smallness predicts larger firms to have lower mortality rates. Aldrich and Auster

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[14]Especially between the liability of newness and the liability of smallness. One would expect there to be a strong positive correlation between firm age and size.

(1986) explained the unique difficulties of being a small firm: difficulty in raising capital, incentives (tax laws) to sell out to large firms, government regulations are particularly harmful, and the firms can not offer stability to their potential labor market. Although empirical evidence has thus far supported the liability of smallness, it may take some time to separate the effects of smallness and newness.

Finance scholars including Banz (1981) have empirical evidence showing that small firms earn higher risk-adjusted returns than large firms. Banz points out that most of this difference is explained by the extremely successful very small firms. In a later work, Basu (1983) showed this effect disappeared after controlling for risk earnings' yield.

Some work followed a paper by Stinchcombe (1965) which proposed that the mortality rate of an organization related to the conditions of the environment at its founding. Like the other mortality explanations, there is also some empirical validity about this theory; but it is harder to define the exact founding condition in this model. The final explanation for mortality is an extension of the argument regarding founding rates and density dependence. Data has been inconsistent when trying to show that the mortality rate is related nonmonitically (decreasing first and then rising) to density. A recent study by Carroll and Hannan (1989) considers the delayed (and persistent) positive effect founding density has on organizations' mortalities. Their empirical tests, considering historical data from five industries, support this claim.

II.4 Empirical Literature

Besides theoretical Industrial Organization and Organizational Ecology, some empirical work has also been done on over entry and its consequences. Lieberman's (1990) paper concerns the chemical processing industry and distinguishes shakeout from stakeout[15] with theoretical justifications for each. A liability of smallness was also seen in this case. These results, however, may not generalize, as there is a large minimum efficient scale existing in the chemical processing industry.[16]

Dunne, Roberts, and Samuelson (1988) went a step beyond the Organizational Ecology literature by classifying entrants into three classes in their empirical work on U.S. manufacturing industries: (1.) new firms, (2.) existing firms that diversify into an industry by opening new production facilities, and (3.) existing firms that alter the mix of outputs they produce in their existing plants. They found significant and consistent differences in both entry and exit rates across industries. Dividing time somewhat subjectively into periods, they found that high entry in one period leads to high exit in the next period. Deily (1991) could not explain the order of firms exiting the United States steel industry by size nor by level of diversification.

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[15]A war of attrition in a declining industry with the smaller firm always "winning".

[16]A large minimum efficient scale also exists in the hotel industry.

Perhaps the most well known of the empirical work, however, is Porter and Spence's (1982) study of the corn wet milling industry. Their findings were: (1). that the equilibrium outcome in an industry is a function of the expected demand as well as the market potential and (2). that uncertainty about demand decreases the entry rate.

Sahlman and Stevenson's (1985) work on the Winchester disk drive industry has the most similarities to the following study of over entry. Their study showed an industry exploding with growth and expectation as the computer industry grew and the availability of venture capital increased (mainly as a result of capital gains tax law changes in 1978 and 1981) between 1977 and 1984. In fact, at one time in 1983; the stock market valuation of the twelve firms in the industry was more than four times the companies' 1983 sales figures and 54 times that of their net income for the year. The computer industry shakeout in 1983 and 1984 increased competition in the disk drive industry itself, and the inability to acquire venture capital led to major problems including nearly an 80% devaluation of stock values (by December 1984) from their high in 1983.

The interesting analysis of the authors shows that this fall could have been predicted, as the firms made *individually rational, but myopic* decisions. They reason that investment decisions in this industry by late 1982 were relying on five critical, but nearly independent, bets (separate events to be realized). Under this rationale, a sophisticated decision maker would have realized the improbability of all five bets succeeding and would have stayed out of the market.[17] The authors had the benefit of hindsight, but the firms should have realized the disk drive industry would soon fall.

II.5 Industry Specific Literature

The specifics of these three hotel markets are not of major importance to this work except in their motivation for theories on over entry and later for empirical tests. It will, however, be of some use to describe the hotel industry in general as well as the three specifics markets of study.

Davis (1985) discussed the saturation of the luxury hotel markets in many areas of the United States at that time.[18] His work included the input of many of the industry experts to support his opinion. In later articles (1986, 1989), Davis explained the negative implications of the 1986 tax law on the hotel industry and the difficult financing prevalent in the over built hotel market.

Recently, Overstreet (1989a,b) researched the hotel market in Charlottesville, Virginia and showed the ruinous competition of two hotel

[17]Each single bet had a good chance of succeeding, but the chance of all five succeeding was ex-ante quite small.

[18]Including the cities of New Orleans and Denver.

openings in 1983 in a market that could only support one.[19] Oddly, these two hotel openings preceded more hotels entering the market (from 1983 to 1989, the Charlottesville hotel market nearly doubled to 2500 rooms). By 1989, the hotel market was is dire straits as many properties (including the two that initiated the over building) went through bankruptcy proceedings, although no hotel rooms actually exited the market.

Over building periods in the hotel industry occurred nationally generally in the 1920s, 1950s and probably in the 1980s (to a lesser degree). These periods were followed by short-term losses, a ceasing of growth, bankruptcies, some hotel closings, and later industry stabilization.

Each of the three markets of this study have experienced a building boom that can at least be partially attributed to a demand shock. In all cases, the demand shock was announced years before its appearance. Due to the combination of demand uncertainty and miscalculations, each of the three markets has seen some over building it its hotel market. Orlando (1972 and 1973) and Atlantic City (the late 1980s) have both recently experienced over building to different degrees, while the Philadelphia market may be in the current process of over building. Orlando's over building was very temporary, as demand for hotel rooms has skyrocketed since the mid 1970s. Atlantic City's over building problems may be more long term, as demand for hotel rooms and casino facilities may have

[19]According to publicly available market studies.

stabilized. The size of the Philadelphia market pales in comparison to both the Atlantic City and Orlando markets, but there has been a definite boom in its luxury segment supply (highest level hotel) since the late 1980s (Bradley and Whiteman; 1985) which should make the problem in Philadelphia interesting enough to consider.

Orlando's hotel business boomed around Walt Disney World during the time of its opening in 1971. A short over building period was experienced in 1972 and 1973, but many businesses came to the Orlando area in the 1970s and the existing hotels became profitable after experiencing a very short period of losses.

During the early 1980s, the supply of hotel rooms temporarily surpassed the demand and hotels began to struggle.[20] However, the hotel market has prospered since that time due to hotel construction slowing down in the mid 1980s and the Experimental Prototype Community of Tomorrow (EPCOT) Center opening in 1982. Even during the early and mid 1980s, while some hotels were in bankruptcy proceedings, others were

[20]Supply always exceeded demand, but at this time the difference became large enough for the hotel market to weaken substantially.

prospering.[21] Currently, the Orlando area (including Orange, Osceola and Seminole Counties) has the largest volume hotel market and the highest average occupancy rates (79%) in the United States as the area continues its rapid expansion (Time Magazine; 1991).

One specific Orlando area more recently hit with a positive demand shock is Lake Buena Vista. This small area bordering the Experimental Prototype Community of Tomorrow (EPCOT) Center currently supports 27 hotels with over 18,000 rooms.[22] This center became the largest ($800 million) privately funded construction project in the world at the time of its opening. EPCOT's opening in 1982 has increased demand for hotel rooms in the Orlando area (mostly Lake Buena Vista) by over 30,000 rooms per day. Even the most optimistic of Disney's officials at the time of EPCOT's opening only estimated an increased daily demand of 15,000 rooms (Pannell Kerr Forster; 1981 and 1983).

Atlantic City saw two large positive demand shocks to the hotel industry in the 1970s: a new Convention Center in 1971 and the legalization of gambling in 1977. This empirical study will only concentrate on the later demand shock and its effect on the casino/hotel industry.

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[21]For instance, 1986 saw three Orlando area hotels file for bankruptcy while the average occupancy rate in the area was still a very strong 72% (Snyder; 1987).

[22]Ten of these 27 hotels have a 4 or 5 star rating from AAA.

The legalization of gambling led to the opening of casino hotels starting with Resorts in 1978. Resorts and the other casino hotels remained generally profitable until the mid 1980s. Casino revenue grew from $134 million in 1978 to $2.3 billion in 1986. Between 1981 and 1985 total casino revenues doubled, but in the next four years the total growth was merely 30%. This slow down and the addition of new casino hotels (The Trump Castle in 1985 and The Showboat in 1987) has put a strain on the market.

In 1989, the first hotel/casino closed in Atlantic City; The Atlantis. Despite this exit, the other hotel/casinos were still fighting for existence. As the market seemed to be at its most depressed stage, the most expensive hotel/casino ever built opened in 1990; the 1250 room Trump Taj Mahal. The Trump Taj Mahal's entry has put a larger strain on the market and we should soon see more shakeout (Casino Association of New Jersey; 1991).[23]

This study concentrates on the 12 existing hotel/casinos in Atlantic City as well as the failed Atlantis. Casino revenue has grown tremendously in Atlantic City from $134 million in 1978 to $2.95 billion in 1990; however this growth has been slower than the number of hotel/casino rooms built since 1983. In fact, the number of visitors to Atlantic City has decreased in both 1989 and 1990.

Within eighteen months of 1989 and 1990 four luxury hotels entered the Philadelphia market to compete with the lone existing luxury property;

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[23]During the first five months of 1991, casino revenues were down from 1990.

The Four Seasons. This recent building boom is generally attributed to a lack of luxury hotels, the Convention Center's expected impact on demand for hotel rooms after its planned opening in 1993, and the success of The Four Seasons between 1983 and 1989.[24] Currently, only The Four Seasons is operating with a profit.

Currently, some of the newer luxury hotels are struggling, as downtown occupancy rates have fallen from nearly 74% in 1987 to 65% in 1990 (Pannell Kerr Forster; 1991). Even with this trend, other hotel chains have begun plans to build in Philadelphia. The fate of these existing and planned hotels after the Convention Center opens is still unclear (a detailed case study of this city's market appears as an appendix).

II.6 Literature Overview and Research Outline

Within these disciplines literature on entry, entry deterrence, business cycles, and exit has been described; but there is nothing tying together these ideas to explain excess entry and its consequences. Because excess entry is perceived to be a common occurrence in many industries, including hotels, it may be useful to study. The models will develop results from different theoretical disciplines. Upon its completion, this thesis should make contributions to the Industrial Organization literature, the Strategic Management (Organizational Ecology) literature, and to industries that are prone to over building. Possibly the most important part

[24]The Convention Center announced its opening (for 1993) in July of 1986.

of this work is to bridge the gaps between disciplines to explain a non-trivial industry phenomenon.

Industrial Organization scholars have long been interested in entry deterrence, both natural and strategic. These results show new tactics used by firms that hurt social welfare. They invariably show an equilibrium with less than an efficient number of firms or units of output in an industry. Even the results on strategic capacity, consider firms holding greater than the monopolistic or collusive units of output, but still less than the efficient number. Recently, scholars have begun to test Industrial Organization theories. This work on over entry should add to this increasing "new" Industrial Organization literature.

Like the Industrial Organization scholars, the Organizational Ecology scholars have not developed a model to specifically predict over entry. Their ideas of birth and death processes, entry and exit rates as a function of the number of firms in the industry, and the types of firms entering at different stages of a business cycle are used in the models of over entry. This research should add to this literature by bringing in over entry as well as some new empirical work. By considering firms at different levels of sophistication, the impersonal ideas of Organizational Ecology with Strategy and Decision Processes can be combined.

People in the hotel industry (and other industries) are well aware of the tendency to over build. This can be seen in industry publications, accountants records and even in mass media publications. These sources are quick to criticize firms for "entering a saturated market" ex-post, but rarely are there warnings ex-ante. This research will begin the process of identifying cases of potential over building. Future scholars may use other data and make revisions until the literature may serve as a practical application for businesses.

The remainder of this thesis will discuss the specifics of the models, their distinct empirical implications, a summary of the data, and the results of the empirical tests. The only models considered are those that could feasibly be tested empirically with obtainable data.[25] A case study of the Philadelphia luxury hotel industry will follow the statistical tests to propose another manner of analyzing the problem facing the potential entrants.

The data samples will include all of the exits and entries from specific segments of the Philadelphia, Atlantic City, and Orlando hotel markets. In Philadelphia, the domain of study will consist of Center City from the time of the Convention Center announcement in 1986 until the

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[25]Certain numbers like market share and occupancy rates for specific hotels are considered confidential.

present.[26] The new convention center will be only a short cab ride or walk from any of the hotels used in this study. Center City's hotel must be further divided based on their price (services). To avoid complication of a large number of classes, only two classes of hotel are considered; full service (luxury and first class) and others. This classification is used by hotel consultants including Pannell Kerr Forster. This system will not account for competition between first class and mid-priced properties, but most other competition should be incorporated.

Atlantic City's properties were easier to distinguish because they all offer the distinct service of gambling facilities (and all of its externalities including entertainment and restaurants). In fact, these casinos do not have much competition for overnight patrons, as they are the only full service properties in the area. Atlantic City's Convention and Visitors Bureau and the New Jersey Casino Association both classify casino hotels apart from other hotels. Since the first casino coincided with the legalization of gambling; this will be the time from which this study begins.

Orlando's hotels were the most difficult to classify into separate groups. The AAA groups hotels by cities. Pannell Kerr Forster groups the Orlando area hotels into three geographic regions. Both the Dick Pope Institute of the University of Central Florida and the Florida Hotel and

[26]Industry consultants from both Pannell Kerr Forster as well as Coopers and Lybrand consider Center City separate from other nearby areas including the airport and the Pennsylvania suburbs (both of which are experiencing a boom).

Motel Association have even different groupings.[27] Because AAA's grouping was the only one which was done totally objectively, this classification will be used in this study of the city of Lake Buena Vista. Future research should be done using other classifications within Orlando. The 1991 AAA ratings separate hotels into two groups similarly to the Philadelphia divisions; full service (4 and 5 star properties) and others. The time period of study will be from 1979 when the EPCOT Center plans were made public.

[27]The director of the Dick Pope Institute, Thor Falk, explained that both sets of groupings consider both geography and market niche.

III. Model:

This section examines models of entry into (and exit out of) a market in which only the sophistication of the decision maker is varied across models. The sophistication differences imply different equilibria which have distinct, testable empirical implications. The model includes a stochastic demand element added to a demand of known size and closely follows the equilibrium results of a former model in the literature.

The paper by Rob (1990) calculates a point of total industry quantity Q_n as the maximum point of profitable entry (industry carrying capacity). When industry quantity exceeds this level, entry is not profitable (over entry). Rob's model results in over entry in equilibrium with positive probability due to the stochastic nature of the industry's demand.

Rob's model only considers the "rational" type of over entry for an industry of identical firms. Firms in his model only experience over entry when demand falls short of expectations. These firms act rationally, but the stochastic demand causes over entry with positive probability. Although this may explain some over entry in real industries when all firms are equivalent, many people feel that entrant "irrationality" and firm heterogeneity also contribute to over entry.

Both models develop results in over entry due to stochastic demand *and the behavior of firms*. Firms may adjust to "rational over entry" by hedging and under entering (producing), but there is no way to avoid this type of over entry altogether (short of staying out of the market entirely).

Only when firms' own actions rather than stochastic demand cause over entry can actions be analyzed and changed to reduce the industry level of over entry.

To better understand the models developed here, the results of Rob's paper are presented. The first model is similar to Rob's when firms are economically rational. Decreasing the level of decision maker sophistication leads to more over entry in this model. In the later model, each firm's demand estimate is independently drawn from the same distribution (the same distribution from which the actual demand is taken).

III.1 Rob Model

The initial consideration is of Rob's (1990) model of entry into an industry with a known demand faced by a demand shock of unknown size. All of the infinite number of potential entrants in this industry are considered identical in both their cost structure and in their demand estimates of the size of the demand shock.

The initially known demand is D(P) where D'(P) $\leq$ 0. The announced positive demand shock can be labeled Δ. This shock is characterized by an *unknown* number of new consumers entering the market with reservation price equal to 1. The existence of a demand shock is announced to the industry prior to its appearance (although its true size will not be known until after it has appeared).[28] Industry quantity increases with entry and industry price adjusts to any quantity change.

Each of the potential entrants face a one time fixed entry cost, F, and an operating cost per unit, cq. Rob also assumes a salvage value to exit, (written here as G), that is less than the fixed cost of entry. There are total industry quantities Q that can be termed the maximum (final) point of profitable entry $Q_n^*(\Delta)$ and the minimum (initial) point of profitable exit $Q_x^*(\Delta)$. Beyond the point $Q_n^*(\Delta)$, entry is a dominated strategy, and before the point $Q_x^*(\Delta)$, exit is a dominated strategy. Of course, these points are dependent on the demand shock's size, Δ. Profit (Π) comparisons for any one of the firms in the industry look like:

$$\Pi(Q^* \mid \text{entry}) \leq \Pi(Q^* \mid \text{stay out}) \quad \text{if } Q^* \geq Q_n^*(\Delta)$$

$$\Pi(Q' \mid \text{exit}) \geq \Pi(Q' \mid \text{stay in}) \quad \text{if } Q' \leq Q_x^*(\Delta)$$

Between the points $Q_n^*(\Delta)$ and $Q_x^*(\Delta)$, the industry should remain stable; no firms have incentive to enter nor exit. Both $Q_n^*(\Delta)$ and $Q_x^*(\Delta)$ are only known once the demand uncertainty is resolved, as they are dependent on the demand shock's size.

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[28]D(P) and Δ are independent, so that total industry demand = D(P) + Δ. This may not be realistic, but it will be a restriction of this and the proposed models.

Each of the infinite potential entrants in the industry knows the distribution (f) characterizing the possible sizes of the demand shock. They know the distribution's upper and lower bounds (i.e., $0 \leq \Delta \leq \Delta_{max}$) and the probabilities associated with the different possible values over this range.

The actual entrants are selected sequentially within a cohort.[29] For each entry position within a cohort, nature chooses exactly one of the firms that is still "available" for entry. A firm's strategy in a period is merely to decide on the maximum industry quantity (stopping rule) for which to make itself available for entry. Upon the final entry (the last point in which at least one firm is still available for entry) in a cohort j, the industry price P_j and the industry quantity Q_j, are made public information.

The next cohort (j+1) uses the public information (P_j, Q_j) to update its estimate on the size of the demand shock. If $P_j = 1$ (the demand shock is still of unknown size), this group of potential entrants in cohort j+1 will increase its lower bound estimate on the size of the demand shock to Q_j.[30] They will also truncate the probabilities associated with the updated distribution from Q_j to Δ_{max}.

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[29]I will use the term cohort to define the firms entering in a specific *time period.*

[30]Since $P_j = 1$, there must be at least Q_j units of demand at the price of 1. Since there was no demand at the price of 1 before the shock, the shock must be at least the size of Q_j.

The size of the shock becomes known *with certainty* once $P_j<1$ at the conclusion of a cohort j. The industry then is reaching the customers consisting of the original demand (which is known) and, therefore, the unknown size of the demand shock can be calculated. In those situations, firms enter or exit under *certainty*.

Firms enter in cohorts of endogenous size. Between cohorts, all firms update their distributions over the demand shock so that before period i, all firms consider a distribution f_i.[31] Although Rob does not model firm strategies, their entry can be modelled without changing his results.

III.1.1 Firm Strategies

Each potential entrant bases its strategy for a cohort j at the beginning of that cohort on f_j. The strategy is merely to decide on its stopping rule for remaining "available for entry" as a function of the distribution, $Q_n(f_j)$.[32] When all firms become unavailable for entry at the industry quantity of $Q_n(f_j)$, one of three situations occur after the entry in cohort j:

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[31]In the degenerate case, f_i refers to the certain sized demand shock.

[32]$Q_n(\cdot)$ is a *function*, but for any specific distribution f_j, $Q_n(f_j)$ is a *single point* (industry quantity).

1. $Q_n(f_j) > Q_n^*(\Delta)$ (Low demand world)

2. $Q_n(f_j) < Q_n^*(\Delta)$ (High demand world)

3. $Q_n(f_j) = Q_n^*(\Delta)$ (Perfect amount of entry)

In the first case, the *entering* firms lose money because they entered beyond $Q_n^*(\Delta)$. In fact, they could lose as much money as F-G if they have to exit ($Q_n(f_j) > Q_x^*(\Delta)$). In the second case, the non-entering firms lose out on a chance to enter in the first cohort profitably because $Q_n(f_j) < Q_n^*(\Delta)$.

For this reason, the point to which firms *should* enter (ex-ante) in the first period can be described as a function of F, G, f_1, and D(P). The losses to a firm for falling into one of the two previously described groups is implicitly incorporated into $Q_n^*(f_1)$.

The calculation of $Q_n^*(f_1)$ must be explained in detail. Rational firms wish to maximize expected profits in period 1 by their choice of strategy. In a monopolistic (or collusive) entry game, a firm (firms) obtains (splits) maximum industry profits. In this competitive game, the equilibrium has firms entering until the expected entry profits are non-positive.[33]

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[33]Regard $\Pi(X \mid f_i)$ as the profit of an ith period entrant when firms enter until the industry is of size X in that period. The profit function is assumed to be continuous in X.

Proposition III.1.1: There exists a number $Q_n^*(f_1)$ such that $Q_n^*(f_1) =$ maximum value $Q_n(f_1)$ for which $E[\Pi(Q_n(f_1) | f_1)] \geq 0$.

Proof: This is shown in Rob's proof of Theorem 1 in his paper. He uses monotonicity of the profit function over $Q_n(f_1)$ to acquire this existence and uniqueness.

III.1.2 Dynamics of the Problem:

Because entry is in cohorts, firms must consider the future actions of others in their entry decisions. Before discussing this, it is necessary to further describe the known demand component:

$$l_{XN} = Q_x^*(\Delta)-Q_n^*(\Delta) \qquad \text{and} \qquad l_{ON} = Q_n^*(\Delta)-\Delta$$

where l_{XN} and l_{ON} are *constants*

Rob's model also considers a positive discount factor δ (<1) per period which makes a profit of X in period i+j worth only $X(\delta)^j$ in period i money.

Definition III.1.1: $R(q, Q, \Delta)$ is a firm's *one period revenue* when the arguments pertain respectively to the *firm's size*, the industry quantity, and the actual size of the demand shock.

4 Post-Entry Cases: The total industry supply $Q_n{}^*(f_i)$ falls into one of the four cases in Figure III.1.1 at the end of each period.

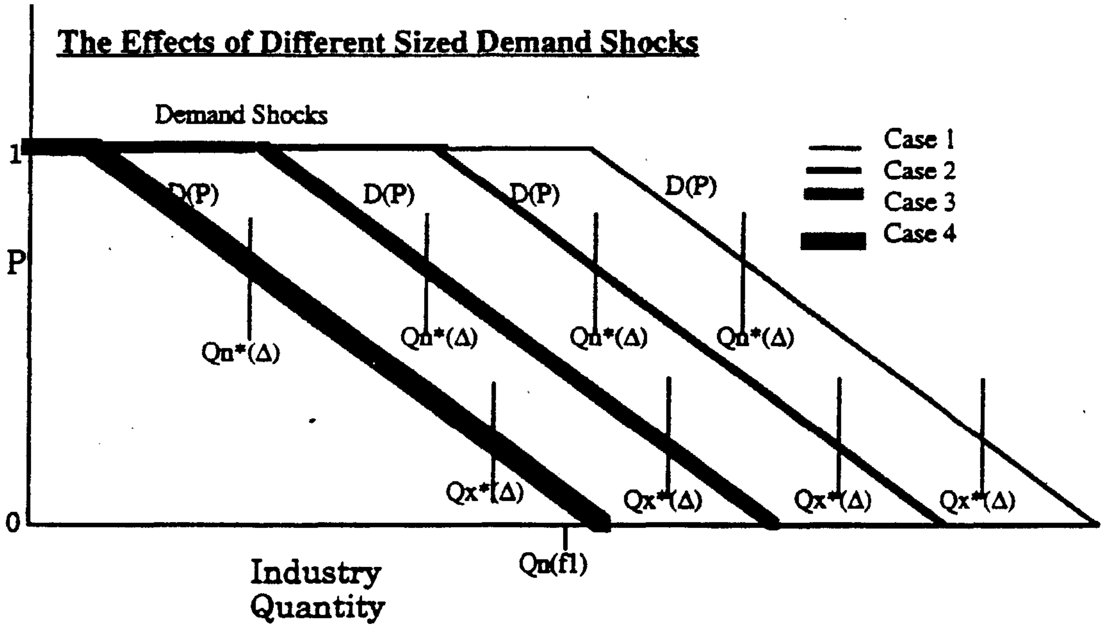


Figure III.1.1

1. $Q_n{}^*(f_i) < \Delta$.
2. $\Delta \leq Q_n{}^*(f_i) < Q_n{}^*(\Delta)$
3. $Q_n{}^*(\Delta) \leq Q_n{}^*(f_i) \leq Q_x{}^*(\Delta)$
4. $Q_n{}^*(f_i) > Q_x$

Over entry only is seen when case 3 or 4 happens. In both cases 3 and 4, the overall profits to entry are negative, but only in case 4 is exit less costly than remaining in the over entered industry.

Following the initial cohort, the case that occurs is a function of the size of the demand shock (in relation to its expectation). The firms in the first cohort will enter until $Q_1 = Q_n^*(f_1)$. If case 1 occurs after the entry of the first cohort ($P_1 = 1$), the remaining potential entrants in cohort 2 truncate their demand distribution lower bound to $Q_n^*(f_1)$ and enter until the final *point* of profitable entry for their new demand estimate, $Q_n^*(f_2)$. After this second period of entry, any of the four described cases could occur with positive probability.

Case 1 is the only one of the four in which the industry will not stabilize with certainty during the next cohort. Case 1 could continue to occur in later cohorts i (if $Q_n^*(f_i) < \Delta$). Always, the next cohort i truncates their lower bound on the demand shock to $Q_n^*(f_i)$ and from this, a new final stopping point for entry, $Q_n^*(f_i)$, is computed.

When $P_i < 1$ and $Q_i < Q_n^*(\Delta)$ (case 2), firms enter until the *known* final point of profitable entry (as the size of the demand shock is revealed) in cohort i+1. The industry will stabilize with certainty at the conclusion of this (i+1)st cohort at the total quantity $Q_n^*(\Delta)$. The third case ($P_i < 1$ and $Q_n^*(\Delta) \leq Q_i \leq Q_x^*(\Delta)$) also reveals the size of the demand shock, but only in this case will the industry be stable (no incentive for future entry nor exit).

In the final case ($P_i < 1$ and $Q_i > Q_x^*(\Delta)$), each of the incumbents make themselves available for exit until the first point of profitable exit, $Q_x^*(\Delta)$. This leaves the industry stable after cohort i+1 with a supply of $Q_x^*(\Delta)$.[34]

III.1.3 Calculating the point $Q_n^*(f_i)$:

Each of these cases imply a different profit structure for the entered firms in the industry. The probabilistic occurrences of the cases is a function of the distribution f_i. A profit expectation must therefore incorporate the profit streams for all four cases. A firm must choose a level of industry supply at which time it will cease attempting entry (all firms will choose the same strategy because they are identical). The firm's profits are described below as a function of the four previously described cases, k.

$$\sum_{k=1}^{4}(Pr(k \mid Q_n(f_i), f_i)^* E[\Pi_i(Q_n(f_i) \mid k)])$$

The respective probabilities for the cases are simple to describe when the firms stop entering at $Q_n(f_i)$ in period i:

[34]All of the incumbents are willing to exit until $Q_{i+1} \leq Q_x^*(\Delta)$. The firm chosen to be the next "exiter" is a random draw (with equal probabilities for each) from all firms still "available" for exit.

Define $\phi_i(x) = Pr(\Delta<x \mid f_i)$.

$$Pr(1 \mid Q_n(f_i), f_i) = 1 - \phi_i(Q_n(f_i))$$

$$Pr(2 \mid Q_n(f_i), f_i) = \phi_i(Q_n(f_i)) - \phi_i(Q_n(f_i)-l_{ON})$$

$$Pr(3 \mid Q_n(f_i), f_i) = \phi_i(Q_n(f_i)-l_{ON}) - \phi_i(Q_n(f_i)-l_{XN}-l_{ON})$$

$$Pr(4 \mid Q_n(f_i), f_i) = \phi_i(Q_n(f_i)-l_{XN}-l_{ON})$$

The expected profits are more difficult to describe as a function of the possible values of the demand shock, Δ, however:

$$E[\Pi_i(Q_n(f_i) \mid 1)] = \int_{Q_n(f_i)}^{\Delta_{max}} (R(q, Q_n(f_i), \Delta)f_i(\Delta) + \delta E[\Pi(Q_n(f_{i+1}) \mid f_{i+1}))]\ )d\Delta$$

$$E[\Pi_i(Q_n(f_i) \mid 2] = \int_{Q_n(f_i)-l_{ON}}^{Q_n(f_i)} (R(q, X, \Delta)f_i(\Delta) + \sum_{i=1}^{\infty}\delta^i R(q, \Delta+l_{ON}, \Delta)f_i(\Delta)\ )d\Delta$$

$$E[\Pi_i(Q_n(f_i) \mid 3] = \int_{Q_n(f_i)-l_{XN}-l_{ON}}^{Q_n(f_i)-l_{ON}} (\ \sum_{i=0}^{\infty}\delta^i R(q, Q_n(f_i), \Delta)f_i(\Delta)\ )d\Delta$$

$$E[\Pi_i(Q_n(f_i) \mid 4)] = \int_{0}^{Q_n(f_i)-l_{XN}-l_{ON}} (R(q, Q_n(f_i), \Delta)f_i(\Delta) + \delta G\ )d\Delta.$$

$$R(q, Q_n(f_i), \Delta) = \begin{cases} (1-c)^*q & \text{in case 1} \\ q^*P(Q_n(f_i)-\Delta) - cq & \text{otherwise} \end{cases}$$

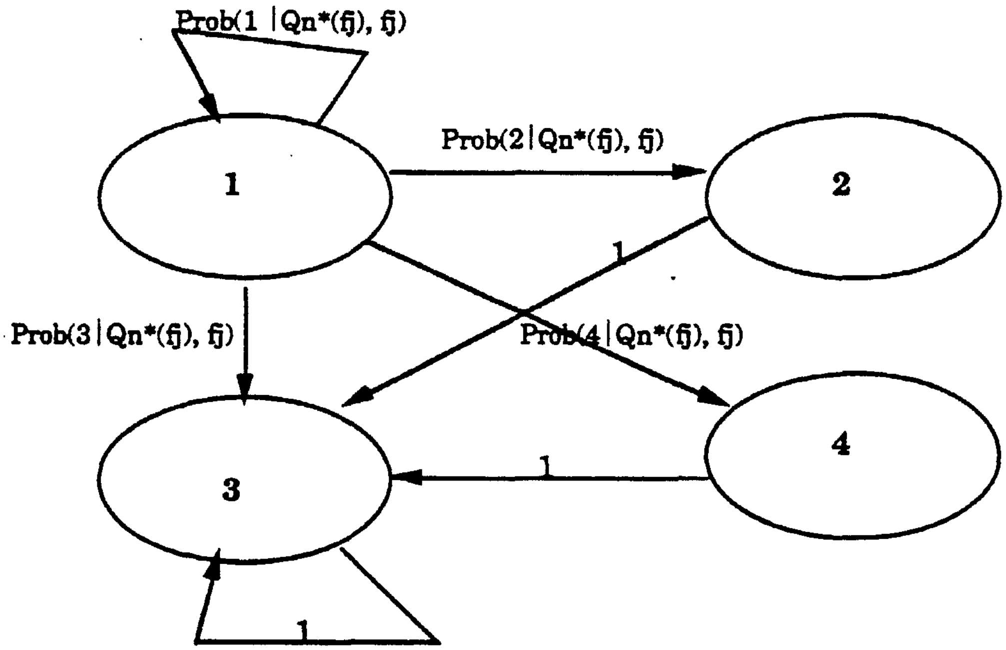
where P(Q) is the inverse demand function for the known demand element D(P).

In a Markovian sense, only case 3 is an absorbing state.

Figure III.1.2

Transition Probabilities between Cases

from Cohorts j to j+1 in equilibrium.



Because of the recursive nature of this profit function[35], the computation of $Q_n^*(f_i)$ must consider the values of $Q_n^*(f_j)$ for all j>i. Through dynamic programming methods, f_i and $Q_n^*(f_i)$ can be computed deterministically for all periods i. These $Q_n^*(f_i)$ can be explicitly calculated for specific values of

[35]$E[\pi_i(Q_n(f_i)\,|\,1)]$ is a function of $E[\pi_i(Q_n(f_{i+1})\,|\,f_{i+1})]$.

F and G. The difference in the values of start-up and salvage must have some effect on $Q_n^*(f_i)$. Based on this intuition and a small assumption, the following is proposed:

Assumption III.1.1: $Q_n^*(f_1)$ is continuous.

Proposition III.1.2: A β^* exists such that

$$Q_n^*(f_1) \leq Q_n^*(\Delta = \mu_1) \qquad \text{when } F\text{-}\delta G > \beta^*.^{36}$$

$$\text{where } \mu_1 = \int_0^{\Delta_{max}} f_1(\Delta)\Delta d\Delta.$$

Proof: Rob's Proposition 1 shows that $Q_n^*(f_1)$ is decreasing in F and increasing in G (decreasing in $F\text{-}\delta G = \beta$).

When $\beta \leq -cq$, this implies

a. There is always a profit to entering ($F+cq \leq \delta G$).

b. $Q_n^*(f_1) = \infty > \mu_1 + l_{ON}$.

[36] $Q_n^*(\Delta = \mu_1) = \mu_1 + ON$.

When $\beta \geq (1-c)q$, this implies

a. Entry can never be profitable ($F+cq \geq \delta G+q$).

b. $Q_n^*(f_1) = 0<\mu_1+l_{ON}$.

Because $Q_n^*(f_1)$ is continuous in (F-G), there exists a value for β^* such that: $Q_n^*(f_1, \beta^*) = Q_n^*(\Delta=\mu_1)$.

$\therefore$ For all $\beta > \beta^*$, $Q_n^*(f_1) \leq Q_n^*(\Delta=\mu_1)$.

The equilibrium seen in this model thus hedges on under entry when the costs to over entry are too high.[37] In the following models, the strategies of firms leading to over entry are explicitly characterized.

[37]The specific characterization of β^* does not take on a closed form expression.

III.2 Symmetric Beliefs Model:

Rob's model is followed exactly in both of these models except when otherwise specified. The following changes will be made to the symmetric model:

Yield:

1. There are two efficiency types of firms in the industry with different abilities to attract demand. Within types, the firms are identical.[38] The infinite number of firms labeled type "C" have a proportionately better ($A > 1$) ability to attract demand than their infinite number of "L" counterparts. Mathematically in an industry with demand D, and L and C units of the two types supplied respectively:

$\mathrm{Min}(C, D[AC/(AC+L)]) = C_Y$	demand units go to C types
$\mathrm{Min}(L, D-C_Y) = L_Y$	demand units go to L types

$\therefore$ This shows that $C_Y/C > L_Y/L$ when supply exceeds demand. In fact, one can put conditions on D for which the yield to the C types (C_Y) will equal C:

[38] Brittain and Freeman's (1981) consideration of firms in two group types (R and K in their model) helped in the motivation of this idea.

Find D such that $C \le D[AC/(AC+L)]$

$1 \le D[A/(AC+L)]$

$AC+L \le DA$

$D \ge (AC+L)/A$

$$\therefore \quad C_Y = \begin{cases} C & \text{when } D \ge (AC+L)/A \\ D[AC/(AC+L)] & \text{when } D < (AC+L)/A \end{cases}$$

The L types' yield is simply the minimum of L and the residual demand. Simple mathematics can show when the L types have a yield of L:

Case 1: When $C_Y = D[AC/(AC+L)] < C$ this implies residual demand $= D[L/(AC+L)] < L$.

Case 2: When $C_Y = C$ this implies residual demand = D-C.

L types *yield L when* $L \le D\text{-}C$*or when $D \ge L+C$.

Both types have the same initial estimate of the size of the demand shock and have the same updating capabilities on these demand estimates. Also, both types of firms may make themselves available for entry (or exit) at any time during any cohort.

The differing abilities to attract demand makes entry lose its profitability earlier (smaller total industry quantity) for the L types than their C counterparts. By the same token, the C types are able to profit in a more saturated industry than the L types. Although these firms differ, neither type is given preferential treatment when nature chooses the next entrant from the pool of available entrants.[39]

Hotel Types

Chain hotels correspond to C firms while independent (local) hotel correspond to L firms in the empirical tests. Industry consultants, hotel managers, and hotel industry scholars all mention a strong difference between national chains (more than 125 of which exist in the United States)

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[39]When X firms of type C and Y firms of type L are "available for entry" position j, each firm of either type has exactly a 1/(X+Y) chance of being the jth entrant. The jth entrant has a X/(X+Y) chance and a Y/(X+Y) chance of being of type C or L respectively.

and local hotels.[40] The national chains' advantages can be explained by reputations, information technology (advanced reservation systems linked with travel agents and businesses), globalization (ability to acquire multinational corporate accounts), and advertising.

2. After the entry of each cohort j is completed, industry price P_j is not revealed because price is set in this model. Instead, total industry sales percentage (the proportion of total units of capacity actual sold) Z_j is revealed after the completion of each cohort. The size of the demand shock will be revealed once this percentage dips below 100%. The analogy in the hotel industry to this updating of sales percentage by cohort is yearly industry reports on occupancy rates.

Initial demand is made up of a known number of customers (D_{IN}). The demand shock adds an unknown number (Δ) of new customers to the

[40]Withiam (1987) described the strength of these chain hotels in virtually every U.S. city. He reported that more than 50% of the U.S. hotels are chain or group owned. When national chain hotels move into a new city, they bring a reputation from other cities (and countries). Since only the good chains will survive, one would expect a good reputation to accompany most newly opening chain hotels. The chains can (and do) set up reservation systems that make it easier for their patrons to reserve a room. These systems include centralized 1-800 numbers listed in many phone books for all of their properties and agreements with airlines and rental car companies to set up "package" deals.

market. The total industry demand ($D = \Delta + D_{IN}$) and the demand shock are easy to compute once $Z_j < 100\%$:

$$D = Q_j * Z_j$$

$$\therefore \Delta = D - D_{IN} = Q_j * Z_j - D_{IN}$$

When $Z_j = 100\%$, one only knows that $D \geq Q_j * Z_j = Q_j$. There, one also knows that $Q_j - D_{in} \leq \Delta \leq \Delta_{max}$. This leaves the industry in a state of demand uncertainty and allows the firms to truncate their demand estimates.

3. Firms' strategies must be explained in more detail than the Rob model. For each entry position within a cohort j, one of the firms in the pool of available entrants (of either type) is chosen to enter. Neither type is given preferential treatment over the other when being chosen for entry.

A firm's strategy in cohort i $Q_n(f_i)$ is more complicated in this game because of the different abilities to attract demand. This strategy must therefore be a function of both the number of C type and L type units supplied (C and L) respectively. In Figure III.2.1, $Q_n^*(f_i)$ defines the equilibrium stopping rules in relation to C and L:

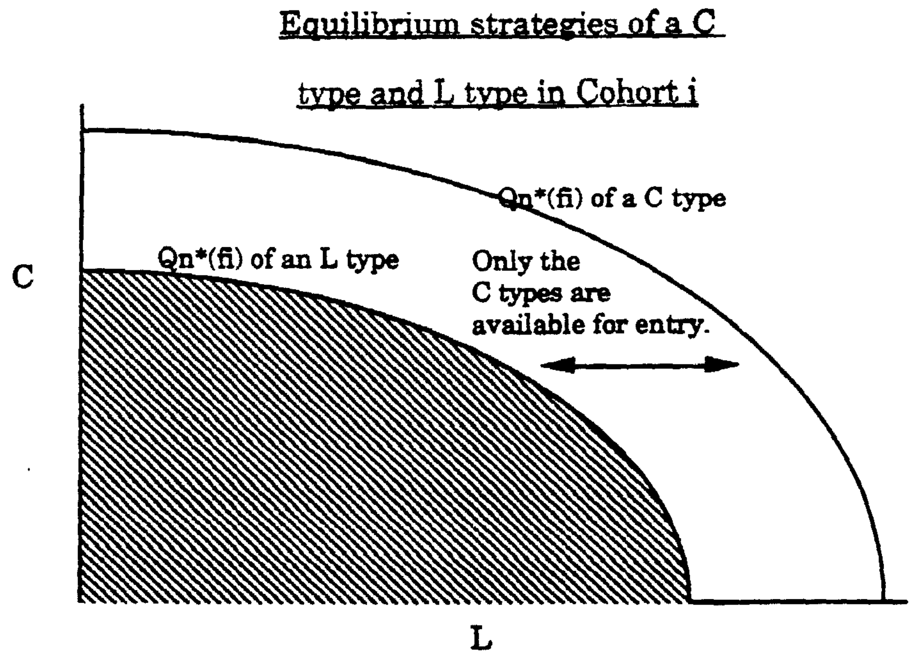

Figure III.2.1

The C types' equilibrium locus of points $Q_{nC}*(f_i)$ should always stochastically dominate those of their L type counterparts ($Q_{nL}*(f_i)$).

The entry of C types has a more damaging effect on residual demand than that of L types. The make-up of current units in the industry *does not have a direct effect on residual demand, however, there is an important indirect effect* that makes the consideration of current unit type necessary. This will be illustrated in the following example.

Consider one industry after cohort j where C = 0 and L = Q_j and another industry of the same size where C = Q_j and L = 0. In both industries, the residual demand = D-Q_j which *is independent of the incumbent firms' types*. If one compares the sales of firm i in both markets, the indirect effect of firm make-up can be seen clearly:

a. When Z_j = 100%, all of firm i's units are always sold.

but, b. When Z_j < 100%, all of firm i's units may not be sold. The percentage of units that firm i sells is higher when the industry is made up of L type firms.

Any rational firm considering entry in cohort j must therefore consider the make-up of firm types after cohort j. To calculate this, firms use the information currently available (the make-up of firm types after cohort j-1 and the earlier entrants in cohort j).

Within cohorts, firms exit in the same manner and make themselves available for exit until the total industry supply drops below their exit strategy $Q_x(f_i)$ (calculated in a similar manner to $Q_n(f_i)$).[41]

4. No firm i will exit in cohort j *before* the demand shock revelation even if the make up of C and L exceeds $Q_x^*(f_i)$.

[41]It is more intuitive that firms consider industry make-up when deciding on exit. Exit is only profitable when a firm can sell less than a certain proportion of its units. This proportion is a positive function of the proportion of L types in the industry.

The following three theoretical explanations of the entry and exit process for this industry respectively assume decision makers that are economically rational, myopic, and subject to overconfidence.

Economically rational decision makers are defined as those who understand the problem they face and the effect their actions have on the industry both presently and in the future. This type of decision maker acts rationally based on that understanding. Myopic decision makers' strategies are based only on the current state of the industry; upon this, they act rationally. An overconfidence bias (Ross and Sicoly; 1979) and myopia does not allow the third group of decision makers to correctly evaluate their initial problem.

III.2.1 The Economically Rational Equilibrium

Once the demand shock is revealed, firms base their strategies on the actual values of $Q_n^*(\Delta)$ and Q_x. Before this time, the firms must make entry decisions based upon their expectation of $Q_n^*(\Delta)$ and Q_x. The C and L types compute separate final loci of points for profitable entry; $Q_{nC}^*(\Delta)$ and $Q_{nL}^*(\Delta)$. These points (along with $Q_{xC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$) are functions of both C and L.

<u>Proposition III.2.1:</u> $Q_{nC}^*(f_i)$ dominates $Q_{nL}^*(f_i)$.

Proof: Consider an industry where $D = \Delta + D_{IN}$ with C and L units of the two types supplied respectively.[42]

It has been previously shown in this situation that $C_Y/C > L_Y/L$. It then follows that a C type firm earns greater profits than an L type of the same size

$\therefore$ For *any* C and L such that $\Pi_L(q, C, L \mid \Delta) = 0$

this implies (C, L) is on the locus of points Q_{nL} and $\Pi_C(q, C, L \mid \Delta) > 0$.[43] Since $d\Pi_C(q, C, L \mid \Delta)/dC < 0$ and $d\Pi_C(q, C, L \mid \Delta)/dL < 0$, the locus of points $Q_{nC}^*(f_i)$ stochastically dominates $Q_{nL}^*(f_i)$.

• Because the C types are the more efficient, they are comfortable (and profitable) attempting entry until their final locus of points of profitable

[42] It is assumed that $D < C+L$. If this is not the case, all units are sold implying that the industry is below $Q_{nL}^*(\Delta)$.

[43] $\Pi_a(b, c, d \mid e)$ = the profits to a firm of type a and size b when the industry has a supply of c and d C and L types respectively and e is the information known about the demand shock.

entry $Q_{nC}^*(f_i)$. By definition, entry of a C type is only profitable before the point $Q_{nC}^*(f_i)$. A C type would then enter before $Q_{nC}^*(f_i)$ if it believed the industry would not increase beyond $Q_{nC}^*(f_i)$ in that cohort. The C types do know the following about expected profits for both C and L types in cohort when (C, L) are on the locus of points $Q_{nC}^*(f_i)$ in cohort i:

$$E[\Pi_C(q, C, L \mid f_i)] = 0 \qquad \text{and} \qquad E[\Pi_L(q, C, L \mid f_i)] < 0$$

This shows that entry is not profitable by either type of firm beyond the locus of points $Q_{nC}^*(f_i)$ in cohort i. Because of this, the C types do not believe that any rational firms (which all firms in the industry are) will attempt entry in this cohort beyond a total industry quantity of $Q_{nC}^*(f_i)$.

Main Entry Proposition: The C types will always enter in a cohort i until total industry quantity reaches $Q_{nC}^*(f_i)$.

It has just been shown that C types will have incentive to enter until the point $Q_{nC}^*(f_i)$. One might think that the C types would enter even beyond this point if they felt that the L types would be forced to exit *and* the industry could be reduced to a profitable level. This is not the case, as later explained for the two possible cases of relations between $Q_{nC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$. The relationship between $Q_{nC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$ depends on the scaling factor A.

Definition III.2.1: For the following proof,

$$\sum_{i=0}^{\infty} \delta^i = \boldsymbol{\delta}$$

Proposition III.2.2: Only in cases for which $A \leq ((F/q\boldsymbol{\delta}) + c)/((G/q\boldsymbol{\delta}) + c)$ will the expression $Q_{nC}^*(\Delta)$ exceed $Q_{xL}^*(\Delta)$.[44]

Proof: $Q_{nC}^*(\Delta)$ is the locus of points in which a C type firm's entry will no longer be profitable. It must therefore be the case that the industry is saturated so that the total profits to the C types in the industry would be (excluding fixed costs):

$$(Q_{nC}^*(\Delta)AC/(AC+L) - cC)^*\boldsymbol{\delta}$$

The profit to a C type entrant of size q putting the industry at the size of $Q_{nC}^*(\Delta)$ would merely equal the above expression multiplied by q/C. By definition, one could incorporate fixed costs to say:

$$(Q_{nC}^*(\Delta)AC/(AC+L) - cC)^*\boldsymbol{\delta} = F(C/q)$$

$$\boldsymbol{\delta}\, Q_{nC}^*(\Delta)A/(AC+L) = F/q + c\boldsymbol{\delta}$$

[44]"q" is the individual firm size.

$$Q_{nC}^*(\Delta)A/(AC+L) = (F/q\delta) + c$$

$$Q_{nC}^*(\Delta) = ((F/q\delta) + c)*((AC+L)/A)$$

For the calculation of $Q_{xL}^*(\Delta)$, a similar logic can be applied. $Q_{xL}^*(\Delta)$ is the point in which a firm's exit is first profitable. It must therefore be the case that the industry is saturated so that the total profits to the L types in the industry would be (excluding fixed costs):

$$(Q_{xL}^*(\Delta)L/(AC+L) - cL)*\delta$$

The profit to an L type entrant of size q putting the industry at the size of Q_{xL} would merely equal the above expression multiplied by q/L. By definition, one could incorporate the definition of G to say:

$$(Q_{xL}^*(\Delta)L/(AC+L) - cL)*\delta = G(L/q)$$

$$\delta\, Q_{xL}^*(\Delta)/(AC+L) = G/q + c\delta$$

$$Q_{xL}^*(\Delta)/(AC+L) = (G/q\delta) + c$$

$$Q_{xL}^*(\Delta) = ((G/q\delta) + c)*(AC+L)$$

One can now use these expressions to define when $Q_{nC} \geq Q_{xL}$ in terms of A.

$$Q_{nC}^*(\Delta) \quad \geq \quad Q_{xL}^*(\Delta)$$

$$((F/q\delta) + c)^*((AC+L)/A) \geq ((G/q\delta) + c)^*(AC+L)$$

$$(F/q\delta) + c) \geq ((G/q\delta) + c)^*A$$

$$\therefore \quad A \leq \frac{(F/q\delta) + c}{(G/q\delta) + c} = A^*$$

Since f_i is only a probabilistic combination of different values of Δ, $Q_{nC}^*(f_i) > Q_{xL}^*(f_i)$, one can now look at strategies for the two distinct cases and generalize

1. When $Q_{nC}^*(f_i) > Q_{xL}^*(f_i)$: C types will have no incentive to increase industry quantity beyond $Q_{nC}^*(f_i)$. Since $Q_{nC}^*(f_i) > Q_{xL}^*(f_i)$, all of the L types will already attempt exit when $Q = Q_{nC}^*(f_i) > Q_{xL}^*(f_i)$.

2. When $Q_{nC}^*(f_i) \leq Q_{xL}^*(f_i)$: If the C types enter beyond $Q_{nC}^*(f_i)$, they will only force out the L types if $Q > Q_{xL}^*(f_i)$. Once $Q > Q_{xL}^*(f_i)$, ***all of the L types will make themselves available for exit***. Once enough L types have been sequentially chosen for exit so that $Q \leq Q_{xL}^*(f_i)$, the L types will have no more incentive to exit. Since $Q_{nC}^*(f_i) \leq Q_{xL}^*(f_i)$, the C types that entered beyond $Q_{nC}^*(f_i)$ will have lost money. The C types

can continue to push the industry beyond $Q_{xL}^*(f_i)$, but the L types corresponding exit will only bring the industry down to the size of $Q_{xL}^*(f_i)$ (which exceeds $Q_{nC}^*(f_i)$).

In either case, the C types have no incentive to enter beyond $Q_{nC}^*(f_i)$. A period-by-period analysis makes the strategies of the C types easier to see:

•In the first cohort, the C type firms will enter until the industry quantity (Q_1) reaches $Q_{nC}^*(f_1)$.[45]

•Case 1: If demand is not revealed after cohort 1, C types truncate their demand shock estimates between Q_1 and Δ_{max}. Using these truncated estimates, they calculate $Q_{nC}^*(f_2)$. In the next cohort 2, the C types will enter until $Q_2 > Q_{nC}^*(f_2)$ (This argument applies to any cohorts j and j+1 when demand is not revealed after cohort j).

•Case 2: If demand is revealed after period j ($Z_j < 1$) and the total industry quantity is below the final point of profitable entry ($Q_j < Q_{nC}^*(\Delta)$), the C type

[45] $Q_{nC}^*(f_1)$ is calculated in a similar manner to the quantity $Q_n^*(f_1)$ in the Rob model.

firms will continue to attempt entry in a world of deterministic demand until $Q_{nC}^*(\Delta)$ is reached.

•Case 3: If demand is revealed between these two points ($Q_{nC}^*(\Delta) \leq Q_j \leq Q_{xC}^*(\Delta)$), both entry and exit are dominated strategies in periods after j.

•Case 4: If demand is revealed and the total industry quantity exceeds the first point of profitable exit after period j ($Q_j > Q_{xC}^*(\Delta)$), entry is curtailed and all incumbent firms will vie for exit in period j+1 until the point where $Q_{j+1} \leq Q_{xC}^*(\Delta)$.

<u>L types</u>

The sophisticated L types must consider that the C types will eventually make the industry at least the size of $Q_{nC}^*(f_i)$. Because this point $Q_{nC}^*(f_i) > Q_{nL}^*(f_i)$, the L firms know that entry should be unprofitable for them. The only way in which they could profit is to enter very early making short-run profits before the industry gets too competitive for them.

<u>Main Entry Proposition:</u> The L types will never enter under the equilibrium conditions of this model.

The size of the scaling factor A directly influences the relationship between $Q_{nC}^*(f_i)$ and $Q_{nL}^*(f_i)$. The following three points are assumed by the model:

1. $A>1$
2. $Q_{xC}^*(f_i) > Q_{nC}^*(f_i)$
3. C and L type firms *only differ* in their abilities to attract demand.

The following proposition also follows from the assumptions of the model.

<u>Proposition III.2.3:</u> $d(Q_{xL}^*(f_i)-Q_{nC}^*(f_i))/dA \leq 0$.

<u>Proof:</u> $dL_Y/dA \leq 0$ and $dC_Y/dA \geq 0$

Implying, $dQ_{xL}^*(f_i)/dA \leq 0$ $dQ_{nC}^*(f_i)/dA \geq 0$

$$\therefore \frac{d(Q_{xL}^*(f_i)-Q_{nC}^*(f_i))}{dA} \leq 0$$

<u>Assumption III.2.1:</u> There are no discontinuous jumps in $Q_{nC}^*(f_i)$ or $Q_{xL}^*(f_i)$ as functions of A.[46]

[46]This assumption is redundant for most profit functions, but there may be some cases for which it is necessary.

If A = 1, the L types and C types would be identical and:

$$Q_{nC}^*(f_i) = Q_{nL}^*(f_i), \quad Q_{nC}^*(f_i) < Q_{xC}^*(f_i)$$

which would imply $Q_{nC}^*(f_i) < Q_{xL}^*(f_i)$

A* was previously calculated to equal the minimum scaling factor A for which $Q_{nC}^*(f_i) \geq Q_{xL}^*(f_i)$. From this and P4, one can see that *there exist values of A from 1 to A* for which $Q_{nC}^*(f_i) < Q_{xL}^*(f_i)$.*[47]

• When the scaling factor "A" is so large that $Q_{nC}^*(f_i) > Q_{xL}^*(f_i)$, there is no point at which entry is profitable for the L types. The L types will be allowed to enter, but they realize that they will likely lose money by entering because eventually the industry will have only "C" types.[48]

[47]This is certainly the case for A = 1. For values of A just above 1, this must also hold unless there are discontinuities in $Q_{nC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$ as functions of A.

[48]The C types will at least enter until $Q_{nC}^*(f_i)$, where exit is the best strategy for the L types.

Short-run Profits

With certainty, total industry quantity will exceed $Q_{nL}^*(f_j)$ at the conclusion of each cohort j. At these levels, the entry of L types is unprofitable. Knowing this, the L types should only enter if there is some expectation of short-run profits before the industry becomes saturated.

Proposition III.2.4: The *expected* profits for L types to enter is *always* negative.

Proof: It is known that:

In *any* cohort j *before* certainty, the final $Q_j = Q_{nC}^*(f_j)$.

$E[\Pi_L(q, C, L \mid f_j)] < 0$ for any (C,L) on the locus $Q_{nC}^*(f_j)$.

•In *any* cohort j *after* demand is revealed, the final $Q_j \geq Q_{nC}^*(\Delta)$.[49]

•$\Pi_L(q, C, L \mid \Delta) < 0$ for any (C, L) on or above the locus $Q_{nC}^*(\Delta)$.

$\therefore E[\Pi_L(q, C, L \mid f_j)] < 0$ in all cohorts.

Under the conditions of this model, only C types will enter this industry in equilibrium. The C types behave exactly like the identical firms in the original Rob model. This behavior in cohort j+1 is described below as a function of the state of the industry after cohort j:

[49]The C types will at least enter until $Q_{nC}^*(\Delta)$.

i. $Z_j = 100\%$: The C types until $Q_{j+1} \geq Q_{nC}^*(f_{j+1})$ in period j+1.

ii. $Z_j < 100\%$ and $Q_j < Q_{nC}^*(\Delta)$: The C types will enter until $Q_{j+1} > Q_{nC}^*(\Delta)$. The industry stabilizes after period j+1.

iii. $Z_j<100\%$ and $Q_{nC}^*(\Delta) \leq Q_j < Q_{xC}^*(\Delta)$: There is no movement in cohort j+1, as the industry is stable.

iv. $Q_j \geq Q_{xC}^*(\Delta)$: The C types will exit until $Q_{j+1} \leq Q_{xC}^*(\Delta)$.

III.2.2 The Myopic Equilibrium

This section describes the same problem from 2A for decision makers that are myopic. These firms are not subject to any decision biases, but they may still lose money because they do not consider the future entry of rivals.

This idea is not new, as Stein (1989) posited about managers' myopia due to the stock market. In another model Gabszewicz and Quinzii (1986) justified the use of myopic behavior in a capacity adjustment game. Myopia places restrictions on their model, but their results (capacity changes as the result of demand shocks) are still quite intuitive.

For this proposed model, myopia limits firms of both types to seeing the industry (quantity) as being fixed in its current state. They will base their entry and exit decisions *solely* on $Q_n^*(f_i)$ and $Q_x^*(f_i)$ and total current industry quantity. This rationale leads to the following behavior:

Definition III.2.2 (of Myopic Behavior): A C (or L) type will only enter if $Q < Q_{nC}^*(f_i)$ (or $Q_{nL}^*(f_i)$) and exit only if $Q > Q_{xC}^*(f_i)$ (or $Q_{xL}^*(f_i)$):[50]

As in the previous setting, the L types' initial point of profitable exit *may*, in fact, come before the C types' final point of profitable entry ($Q_{xL}^*(\Delta) \leq Q_{nC}^*(\Delta)$) depending on the assumed size of A.[51] If this is the case, the industry will transform from one with a mix of L and C types to one of only C types once the total industry quantity exceeds $Q_{xL}^*(\Delta)$. At the conclusion of this transformation, the industry will stabilize with only C types. The L types' myopia causes them to enter until $Q_{nL}^*(\Delta)$ instead of showing foresight and avoiding entry altogether.

After the first cohort j for which $Q_j > Q_{xL}^*(\Delta)$, the industry will stabilize in cohort j+1 at a size between $Q_{nC}^*(\Delta)$ and $Q_{xC}^*(\Delta)$. In any case,

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[50]For both types, the calculation of expected entry and exit points will be done in the same manner as was done in 2A before the demand shock is revealed.

[51]The existence of cases when $Q_{xL}^*(\Delta) < Q_{nC}^*(\Delta)$and $Q_{xL}^*(\Delta) \geq Q_{nC}^*(\Delta)$ was shown in 2A.

the stabilized industry only consists of C types.[52] A more detailed description of strategies appears below for cohort j+1 after the information is obtained from cohort j:[53]

i. $Z_j = 100\%$: Both types will readjust their demand estimates and enter until $Q_{j+1} \geq Q_{nC}^*(f_{j+1})$ and $Q_{nL}^*(f_{j+1})$ respectively.

ii. $Z_j < 100\%$ and $Q_j < Q_{nL}^*(\Delta)$: Initially, both types will enter until $Q_{j+1} \geq Q_{nC}^*(\Delta)$ and $Q_{nL}^*(\Delta)$ respectively. Because $Q_{xL}^*(\Delta) < Q_{nC}^*(\Delta)$, the L types will go through an exit process once $Q_{j+1} \geq Q_{xL}^*(\Delta)$. Because the C types will continue to enter until $Q_{j+1} \geq Q_{nC}^*(\Delta)$, all of the L types will eventually exit the industry. When $Q_{xL}^*(\Delta) < Q_{j+1} < Q_{nC}^*(\Delta)$, the L types will attempt exit while the C types are attempting entry. The industry stabilizes after cohort j+1 once all of the L types have exited and $Q_{j+1} \geq Q_{nC}^*(\Delta)$.

iii. $Z_j < 100\%$ and $Q_{nL}^*(\Delta) \leq Q_j < Q_{xL}^*(\Delta)$ The C types will enter until $Q_{j+1} \geq Q_{nC}^*(\Delta)$. The L types will initially do nothing as $Q_{nL}^*(\Delta) < Q_j <$

[52]If $Q_j < Q_{nC}^*(\Delta)$, the industry will stabilize at $Q_{nC}^*(\Delta)$. Otherwise, the industry will stabilize once the L types have exited.

[53]This is merely a detailed listing of the behavior described by Definition III.2.2.

$Q_{xL}^*(\Delta)$. The C types' entry will increase industry capacity beyond $Q_{xL}^*(\Delta)$ at some point. At this point (when $Q_{j+1} \geq Q_{xL}^*(\Delta)$), the L types will continue to exit until they no longer exist. The industry stabilizes after this exit concludes *and* $Q_{j+1} \geq Q_{nC}^*(\Delta)$.

iv. $Q_{xL}^*(\Delta) \leq Q_j < Q_{nC}^*(\Delta)$: There will be simultaneous exit of the L types and entry of the C types until all of the L types have exited *and* $Q_{j+1} \geq Q_{nC}^*(\Delta)$. After this process, the industry stabilizes.

v. $Q_{nC}^*(\Delta) \leq Q_j < Q_{xC}^*(\Delta)$: Initially, the C types will do nothing and the L types will exit. The exit of the L types will continue until a.) they no longer exist or b.) it is no longer the preferred strategy ($Q_{j+1} \leq Q_{xL}^*(\Delta)$).

a.) •In the first case, and if the L types' exit concludes and $Q_{j+1} \geq Q_{nC}^*(\Delta)$, the industry is stable.

•If, however, $Q_{xL}^*(\Delta) < Q_{j+1} < Q_{nC}^*(\Delta)$; the C types will then enter to stabilize the industry at $Q_{nC}^*(\Delta)$.

b.) In the second case once $Q_{j+1} < Q_{nC}^*(\Delta)$, the industry will see simultaneous entry of the C types and exit of the L types until $Q_{j+1} \geq Q_{nC}^*(\Delta)$ *and* no L type firm remains in the industry.

vi. $Q_j \geq Q_{xC}*(\Delta)$: Both types will exit until $Q_{j+1} < Q_{xC}*(\Delta)$. The L types will continue to exit until a.) they no longer exist or b.) it is no longer the preferred strategy ($Q_{j+1} \leq Q_{xL}*(\Delta)$).

a.) •In the first case, and if the L types' exit concludes and $Q_{j+1} \geq Q_{nC}*(\Delta)$, the industry is stable.

•If, however, $Q_{xL}*(\Delta) < Q_{j+1} < Q_{nC}*(\Delta)$; the C types will then enter to stabilize the industry at $Q_{nC}*(\Delta)$.

b.) In the second case once $Q_{j+1} < Q_{nC}*(\Delta)$, the industry will see simultaneous entry of the C types and exit of the L types until $Q_{j+1} \geq Q_{nC}*(\Delta)$ *and* no L type firm remains in the industry.

If $Q_{xL}*(\Delta) > Q_{nC}*(\Delta)$, the industry may stabilize with a mixture of "C" and "L" types at a total industry supply between $Q_{nC}*(\Delta)$ and $Q_{xL}*(\Delta)$. The stabilization process in periods j+1 and beyond is much more complicated here. The descriptions below pertain to the behavior of both types of firms in cohort j+1 in relation to the industry output following the previous cohort, Q_j:[54]

[54]This is merely a detailed listing of the behavior described by Definition III.2.2.

i. $Z_j = 100\%$: Both types will readjust their demand estimates and enter until $Q_{j+1} \geq Q_{nC}^*(f_{j+1})$ and $Q_{nL}^*(f_{j+1})$ respectively.

ii. $Z_j < 100\%$ and $Q_j < Q_{nL}^*(\Delta)$: Both C and L types will enter until $Q_{j+1} > Q_{nC}^*(\Delta)$ and $Q_{nL}^*(\Delta)$ respectively. The industry stabilizes after period j+1 at $Q_{nC}^*(\Delta)$.

iii. $Z_j < 100\%$ and $Q_{nL}^*(\Delta) \leq Q_j < Q_{nC}^*(\Delta)$: The C types will enter until $Q_{j+1} > Q_{nC}^*(\Delta)$ The L types will do nothing as $Q_{nL}^*(\Delta) < Q_j < Q_{xL}^*(\Delta)$. The industry stabilizes after period j+1.

iv. $Q_{nC}^*(\Delta) \leq Q_j < Q_{xL}^*(\Delta)$: There is no movement in cohort j+1, as the industry is stable.

v. $Q_{xL}^*(\Delta) \leq Q_j < Q_{xC}^*(\Delta)$: The C types will do nothing, as $Q_{nC}^*(\Delta) < Q_j < Q_{xC}^*(\Delta)$. The L types will exit until $Q_{j+1} < Q_{xL}^*(\Delta)$ or until they no longer exist. The industry stabilizes after period j+1.

vi. $Q_j \geq Q_{xC}^*(\Delta)$: Both types will exit until $Q_{j+1} < Q_{xC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$ respectively. The industry stabilizes when either all of the L types have exited or when $Q_{j+1} \leq Q_{xL}^*(\Delta)$. In the first case, $Q_{nC}^*(\Delta) \leq Q_{j+1} \leq Q_{xC}^*(\Delta)$; implying that an industry with only C types is stable. In the second case,

$Q_{nC}^*(\Delta) \leq Q_{j+1} \leq Q_{xL}^*(\Delta)$; implying that neither type firm has incentive to enter or exit.

Both types of firms are myopic, but only the L types actually get hurt (experience over entry) by this lack of sophistication. In model 2A, the L types never had a positive expectation on profit for entry. The current model would predict these L firms to enter until $Q_{nL}^*(f_i)$ in cohort i. All of the L firms are thus expecting to lose money. Their myopia, however, shields this problem from their view. The C types entered in the previous model until $Q_{nC}^*(f_i)$ in cohort j. Their behavior in this model is similar. The C type firms will not *expect* to lose money (enter beyond $Q_{nC}^*(f_i)$), but they will lose money with positive probability when demand falls below expectations.

III.2.3 The Behavioral (Overconfidence) Equilibrium

The final section examines the problem when decision makers are both overconfident and myopic. Although this change does not drastically affect the firms' strategies, a complicated problem with industry stability arises.

Experimental economists and psychologists have shown consistent overconfidence in (mostly student) experimental subjects. This literature stems from von Neumann and Morgenstern's (1947) expected utility theory explaining people's preferences as a concave function of money. When Allais (1953) showed that people did not follow this theory in their actions, a new field was born which has attempted to mathematically model preferences. Since that time, the literature has taken two paths: (1.) devising revised utility models using mathematics and experimentation and (2.) describing specific fallacies like overconfidence made during experiments (see Weber and Camerer; 1987 for more details). The many different utility models have shown varied degrees of predictive value, but no one theory has yet to capture all of the behavioral fallacies observed in the experiments.

In many studies reviewed by Oskamp (1965), people were shown to be consistently overconfident. Even trained psychologists showed this fallacy concerning evaluations of their patients' disorders. Ross and Sicoly (1979) presented work showing people overvaluing their own impact to a project. Cooper et. al. (1988) found that 81% of new entrepreneurs believed they had a better than 70% chance of long-run survival, although statistics show that only between 29% and 50% of these firms will survive for five years. In fact, 33% of the entrepreneurs in this sample stated that their chances of success were *100%*. On the other hand, only 39% of these same entrepreneurs felt the *other* firms had at least a 70% chance of success.

In this problem, overconfidence and myopia confound the problem of an uncertain demand. Overconfidence is modeled here by *having firms think that their ability to attract demand is greater than the other firms of their type.*

<u>Assumption III.2.2:</u> Firms will keep the same level of *overconfidence* throughout their lifetimes even after demand is revealed.

This group of decision makers is considered less sophisticated than either the strategic or individually rational groups. To assure this, the firms in this model *display both overconfidence and myopia.* The firms' strategies in this setting are very similar to the myopic case, but there are some differences worth mentioning.

•The same equilibrium as in the myopic case results except that both types enter longer and wait too long to exit due to overconfidence. There are overconfident (oc) points of initial exit and final entry for both types:

$$Q_{nC}{}^{*}(f_i) < Q_{nC}{}^{oc*}(f_i) \qquad Q_{xC}{}^{*}(f_i) < Q_{xC}{}^{oc*}(f_i)$$

$$Q_{nl}{}^{*}(f_i) < Q_{nL}{}^{oc*}(f_i) \qquad Q_{xl}{}^{*}(f_i) < Q_{xL}{}^{oc*}(f_i).$$ [55]

Based on these overconfident points, the firms of this model will behave exactly like the myopic firms on the correct points of entry and exit.

Over entry in this model is even greater than in the myopic setting. Before the demand shock is revealed in a cohort j, the L types will enter

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[55] This relationship holds even for the degenerate distribution Δ (firms do not lose their overconfidence when demand is known).

until $Q_{nL}^{oc*}(f_j)$. All of the entering L types will have a losing expectation for profit. The C types should also *expect to lose money* by entering at industry quantity levels between $Q_{nC}^{*}(f_j)$ and $Q_{nC}^{oc*}(f_j)$.

Stability in this model is quite complicated. Even under certainty, a firm of type C may believe it has no entry nor exit incentive in cohort j ($Q_{nC}^{oc*}(\Delta) < Q_j < Q_{xC}^{oc*}(\Delta)$); however, Q_j may actually exceed the real $Q_{xC}^{*}(\Delta)$. Although exit is profitable here, the firm will not exit the market until its capital is depleted (only when $Q > Q_{xC}^{*}(\Delta)$ for some time).

This industry can stabilize if $Q_{xC}^{*}(\Delta) \geq Q_{nC}^{*}(\Delta)$. The stabilization will occur between these two points. In this interval, no C type firm has incentive to enter (even factoring in their overconfidence) and by definition of $Q_{xC}^{*}(\Delta)$, the C type firms find it less costly to remain in the industry than to exit. In this situation, the strategies of the L types are a function of the relationship between $Q_{nC}^{oc*}(\Delta)$ and both $Q_{xL}^{*}(\Delta)$ and $Q_{xL}^{oc*}(\Delta)$. The three following relationships produce the corresponding behavior:

1. $Q_{nC}^{oc*}(\Delta) > Q_{xL}^{oc*}(\Delta)$: The L types will all exit the industry once Q exceeds $Q_{xL}^{oc*}(\Delta)$ (before $Q_{nC}^{oc*}(\Delta)$). The C types will stop entering and will not be doing poor enough to be forced to exit when $Q_{nC}^{oc*}(\Delta) \leq Q \leq Q_{xC}^{*}(\Delta)$.
2. $Q_{xL}^{*}(\Delta) \leq Q_{nC}^{oc*}(\Delta) \leq Q_{xL}^{oc*}(\Delta)$: The L types will not exit on their own, but they will go bankrupt and leave the market when Q

increases beyond $Q_{xL}^*(\Delta)$. The C types will stop entering and will not be doing poor enough to be forced to exit when $Q_{nC}^{oc*}(\Delta) \leq Q \leq Q_{xC}^*(\Delta)$.

3. $Q_{xL}^*(\Delta) > Q_{nC}^{oc*}(\Delta)$: The L types remain in the industry. When $Q_{nC}^{oc*}(\Delta) \leq Q \leq Q_{xL}^*(\Delta)$, neither firm type will go bankrupt and neither has incentive to enter or exit.

Although the L types behave differently than the C types, the industry still stabilizes for all cases when $Q_{xC}^*(\Delta) \geq Q_{nC}^{oc*}(\Delta)$.

When firms are so overconfident that $Q_{xC}^*(\Delta) < Q_{nC}^{oc*}(\Delta)$, stability should not be reached after a cohort j. No region exists for Q_j where the industry is stable.

1. When $Q_j > Q_{nC}^{oc*}(\Delta)$: firms will not enter, but they will be eventually stripped of all capital as $Q_j > Q_{xC}^*(\Delta)$. Once a firm has been depleted of capital, it will be *forced* to exit. When these firms exit, eventually Q will fall below $Q_{nC}^{oc*}(\Delta)$ and new firms will enter.

2. When $Q_{xC}^*(\Delta) \leq Q_j \leq Q_{nC}^{oc*}(\Delta)$: firms will have incentive to enter *and* the incumbent firms will eventually be forced to exit.

3. When $Q_{xC}^*(\Delta) > Q_j$: incumbent firms will not be forced to exit, but there is incentive for entry. The entry will bring Q up to $Q_{nC}^{oc*}(\Delta)$ where the incumbents will begin to have their capital depleted.

This problem of stabilization can be approached in different manners, but it is quite complicated. Two ways to consider this are the depletion of firm capital and the revision of overconfident estimates. This model only considers the depletion of firm capital (forced exit). Revision of overconfident estimates will be beyond the scope of this work, but future work can be devoted to this problem of industry stabilization with overconfident firms.

III.3 Asymmetric Beliefs:

This model is similar to the symmetric model, but each of the firms have independent private demand estimates on the size of the demand shock ($\Delta^1, \Delta^2, ..., \Delta^N$) ranging from 0 to Δ_{max}.[56] These estimates are all random draws from the same demand distribution f. The sophistication of the decision maker is modeled on three separate levels like the procedure in the symmetric model.

Assumption III.3.1: All firms of both types know the family of distributions from which the demand estimates come. This distribution is continuous and its median equal its mean.

The Entry Process

The entry process is conducted in cohorts where the size (number of positions for firms to enter) of the cohort is *chosen by nature* each period from a commonly known distribution ranging from 0 to Y_{max}. All firms of each type are aware of cohort i's size before making their strategy decisions

[56]There are N potential C types and N potential L types.

for the entry positions within cohort i.[57] Firms choose to "attempt entry"or "stay out" before *each* entry position. After a firm has been randomly selected as the ith entrant in cohort j, all remaining potential entrants decide whether to make themselves available for the (i+1)st entry position in the jth cohort. The number of firms of *each type* that vied to be the ith entrant within any cohort is *revealed after the entry of the ith entrant in that cohort.*

The rest of this entry (exit) game is set up exactly like the symmetric game including definitions of the loci $Q_n*(\Delta)$ and $Q_x*(\Delta)$ for both C and L types. Once the industry moves into a world of certainty, the asymmetric game looks exactly like the symmetric game because firms substitute actual demand for their demand estimates in both cases.

Choice of Size

Once a firm has been chosen as the next entrant, it has a choice of size from q_S to q_B.[58] Once this choice is made, the firm's size becomes public knowledge.

[57]The empirical rationale for this idea is the state of the economy, tax law changes, other variables affecting the industry each year, and the industry's ability to attract new firms.

[58]Hoteliers generally agree that there is a minimum and maximum size hotel that is feasible for a specific market segment.

III.3.1 The Economically Rational ("Herd-Like") Equilibrium

In this asymmetric model, the economically rational firms perform a sophisticated form of updating demand. They decide strategies based on both the previous cohort's industry sales percentage and on the *number of firms (of their type) that attempted entry in the previous position.*[59] They use the later piece of information to infer the strategy of the firm that was initially given the median demand estimate of the potential entrants (F_{med}) within their type. Specifically, they can tell whether this firm attempted entry for the previous position by noticing if more than half of the potential entrants of their type attempted entry.[60,61]

Since all firms follow the same rules for attempting entry and they each witness the same entry, "herd-like" behavior will ensue. Firms

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[59]This previous position can be in the same cohort or the final entry position of the previous cohort.

[60]Assuming firms within a type are equivalent except in their demand estimates, the attempted entry of more than half of the firms of a specific type implies the attempted entry of F_{med} of that type.

[61]Because firms enter, the identity of F_{med} may differ for different entry positions. Since N is large and few firms can enter, the demand estimates of F_{med} will vary little and will always be a good estimate for the mean of the demand distribution.

continue attempting entry (or staying out) based on the previous strategies of their competitors, not on their own initial (or revised) demand estimate. As far back as Keynes (1936), it has been suggested that many human decisions are heavily influenced by what other people in the same area are doing. Recently, Bannerjee (1992) points out that "the very act of trying to use the information contained in the decisions made by others makes each person's decision less responsive to her own information and hence less informative to others" (p. 798). His model only allows firms to view the *actions* of previous entrants, but firms still lose money under this herd-like behavior description. He also shows that by forcing the first few entrants to only rely on their own information, profits increase.

All economically rational firms would consider the median demand (of all firms or all remaining firms) estimate as a *better proxy for demand than their own initial estimate.* The only available information that is more useful than F_{med}'s strategy is actual demand.

	Information about Demand in Ascending Order of Accuracy	**When firms use this Information**
1.	No Information	Never
2.	Given Demand Estimate	First Entry Position
3.	Median Demand Estimate (Previous behavior)	From 2nd Overall Entry Position until Demand Uncertainty Resolved
4.	Actual Demand	No Demand Uncertainty

Both types of firms attempt to mimic the expected behavior of their F_{med} before demand is revealed. This behavior is defined below:

Main Behavior Idea (Definition III.3.1): A firm of type j will attempt entry before certainty iff in the previous position (i-1), the proportion of type j's that attempted entry exceeded $B_j(q_{i-1}, T_{i-1})$. $B \leq 1$, q_{i-1} is the size of the entrant in position i-1, and T is the entrant type in position i-1.

The equilibrium calculations and justifications follow:

Main Entry Proposition: For any entry position (except the first) *all* firms within type will either attempt entry or *all* firms within type will stay out.[62]

Behavior of the C types before certainty

- In position 1 of cohort 1, firm i enters only if $Q_{nC}{}^*(\Delta^i) \geq q_S$.
- In all other entry positions before certainty, the C types will follow the decision rule of Definition III.3.1.

Two very different scenarios arise as a function of the proportion of C types attempting entry in the first position:

[62]The post-revelation behavior is the same as the symmetric model.

1. The proportion attempting entry in position 1 exceeds $B_C(q_1, T_1)$.

2. The proportion attempting entry in position 1 is not above $B_C(q_1, T_1)$.

In the first case, the decision rule will tell all of the firms to attempt entry in the second overall position. The decision rule will therefore tell *all* of the firms to attempt entry in the third overall position (since $1 > B$).

The decision rule tells the firms in the second overall position not to attempt entry in the second case. In the third overall position, then, *all* of the firms will follow the decision rule of staying out.

• Once demand is revealed, the C types will behave like the C types in the economically rational symmetric model.

• As mentioned previously, if a cohort j concludes after position i and $Z_j =$ 100% (demand is uncertain), the first entry position in cohort j+1 is strategically treated as if it were position i+1 of cohort j. Since demand was not revealed following cohort j, firms will continue to follow Definition III.3.1's strategy. It thus follows that the "herd-like" behavior displayed in Case 1 or 2 will continue through any number of cohorts *until demand is revealed.*

Once Demand is Revealed:

• If a cohort j concludes with $Z_j < 100\%$, the C types follow one of the three strategies listed below:

1. When $Q_j < Q_{nC}^*(\Delta)$: continued entry of C types until $Q_{nC}^*(\Delta)$.

2. When $Q_{nC}^*(\Delta) \leq Q_j \leq Q_{xC}^*(\Delta)$: no entry nor exit.

3. When $Q_j > Q_{xC}^*(\Delta)$: exit until $Q_{xC}^*(\Delta)$.

Behavior of the L types

The L types should be more cautious in their entry process than the C types because they can only survive in a less saturated world. They will be cautious, but they will still follow the behavior of F_{med}.[63] Unfortunately, if the fraction of L types who attempted entry in position 1 of the first cohort exceeds $B_L(q_1, T_1)$, the L types will continue to enter until the demand uncertainty has been resolved just like the C types (Case 1). Often, very few (or even zero) of the L types will enter in the first position because the expected short-run profits do not compensate for the eventual losses in the future (Case 2).[64]

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[63]The firms of L type will assume that their F_{med} is also being strategic and as cautious about entry as they would be if they had the median demand estimate.

[64]The expected short-run profits in position 1 of cohort 1 vary across the L firms because their demand estimates vary.

The same type of behavior is seen in the two cases for the L types as was shown for the C types after the first entry position *before demand is revealed*. To make entry profitable for an L type in position 1 of cohort 1;

1. $Q_{nL}^*(\Delta i) \geq q_S$ and
2. The expected short run profits must compensate for the known eventual losses when the industry is of size $Q_{nC}^*(\Delta) > Q_{nL}^*(\Delta)$.

Because cohort size is constrained by nature, a cohort may be so small that it may conclude entry with industry supply falling far below many firms' estimates of $Q_{nL}^*(\Delta)$. When the early cohorts are small, there is room for positive revenues in these periods (for both types) before the industry gets saturated. These short-run profits *can* compensate for the eventual losses for an L type firm. The relative size of short-run profits is only relevant for the first position in the first cohort (thereafter, firms will use Definition III.3.1 for entry decisions). Only if at least $B_L(q_1, T_1)$ of these firms attempt entry in position 1, is Case 1 seen.

Post-Revelation Behavior of the L types

When demand is revealed before cohort j, the behavior of the C types has already been described. The L types will probably not be involved post-revelation in either case, with the following exceptions:

a. If $Q_{j-1} < Q_{nL}^*(\Delta)$ and cohort j is a small size, the L types might find the short run profits large enough to justify some entry before they begin to lose money ($Q > Q_{nL}^*(\Delta)$) or must exit ($Q > Q_{xL}^*(\Delta)$).

b. If any L types exist in the industry and $Q > Q_{xL}^*(\Delta)$, the L types will exit until $Q \leq Q_{xL}^*(\Delta)$.

Post Revelation Behavior when $Q_{xL}^*(\Delta) > Q_{nC}^*(\Delta)$:

The stabilization process *after the demand uncertainty has been resolved* in periods j+1 and beyond is exactly the same as the behavior of the myopic firms in the symmetric model (except in this model, cohort size is endogenous). The following describes the behavior of both types of firms in cohort j+1 (and future cohorts j+b) in Case 2 in relation to the industry output following the previous cohort, Q_j when $Q_{xL}^*(\Delta) > Q_{nC}^*(\Delta)$:[65]

i. $Z_j < 100\%$ and $Q_j < Q_{nL}^*(\Delta)$: C types will enter until $Q > Q_{nC}^*(\Delta)$. The L types may enter if cohort j+1 is small and the short-run profits are high enough. This entry (if it happens) concludes before $Q = Q_{nL}^*(\Delta)$. The industry stabilizes after this entry process concludes.

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[65]In the symmetric model, it was previously shown that $Q_{xL}^*(\Delta) > Q_{nC}^*(\Delta)$ with positive probability.

ii. $Z_j < 100\%$ and $Q_{nL}*(\Delta) < Q_j < Q_{nC}*(\Delta)$.: The C types will enter until $Q > Q_{nC}*(\Delta)$. The L types will do nothing, as $Q_{nL}*(\Delta) < Q_j < Q_{xL}*(\Delta)$. The industry stabilizes after this entry process concludes.

iii. $Q_{nC}*(\Delta) < Q_j < Q_{xL}*(\Delta)$: There is no movement in cohort j+1.

iv. $Q_{xL}*(\Delta) < Q_j < Q_{xC}*(\Delta)$: The C types will do nothing, as $Q_{nC}*(\Delta) < Q_j < Q_{xC}*(\Delta)$. The L types will exit until $Q < Q_{xL}*(\Delta)$. The industry stabilizes after this exit process concludes.

v. $Q_j > Q_{xC}*(\Delta)$: Both types will exit until $Q < Q_{xC}*(\Delta)$ and $Q_{xL}*(\Delta)$ respectively. The industry stabilizes when either all of the L types have exited or when $Q \leq Q_{xL}*(\Delta)$. In the first case, $Q_{nC}*(\Delta) \leq Q_{j+b} \leq Q_{xC}*(\Delta)$); implying that an industry with only C types is stable. In the second case, $Q_{nC}*(\Delta) \leq Q \leq Q_{xL}*(\Delta)$); implying that neither type firm has incentive to enter or exit.

Post Revelation Behavior when $Q_{xL}*(\Delta) \leq Q_{nC}*(\Delta)$:

When $Q_{xL}*(\Delta) \leq Q_{nC}*(\Delta)$, the strategies and outcomes after the revelation can be described somewhat differently (similar to the post-certainty behavior of the myopic firms in the symmetric model):

i. Z_j <100% and $Q_j < Q_{nL}^*(\Delta)$: C types will enter until $Q > Q_{nC}^*(\Delta)$. The L types may enter if cohort j+1 is small and the short-run profits are high enough. This entry (if it happens) concludes before $Q = Q_{nL}^*(\Delta)$. The industry stabilizes after this entry process concludes.

ii. Z_j < 100% and $Q_{nL}^*(\Delta) < Q_j < Q_{xL}^*(\Delta)$: The C types will enter until $Q > Q_{nC}^*(\Delta)$. The L types will do nothing until $Q > Q_{xL}^*(\Delta)$. From this point on, there will be simultaneous entry of C types and exit of L types.

iii. $Q_{xL}^*(\Delta) < Q_j < Q_{nC}^*(\Delta)$: The C types will enter and the L types will exit until the industry gets to $Q_{nC}^*(\Delta)$ and no L types remain.

iv. $Q_{nC}^*(\Delta) < Q_j < Q_{xC}^*(\Delta)$: The C types will do nothing initially as, $Q_{nC}^*(\Delta) < Q_j < Q_{xC}^*(\Delta)$. The L types will exit until $Q < Q_{xL}^*(\Delta)$ or no L types remain. If all of the L types exit and $Q_{nC}^*(\Delta) < Q$, the industry stabilizes after this exit process concludes. If the L types exit beyond $Q_{nC}^*(\Delta)$, The C types will enter and the L types will exit until the industry gets to $Q_{nC}^*(\Delta)$ and no L types remain.

v. $Q_j > Q_{xC}^*(\Delta)$: Both types will exit until $Q < Q_{xC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$ respectively. If all of the L types exit and $Q_{nC}^*(\Delta) < Q$, the industry stabilizes after this exit process concludes. If the L types exit beyond $Q_{nC}^*(\Delta)$, The C types will enter and the L types will exit until the industry gets to $Q_{nC}^*(\Delta)$ and no L types remain.

In this model, both firm types may enter the industry well beyond the time that entry remains profitable. In the case of very large cohorts before the revelation (in which all firms will continue to attempt entry), many firms (even C types) will be forced to exit once demand is resolved. These large cohorts breed over entry because firms continue to enter "blindly" until demand uncertainty has been resolved. With larger cohorts, more firms will enter which increases the probability of over entry. Although these firms show sophistication, this sophistication (herd-like behavior) strongly contributes to over entry here.

Equilibrium Calculation of $B_C(q_i, T_i)$:

The previous analysis was based on a specific break point B that firms used in their strategy decisions. Firms attempt to *mimic the behavior of F_{med} in position i+1 based on the proportion of firms attempting entry in position i.* $B_C(q_i, T_i)$ can thus be interpreted as follows:

$B_C(q_i, T_i)$ = Min(Proportion of position i attempted entrants) that implies E[Proportion of position i+1 attempted entrants] $\geq .5$ when the position i entrant is of size q and type T_i.

When Δ is known to be in the distribution f:

Call $\Phi_{c,f}(C, L) = Pr((C, L)$ is above the locus $Q_{nc}^*(f))$

$B_C(q_i, T_i)$ is the function such that:

$\Phi_{c,f}(C, L) = B_C(q_i, T_i)$ when:

$\Phi_{c,f}((C + q_i, L)) = .5$ and $\Phi_{c,f}((C, L + q_i)) = .5$

for all industry supply combinations of C and L types (C, L).

Note: This is only an "equilibrium" analysis for B. The information needed to calculate $B_C(q_i, T_i)$ (that is, the function $\Phi_{c,fi}(C, L)$), is more desirable than $B_C(q_i, T_i)$ itself or the behavior of F_{med}.

Choice of Size

After the first entry position all firms within type have the same beliefs.[66] A firm must decide on size after being chosen for entry.

Before Demand is Revealed:

A. First Overall Position

If this chosen firm i had a ***specific expectation of demand***, it would fit into one of the two groups described below:

[66]Specifically, believing F_{med}'s previous strategy is their best demand estimate.

1. Firms for which $Q + q_S \leq Q_n^*(\Delta^i) < Q + q_B$

2. Firms for which $Q_n^*(\Delta^i) > Q + q_B$

The first group of firms would not choose the maximum efficient scale size (q_B) because that would leave Q above $Q_n^*(\Delta^i)$. An entrant of this group would then choose a size of $Q_n^*(\Delta^i)$-Q. The second group can enter at the maximum size and still keep the total industry quantity below $Q_n^*(\Delta^i)$.[67] This type of analysis is done only for firms in the first position of this model.

B. Other Positions Before Certainty

The firms that are chosen as entrants in this model after the first position do not directly consider demand expectation after the first position. A potential entrant in position p bases its entry decision on the proportion of its type that attempted entry in the previous position (R_{p-1}), and the size and type of the previous entrant. To be consistent, firms' size choice behavior is described similarly:

Definition III.3.2: Once a firm has been chosen as the entrant for position p in cohort j, he chooses size ($q_p(R_{p-1}, q_{p-1}, T_{p-1})$) based on the proportion of its

[67] TAn L type must also consider short-term profits.

type that attempted entry in the previous position, q_{p-1}, and T_{p-1}

where $dq_p(R_{p-1}, q_{p-1}, T_{p-1})/dR_{p-1} \geq 0$ and $(q_p(R_{p-1}, q_{p-1}, T_{p-1}))$.

C. After Demand is Revealed

C types

Once demand is revealed, C type firms simply compare $Q_{nC}*(\Delta)$ with Q in their after being chosen as entrants. Three possible entry cases exist:

1. If $(Q_{nC}*(\Delta) \geq Q + q_B)$, all firms enter with size q_B.

2. When $Q+q_S \leq Q_{nC}*(\Delta) < Q + q_B$, all firms profitably enter at size $Q_{nC}*(\Delta)-Q$ without bringing industry quantity above $Q_{nC}*(\Delta)$.

3. When $Q > Q_n*(\Delta)-q_S$, entry would bring industry quantity above Q_n. Therefore, firms will not enter in this case.[68]

The L types must also consider short-run profits with entry (or exit) decisions. In whatever manner the L types consider short-run profits, they will have symmetric behavior.

[68]In fact, firms might exit here if $Q > Q_x*(\Delta)$.

Main Size Proposition: A.) The first entrant can be of any size, B.) all other firms entering *before certainty must be of size* q_B, and C.) all firms entering after certainty can be of any size.

Proof:

A. There is no constraint imposed on $Q_n^*(\Delta^i)$. Potential entrants can therefore fit into either described group or even choose not to enter. The chosen entrant can therefore be either a group 1 or group 2 type.

B.

Definition III.3.3: Call $R_{p-1}^*(T_{p-1})$ the minimum value of R_{p-1} such that

$$q_p(R_{p-1}, q_B, T_{p-1}) = q_B.$$

Assumption III.3.2: $R_{p-1}^*(T_{p-1}) < 1$ always.

It is known that firms in position p ***will not attempt entry*** when $R_{p-1} \leq B(q_{p-1}, T_{p-1})$. Therefore, for all

$R_{p-1} \leq B(q_{p-1}, T_{p-1})$, $\qquad q_p(R_{p-1}, q_{p-1}, T_{p-1}) < q_S$.

Proposition III.3.1: When $R_{p-1} \geq R_{p-1}^*(T_{p-1})$, this implies

$$q_p(R_{p-1}, q_{p-1}, T_{p-1}) = q_B.$$

Proof: $dq_p(R_{p-1}, q_B, T_{p-1})/dR_{p-1} \geq 0$ (Definition III.3.2)

$v^*(T_{p-1})$ exists (Assumption III.3.2) for all $R_{p-1} \geq R_{p-1}^*(T_{p-1})$

$\therefore q_p(R_{p-1}, q_B, T_{p-1}) \geq q_B$.

But $q_p(R_{p-1}, q_B, T_{p-1}) \leq q_B$ due to its size constraint.

$\therefore q_B \leq q_p(R_{p-1}, q_B, T_{p-1}) \leq q_B$ or $q_p(R_{p-1}, q_B, T_{p-1}) = q_B$

For all entrants of position p (>1) before certainty, $R_{p-1} = 1$ or 0.

$R_{p-1} = 1 > R_{p-1}^*(T_{p-1})$ by Assumption III.3.2.

When $R_{p-1} = 0$, there is no entry in position p.

$\therefore$ From Proposition III.3.1, all *entrants* of position p (>1) before certainty have size q_B.

C.

Because the distribution over $Q_n^*(\Delta)$ is continuous and Q can take on different values as a function of the size of cohorts, any of the three described cases occur with positive probability.

$\therefore$For all firms in position p after certainty, $q_S \leq q_p \leq q_B$.

This main size proposition applies to all of the *entering* firms. It was previously shown that there may be no attempted entries of either C or L types after the first position (if the proportion of entrants does not exceed the break point), but this proposition applies when firms of *either type* do enter.

III.3.2 The Non-Updating Equilibrium

In the symmetric belief game, the myopic firms did not consider future entrants when making their decisions. The level of rationality in this asymmetric game can be defined as myopic firms *only relying on their demand estimate and not updating these estimates based on the number of firms attempting entry in previous positions.* These firms' use of information is described in the following chart.

	Information about Demand in Ascending Order of Accuracy	**When firms use this Information**
1.	No Information	Never
2.	Given Demand Estimate	Under demand Uncertainty
3.	Actual Demand	No Demand Uncertainty

The non-updating firms of this model have a different stopping rule for entry than their economically rational counterparts. A firm i will stop attempting entry only when industry quantity exceeds $Q_n^*(\Delta^i)$. Firm i will behave as if $Q_n^*(\Delta)$ equals $Q_n^*(\Delta^i)$ *until* the demand shock is revealed. Once demand is revealed, these firms will behave exactly as their myopic counterparts in the symmetric model.

Main Entry Proposition: Before demand is revealed, $d\mathcal{R}_p/dp \leq 0$ for both types of firms.

Proof: A firm will attempt entry overall in position p+1 before certainty if:

Attempt entry if $\quad Q(p) < Q_n^*(\Delta^i)+q_S$

where Q(p) = total industry quantity after the entrant from position p

• $Q'(p) \geq 0$ because only net entry occurs before certainty

• For any firm i such that $Q(p) \geq Q_n^*(\Delta^i)+q_S$, this implies $Q(p+k) \geq Q_n^*(\Delta^i)+q_S$ for all $k>0$.

$\therefore \mathcal{R}_{p+k} \leq \mathcal{R}_p$ for all k, p > 0

$\therefore d\mathcal{R}_p/dp \leq 0$

Unlike the economically rational model, the L types' entry strategies only consider total industry quantity against their best guess of $Q_{nL}^*(\Delta)$ in their entry decisions (regardless of short-run profits). Because of the reliance on initial estimates and myopia, some unintuitive outcomes result.

Post Revelation Behavior when $Q_{nC}^*(\Delta) < Q_{xL}^*(\Delta)$:

•Once the demand shock's size has been revealed, both types follow strategies under certainty like the myopic firms in the symmetric model. Specifically, if one defines j as the first cohort such that $Z_j < 100\%$, the strategy of each type of firm (in cohorts j+b for b=1,2... , n) can easily be described. For those cases in which $Q_{nC}^*(\Delta) < Q_{xL}^*(\Delta)$, the following strategies apply:

i. $Z_j < 100\%$ and $Q_j < Q_{nL}^*(\Delta)$: Both C and L types will enter until $Q > Q_{nC}^*(\Delta)$ and $Q_{nL}^*(\Delta)$ respectively. The industry stabilizes after period j+b at $Q_{nC}^*(\Delta)$.

ii. $Z_j < 100\%$ and $Q_{nL}^*(\Delta) \leq Q_j < Q_{nC}^*(\Delta)$: The C types will enter until $Q > Q_{nC}^*(\Delta)$. The L types will do nothing as $Q_{nL}^*(\Delta)<Q_j<Q_{xL}^*(\Delta)$. The industry stabilizes after period j+b.

iii. $Q_{nC}^*(\Delta) \leq Q_j < Q_{xL}^*(\Delta)$: There is no movement in future cohorts, as the industry is stable.

iv. $Q_{xL}^*(\Delta) \leq Q_j < Q_{xC}^*(\Delta)$: The C types will do nothing, as $Q_{nC}^*(\Delta) < Q_j < Q_{xC}^*(\Delta)$. The L types will exit until $Q < Q_{xL}^*(\Delta)$ or until they no longer exist. The industry stabilizes after period j+b.

v. $Q_j \geq Q_{xC}^*(\Delta)$: Both types will exit until $Q < Q_{xC}^*(\Delta)$ and $Q_{xL}^*(\Delta)$ respectively. The industry stabilizes when either all of the L types have exited or when $Q \leq Q_{xL}^*(\Delta)$. In the first case, $Q_{nC}^*(\Delta) \leq Q \leq Q_{xC}^*(\Delta)$; implying that an industry with only C types is stable. In the second case, $Q_{nC}^*(\Delta) \leq Q \leq Q_{xL}^*(\Delta)$; implying neither type has incentive to enter or exit.

Post Revelation Behavior when $Q_{nC}^*(\Delta) \geq Q_{xL}^*(\Delta)$:

The preceding strategies were simply based on the definition of $Q_n^*(\Delta)$ and $Q_x^*(\Delta)$ and considered the myopia of the decision makers only when $Q_{xL}^*(\Delta) > Q_{nC}^*(\Delta)$. The L types' initial point of profitable exit *may* come before the C types' final point of profitable entry ($Q_{xL}^*(\Delta) < Q_{nC}^*(\Delta)$) depending on the assumed size of "A". The strategies of firms do not differ in this case, but the outcomes will see some change:

i. Z_j<100% and $Q_j < Q_{nL}^*(\Delta)$: Initially, both C and L types will enter until $Q \geq Q_{nC}^*(\Delta)$ and $Q_{nL}^*(\Delta)$ respectively. Because $Q_{xL}^*(\Delta) < Q_{nC}^*(\Delta)$, the L types will also go through an exit process once $Q \geq Q_{xL}^*(\Delta)$. Because the C types will continue to enter until $Q \geq Q_{nC}^*(\Delta)$, all of the L types will eventually exit the industry. When $Q_{xL}^*(\Delta) < Q < Q_{nC}^*(\Delta)$, the L types will attempt exit while the C types are attempting entry.[69] The industry stabilizes after cohort j+b once all of the L types have exited and $Q \geq Q_{nC}^*(\Delta)$.

ii. Z_j<100% and $Q_{nL}^*(\Delta) \leq Q_j < Q_{xL}^*(\Delta)$: The C types will enter until $Q \geq Q_{nC}^*(\Delta)$. The L types will initially do nothing as $Q_{nL}^*(\Delta) < Q_j < Q_{xL}^*(\Delta)$. The C types' entry will increase industry capacity beyond $Q_{xL}^*(\Delta)$ at some point. At this point (when $Q \geq Q_{xL}^*(\Delta)$), the L types will continue to exit until they no longer exist. The industry stabilizes after this exit concludes *and* $Q \geq Q_{nC}^*(\Delta)$.

iii. $Q_{xL}^*(\Delta) \leq Q_j < Q_{nC}^*(\Delta)$: There will be simultaneous exit of the L types and entry of the C types until all of the L types have exited *and* $Q \geq Q_{nC}^*(\Delta)$. After this process, the industry stabilizes.

iv. $Q_{nC}^*(\Delta) \leq Q_j < Q_{xC}^*(\Delta)$: Initially, the C types will do nothing and the L types will exit. The exit of the L types will continue until a.) they no longer exist or b.) it is no longer the preferred strategy ($Q \leq Q_{xL}^*(\Delta)$).

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[69]When $Q_{j+b} < Q_{nC}^*(\Delta)$, the C types have incentive to enter. Any incumbent L type firm has incentive to exit when $Q_{j+b} \geq Q_{xL}^*(\Delta)$.

a.) • In the first case, and if the L types' exit concludes and $Q \geq Q_{nC}^*(\Delta)$, the industry is stable.

• If, however, $Q_{xL}^*(\Delta) < Q < Q_{nC}^*(\Delta)$; the C types will then enter to stabilize the industry at $Q_{nC}^*(\Delta)$.

b.) In the second case once $Q < Q_{nC}^*(\Delta)$, the industry will see simultaneous entry of the C types and exit of the L types until $Q \geq Q_{nC}^*(\Delta)$ *and* no L type firm remains in the industry.

v. $Q_j \geq Q_{xC}^*(\Delta)$: Both types will exit until $Q < Q_{xC}^*(\Delta)$. The L types will continue to exit until a.) they no longer exist or b.) it is no longer the preferred strategy ($Q \leq Q_{xL}^*(\Delta)$).

a.) • In the first case, and if the L types' exit concludes and $Q \geq Q_{nC}^*(\Delta)$, the industry is stable.

• If, however, $Q_{xL}^*(\Delta) < Q < Q_{nC}^*(\Delta)$; the C types will then enter to stabilize the industry at $Q_{nC}^*(\Delta)$.

b.) In the second case once $Q < Q_{nC}^*(\Delta)$, the industry will see simultaneous entry of the C types and exit of the L types until $Q \geq Q_{nC}^*(\Delta)$ *and* no L type firm remains in the industry.

Over entry is very prevalent in this model because of uncertainty, the inability to adjust demand estimates, and myopia. Uncertainty leads to over entry when the demand expectation exceeds the actual demand. Even when the estimate of F_{med} is correct, over entry is still present. The firms' reliance on their own estimates forces those firms with high estimates to enter well after F_{med} has ceased attempting entry.

Choice of Size

Definition III.3.4: For notational purposes, the firm labeled "firm i" is that firm with the ith lowest demand estimate.

Main Size Proposition: All of the entrants both before and after certainty may be of any size between q_S and q_B. Before certainty, the probability that a given entrant in position p is of size q_B is negatively correlated with p.

Proof:

Before Certainty

It is known from the definition of Q_n that a firm i will only attempt entry if $Q_n^*(\Delta i) > Q$ in this setting. For *any* specific entry position before certainty, three "groups" of potential entrants usually exist in the industry:[70]

[70]Very late in the industry's lifetime, the second and third groups may be empty. Early in the first few cohorts, the first group may have no members.

1. Firms for which $Q_n^*(\Delta^i) < Q + q_S$

2. Firms for which $Q + q_S < Q_n^*(\Delta^i) < Q + q_B$

3. Firms for which $Q_n^*(\Delta^i) > Q + q_B$

For any entry position, only the firms in the second and third groups will attempt entry. When a firm of the second group is chosen for this entry position, this firm's size will be constrained by his demand expectation and will equal $Q_n^*(\Delta^i) - Q$. On the other hand, a firm of group three will only be constrained by the maximum efficient scale and produce q_B. Because there are an extremely large number of each type of potential entrant, the proportions of each type in specific groups at any time can be described as a function of the industry supply of C and L units and the distribution f:

Group Number	Proportion
1	$\Phi_{c,f}(C+q_S, L)$
2	$\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L)$
3	$1-\Phi_{c,f}(C+q_B, L)$.[71]

[71]The chart is only for C type potential entrants. An L type chart would be similar with $\Phi_{L,f}$ in place of $\Phi_{c,f}$ and firm size added to the industry supply of L types.

•Since the distribution is continuous, $\Phi_{c,f}(C+q_B, L) > \Phi_{c,f}(C+q_S, L)$ except when both =1 (or when both =0).[72]

a. If $\Phi_{c,f}(C+q_B, L) = \Phi_{c,f}(C+q_S, L)=1$, all firms are in group 1 and there is no attempted entry.

b. If $\Phi_{c,f}(C+q_B, L) > \Phi_{c,f}(C+q_S, L)$, this implies:

$$\therefore [\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L)]/[\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L)+1-\Phi_{c,f}(C+q_B, L)]$$

$$= [\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L)]/[1-\Phi_{c,f}(C+q_S, L)] > 0$$

∴Every entrant has a positive probability of being below size q_B.

•$\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L)$ is "generally" unaffected by C and L.[73]

•$\Phi_{c,f}(C+q_S, L)$ is a negative function of both C and L

[72]The second possibility does not exist in this entry game.

[73]Eventually C and L will increase so much that $\Phi_{c,f}(C+q_B, L)-\Phi_{c,f}(C+q_S, L) = 1-1 = 0$, but before that time group 2's size will be only a function of the distribution type f. If f is uniform, group 2's size will not change *until* it finally becomes 0. If f is normal, group 2's size will initially be increasing and then decreasing.

$\therefore [\Phi_{c,f}(C+q_B, L) - \Phi_{c,f}(C+q_S, L)]/[1-\Phi_{c,f}(C+q_S, L)]$ is "generally" increasing in both C and L.

$\therefore$ Before certainty, the probability that a given entrant in position p is of size q_B is negatively correlated with p.

Graphically, as more firms enter, Q increases which moves the industry to the right in the following Figure III.3.1.

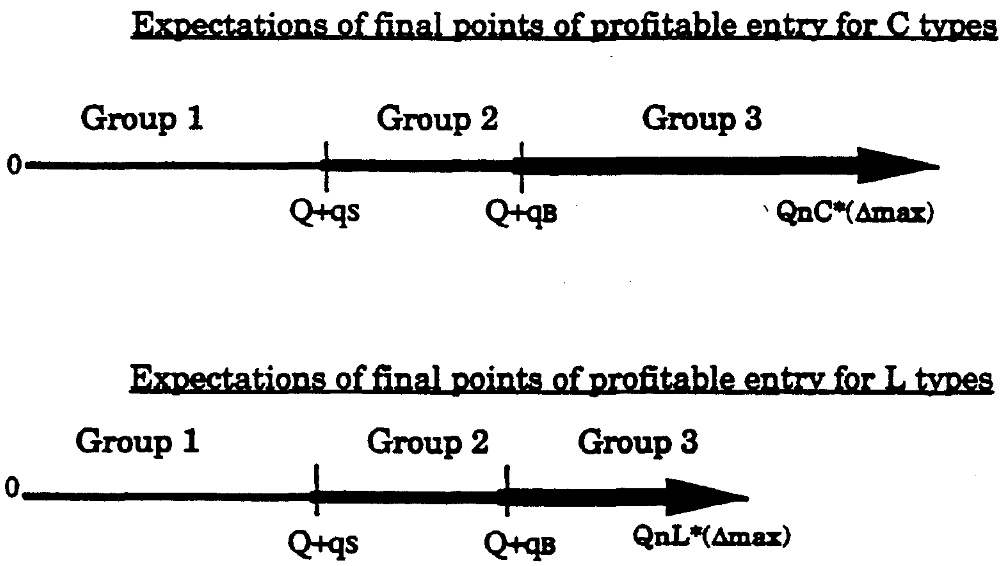

Figure III.3.1

After Certainty

Since these firms have been described as myopic, their post-revelation behavior will be exactly like that of their myopic counterparts in the symmetric game. All of the firms will merely base entry (exit) decisions on a comparison of $Q_n^*(\Delta)$ ($Q_x^*(\Delta)$) and C and L.

III.3.3 The Behavioral (Anchoring and Adjustment) Equilibrium

In the asymmetric game, the two behavior extremes are total reliance on the median demand (seen in the economically rational case) and total reliance on one's own initial demand estimate (seen in the non-updating model). Experimental research has shown that subjects do not revise their initial estimates enough; that is, they anchor and adjust (Slovic and Lichtenstein; 1971).[74] Anywhere in between these two extremes are the "Anchoring and Adjusting" decision makers.

Firms in this group do not adjust their demand estimates fully (to that of F_{med}) to the information that they are given. To account for these firms' lower level of sophistication, it is also assumed that they are myopic.

If full rational adjustment is assigned a value of 1 and no adjustment a value of 0, the firms will each adjust their estimates the same positive level of $K<1$ as a response to new information.

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[74]One of Slovic and Lichtenstein's tests asked subjects to estimate the percentage of African countries in the United Nations. Although there is no correlation between the percentage of African countries in the United Nations and a number spun on a wheel, the experimenter spun a wheel numbered 0-100 before asking the subjects to estimate this percentage. Those subjects witnessing higher numbers on the wheel estimated significantly higher values for the percentage of African countries in the United Nations than those with lower numbers (for instance, subjects who witnessed 65 estimated 45, while those who saw 10 estimated 25).

Updating Techniques:[75]

Firms will adjust their demand estimate *toward* the median after the first entry position when demand is uncertain. They will still use the best information possible in their adjustments.

	Information about Demand in Ascending Order of Accuracy	When firms use this Information
1.	No Information	Never
2.	Given Demand Estimate	First Entry Position
3.	Adjusted Demand Estimate	Under demand Uncertainty after first position
4.	Actual Demand	No Demand Uncertainty

Firms with Initially High Demand Estimates

Until F_{med} does not attempt entry for a specific position p in cohort j, there is no useful "information" for those firms initially given a *high* demand estimate. F_{med}'s attempted entry merely shows that $(C+q_S L)$ is below the locus of points $Q_{nC}^*(\Delta^{Fmed})$. For any firm i with an initially high demand estimate, $Q_{nC}^*(\Delta^{Fmed}) < Q_{nC}^*(\Delta^i)$, so F_{med}'s attempted entry is merely *confirming information.*

[75]The updating discussion will consider a potential C type entrant. An L type entrant's decision can be analyzed in exactly the same way.

Adjustment Process Downward:

When $(C+q_S, L)$ is below the locus of points $Q_{nC}^*(\Delta^i)$, but above the locus $Q_{nC}^*(\Delta^{Fmed})$, firm i will adjust its estimate downward by $K(\Delta^i-\Delta^{i'})$ where $0 < K < 1$. $\Delta^{i'}$ is such that $(C+q_s, L)$ is on the locus $Q_{nC}^*(\Delta^{i'})$.

For many firms, this adjustment may not be great enough to deter entry in the next position (or positions farther in the future). *Eventually*, these same firms with initially high estimates will find entry unprofitable due to the growing industry size and their periodic adjustments downward. Once one of these firms decides not to attempt entry, it will not adjust its demand estimate anymore.[76]

Firms with Initially Low Demand Estimates

By the same token, those firms i with *low* estimates should only have reason to adjust upward when $(C+q_S, L)$ is below the locus $Q_{nC}^*(\Delta^{Fmed})$., but above the locus $Q_{nC}^*(\Delta^i)$. At this point, it can be shown that this firm's small adjustment will not allow it to enter in the following position.

[76]From this point onward, this firm will only be receiving confirming information.

Adjustment Process Upward:

When $(C+q_S, L)$ is below the locus $Q_{nC}^*(\Delta^{F_{med}})$., but above the locus $Q_{nC}^*(\Delta^i)$., firm i should adjust its Δ^i to $\Delta^{i'}$ where $(C+q_S, L)$ is on the locus $Q_{nC}^*(\Delta^{i'})$. The actual adjustment is to change Δ^i to $\Delta^i+K^*(\Delta^{i'}-\Delta^i)$.

Adjustments' Effect on Entry Behavior

<u>Proposition III.3.2:</u> A firm not attempting entry in position t *for which F_{med} attempted entry* will not entry attempt entry in position t+1 (before demand is revealed).

<u>Proof:</u> Taking the previous notation:

$$\Delta^i(\text{position } t+1) = \Delta^i+K^*(\Delta^{i'}-\Delta^i)$$

$$\Delta^i+K^*(\Delta^{i'}-\Delta^i) < \Delta^i+ (\Delta^{i'}-\Delta^i) = \Delta^{i'}$$

$$\Delta^i+K^*(\Delta^{i'}-\Delta^i) < \Delta^{i'} \le \Delta^{i'}\ (t+1).$$ [77]

$$\therefore \quad \Delta^i(\text{position } t+1) < \Delta^{i'}\ (t+1)$$

<u>Proposition III.3.3:</u> A firm not attempting entry in position t *for which F_{med} does not attempt to enter*, will not attempt entry in position t+1 (before demand is revealed).

[77] The demand estimate needed to justify entry in position t+1.

Proof: Using the above notation:

$$\Delta^i(\text{position } t+1) = \Delta^i < \Delta^{i'}$$

$$\Delta^i(\text{position } t+1) < \Delta^{i'} \leq \Delta^{i'}\,(t+1)$$

$$\therefore \quad \Delta^i(\text{position } t+1) < \Delta^{i'}\,(t+1)$$

Main Entry Proposition: Once a firm has decided not to enter, it will never adjust enough to enter before the revelation.

Proof: For any position t that the firm does not enter, F_{med} may do one of two things:

1. F_{med} enters: The firm will stay out in position t+1 by Proposition III.3.2.

2. F_{med} stays out: The firm will stay out in position t+1 by Proposition III.3.3.

$\therefore$ The firm will stay out of the industry in any position t+1.

Post-Revelation Play

The described adjustment processes will only be seen in cohorts before the demand revelation. Once the demand revelation occurs, the game will be played exactly like the non-updating equilibrium because these firms are also myopic.

Firms in this model adjust more than the non-updating firms which curtails some over entry. Specifically, the over entry of the firms with high demand estimates during periods of uncertainty is diminished by their adjustments. The firms with low demand estimates do revise their estimates, but not enough to change their entry behavior before demand is known. Over entry caused by low demand and myopia is not affected by these firms' adjustment processes.

IV. Data and Statistical Tests

In each market data consists of the entry dates (year) of each hotel, their type, and their size. For each of the three markets, it was further necessary to consider a specific group of hotels in the city in which the hotels are located like Center City, Philadelphia (approximately 250 square blocks). In Orlando, the data set consists of hotels in the Lake Buena Vista area both inside and outside of the Walt Disney World grounds (near EPCOT Center). Those hotels that have operating casinos are the only establishments considered for Atlantic City. These groups were chosen in the three cities because they are the groups exploiting the demand shocks of the new Convention Center, EPCOT Center and legalized gambling. Different data sets were available for each of the three cities. The relevant data appears in this section prior to the empirical tests. The data sets for the three cities do vary somewhat due to availability.

Center City, Philadelphia Hotels Operating Since 1986

Philadelphia Hotel	Type	Year Opened	Size	Close
Hotel Atop the Bellevue	Luxury	1989*****	170	
Four Seasons	Luxury	1983	361	
Omni	Luxury	1990	155	
The Rittenhouse	Luxury	1989	114	
The Ritz-Carlton	Luxury	1990	290	
The Barclay	First Class	1929	240	
Hilton	First Class	1983******	428	
The Latham	First Class	1970	139	
Radisson	First Class	1979*	270	1991
Sheraton Society Hill	First Class	1986	366	
The Warwick	First Class	1978**	180	
Wyndam Franklin Plaza	First Class	1981	758	
Holiday Inn Center City	Mid-Priced	1971	450	
Holiday Inn Ind. Mall	Mid-Priced	1966	364	
Holiday Inn Midtown	Mid-Priced	1966	161	
Penn Tower	Mid-Priced	1974***	221	
Quality Inn Hist. Sites	Mid-Priced	1986	96	
Sheraton University City	Mid-Priced	1976	377	
Comfort Inn / Penn's La.	Budget	1987	185	
Ramada Inn Center City	Budget	1984****	278	
Independence Park Inn	Boutique	1988	36	
Penn's View Inn	Boutique	1990	26	
Society Hill Hotel	Boutique	1980	12	
The Ben Franklin	Mid-Priced	<1970	1400	1986
Totals			**5677**	

*: site opened as apartments in 1965, converted to the Palace Hotel in 1979, taken over by the Radisson in 1990. Closed in fall '91 for "temporary restorations". Guests were actually thrown out of the hotel.
**: originally opened from 1929-1976, reopened in 1978
***: Hilton from 1974-1987
****: Franklin Inn Motor Lodge 1953-1983, EconoLodge from 1984-1986, Quality Inn from 1986-1991, Ramada Inn since
*****: Originally built in 1901, it went through many owners until it closed down in 1986; reopened in 1989
******: Bought out by Hilton in 1991

Note: The thirteen chain hotels are written in italics

Figure IV.1

Lake Buena Vista (Walt Disney World Area) Hotels

Hotel Name	Rooms	AAA	Opening	Closing
Best Western Grosvenor	628	3	1971	
Buena Vista Palace Hotel	840	4	1983	
Comfort Inn	640	2	1987	
Compri Hotel	167	4	1988	
Days Inn II	490	3	1985	
Days Inn	245	2	1973	
The Disney Inn	288	4	1973	
Disney's Beach Club	580	U	1991	
Disney's Caribbean	2112	3	1988	
Disney's Contemporary	1053	3	1971	
Disney's Polynesian	855	3	1971	
Disney's Village Resort	578	4	1975	
Disney's Yacht Club	634	L	1990	
Grand Floridian	901	4	1988	
Guest Quarters	229	4	1986	
Hilton	813	4	1983	
Holiday Inn	507	L	1991	
Howard Johnson	308	3	1989	
Howard Johnson Resort	323	3	1972	
Hyatt Regency	750	5	1984	
Marriott	1503	4	1986	
Radisson Inn	200	3	1989	
Hotel Royal Plaza*	396	3	1971	
Travelodge	325	3	1972	
Vistana Resort	722	3	1981	
Walt Disney World Dolphin	1509	U	1990	
Walt Disney World Swan	758	4	1990	
Total	**18,354**			

*: sold in 1986 for $28 million or $71,000/room, foreclosed and auctioned in 1992
Note: The twenty-two chain hotels are written in italics

Figure IV.2

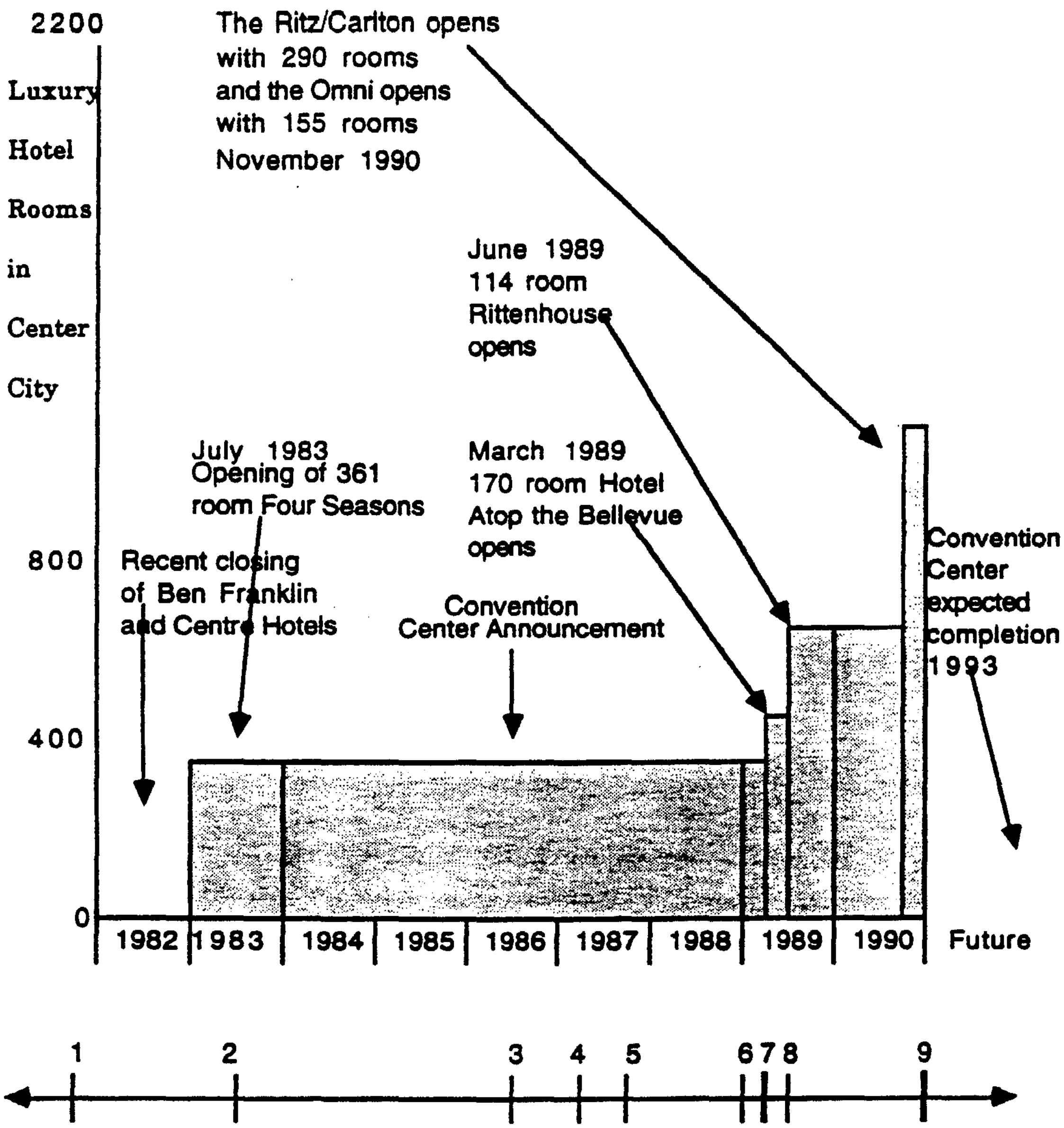
Casino Hotels Operating in Atlantic City since 1978

Casino Hotel	Year Opened	Number of Rooms	Year Closed
Resorts	1978	673	
Caesars	1979	637	
Bally's	1979	500	
Sands	1980	501	
Harrah's Marina	1980	750	
Bally's Grand	1980	518	
Claridge	1981	501	
Tropworld	1981	1014	
Atlantis	1981	500	1989
Trump Plaza	1984	556	
Trump Castle	1985	703	
Showboat	1987	516	
Bally's	1989	800 (expansion)	
Trump Taj Mahal	1990	1250	
Current Total		**8,919**	

Note: All of the casino/hotels are chain operated

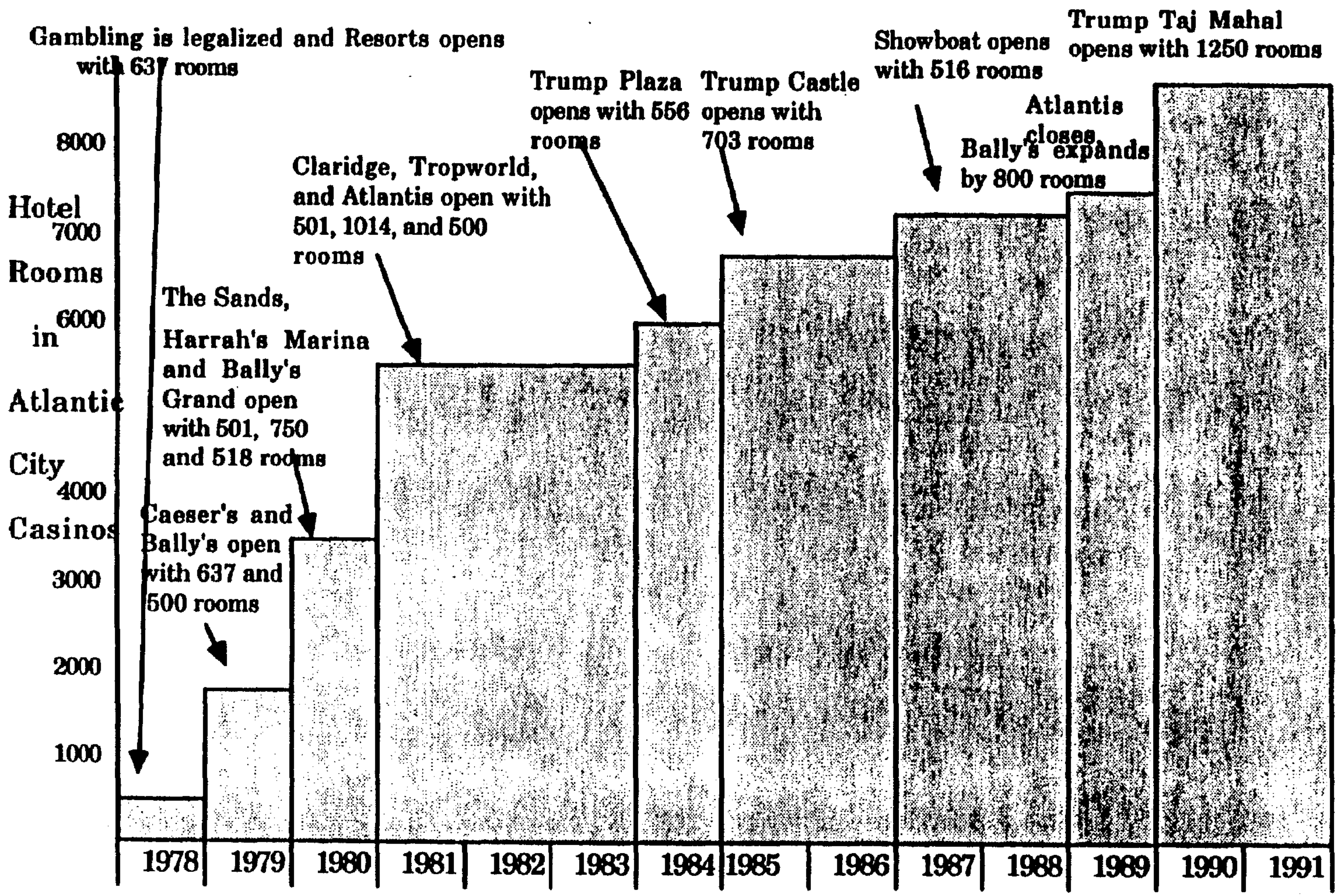
Figure IV.3

Philadelphia'a Luxury Hotels



1. Four Seasons construction begins.
2. Four Seasons opens.
3. Convention Center is announced to open in 1993.
4. The Hotel Atop the Bellevue begins reconstruction after closing in 1986.
5. The Rittenhouse begins construction.
6. The Omni begins construction.
7. The Ritz-Carlton begins construction, the Hotel Atop the Bellevue reopens.
8. The Rittenhouse opens.
9. The Ritz-Carlton and the Omni open.

Figure IV.4



Atlantic City Timeline (Figure IV.5)

Atlantic City Hotel/Casino Yearly Revenue Data: 1978-1990

(base year: 1978, in thousands)

Year	Total Real Casino Revenues	Total Real Revenues/Room
1978	$134,073	$199.02
1979	$292,436	$179.82
1980	$508,760	$179.57
1981	$789,297	$196.60
1982	$1,009,059	$266.92
1983	$1,159,668	$316.58
1984	$1,225,386	$317.36
1985	$1,296,061	$312.08
1986	$1,356,673	$332.88
1987	$1,432,647	$338.67
1988	$1,508,072	$371.12
1989	$1,476,998	$366.02
1990	$1,473,512	$330.93

Figure IV.6

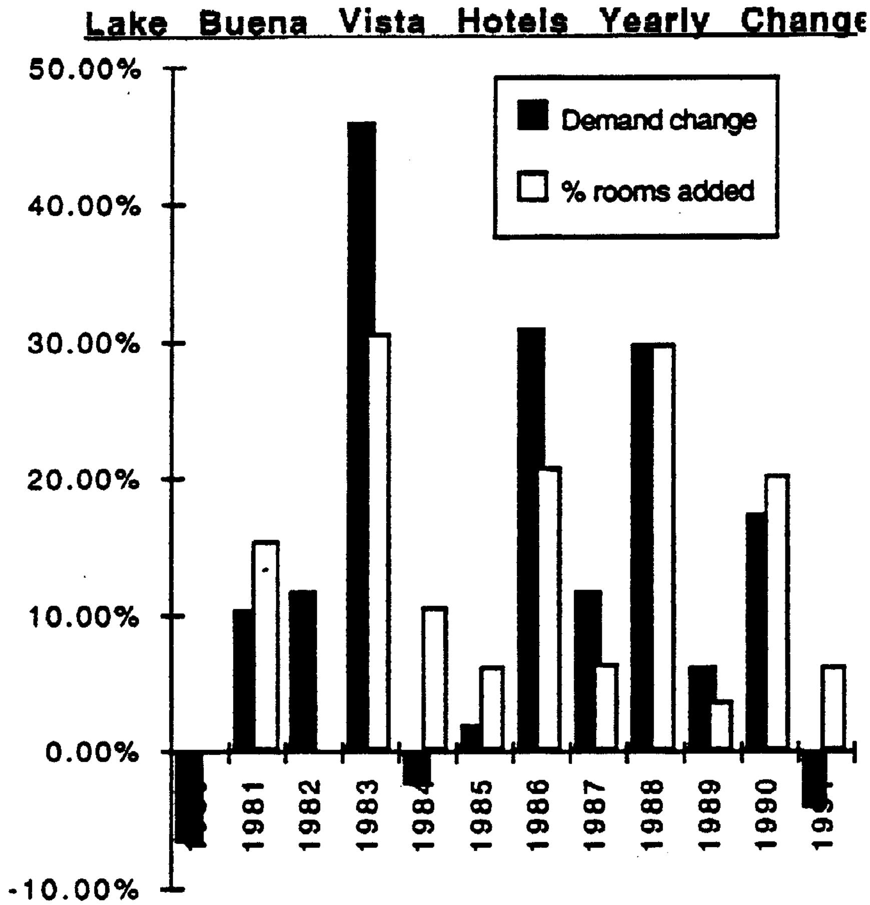

Lake Buena Vista Hotels Yearly Change
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
-10.00%
Demand change
% rooms added
1981
1982
1983
1985
1986
1987
1988
1989
1990

Figure IV.7

IV.1 Definition of Variables

1. L and C type firms: All of the hotels listed as "local" are considered L type firms and the "chain" hotels are considered C type firms.

2. The time of the demand shock announcement:
   a. Atlantic City: Casino/hotels could not open until 1978. This is treated as the time of the announcement because entry could not occur before this.
   b. Orlando: Finalized plans for EPCOT were announced publicly in 1980.
   c. Philadelphia: The building of a Convention Center was announced in 1986.

3. The time of the demand revelation:
   a. Atlantic City: Demand (measured by total casino revenue)[78] had yearly increases until 1988. For the purposes of the tests, 1988 was used as the time when demand was first known.

[78]Occupancy rates are not indicative of market strength due to complementary rooms given to gamblers.

b. Orlando: Demand (measured by industry occupancy times industry supply) is graphed in a previous chart. After significant increases in 1986-1988, demand has only increased slowly since then.[79] From this graph, 1988 is considered the time of the demand shock.

c. Philadelphia: The demand shock has not occurred yet (the Convention Center is still being built), so the demand shock has yet to be revealed.

4. Breaking the markets into groups by hotel class:

a. This was not necessary for Atlantic City because all of the hotels were considered to be of the same class.

b. In Orlando, the 4 and 5 star hotels were grouped together, and 3 star hotels. The four unrated hotels were placed in the first group ("U" for upscale hotels) or in the second group ("L" for low-price) based on their room rates.

c. Philadelphia's hotels are divided into two similar

[79]Demand also saw a significant increase in 1990, but the entire period 1989-1991 saw little overall change to demand.

groups for some tests. The upscale group consists of only the "luxury" and "first class" hotels.

5. Myopic Stopping Time for Locals to enter: Industry occupancy of 68%, by consensus of industry consultants.

IV.2 Distinct Implications of the Symmetric Model

The behavior of the C type firms did not vary between the economically rational and myopic firms. The L types would only enter when they are myopic. This is really the only difference in the equilibrium results between the two levels of decision maker sophistication. Local firms were present in all of the markets except for Atlantic City.

IV.2 Distinct Implications of the Asymmetric Model

The model is not a perfect description of hotel markets and some theoretical differences can not be tested, but there are some testable distinctions. None of these three markets *exactly* mimics the model, but there are some strong similarities:

1. There is an announced positive demand shock in all 3 markets.
2. The hotels are constrained by a maximum and minimum efficient scale of size. The scales differ across city and hotel type, but the scales do exist.

3. Yearly reports on the state of the industry (industry-wide occupancy rates, revenues, etc.) are public information.

4. Firms of different type (chain and local) exist and have equal access to industry information.[80]

5. There is a high fixed cost of entry and a relatively low operating cost.

There are also a few points that were not considered in this model:

1. The demand shocks do not always occur instantaneously.[81] A demand shock may increase the rate of demand change for a number of years or it may make periodic boosts to total demand. This model only considers the case when the shock has a one time effect.

2. There is *some* heterogeneity within firm types in their ability to attract demand.

[80]Some might argue that locals have better access to information because they have relationships with local people, but the chains have more money and can acquire their own information.

[81]For instance, gambling was legalized in Atlantic City in 1978, but there were significant increases in casino revenue until 1988.

3. The process of entering is not instantaneous (it may take over 2 years to build a hotel).

III.1 Testable Implications of the Model

There were many differences for the different levels of decision maker sophistication, but many could not be empirically tested due to the limitation on the data sets. The five tests represent the testable differences for the herd-like and myopic firm types.

1. Firm Size *before demand is known*:

The herd-like firms (except the first entrant) base their size *solely* on the proportion of their type that attempted entry in the previous position. Since this number will always be 1, they will *always* enter at the maximum size.

In the non-updating case, the group of firms with demand estimates allowing them to enter at the maximum size, decreases with industry supply. The group of firms that can enter, but only below maximum size, stays relatively constant with changes in industry supply. This implies that firm size should be negatively correlated with time. This was explained in the discussion of the three groups in the modeling section.

Tests:

Strong test: Herd-like entrants 2, ... , n-1 of size q_B

Weaker test: Herd-like entrants' size is monotonic

Strong test: Non-Updating firms' Correlation (Size of Entrant i, i) < 0 before the demand revelation

Also: Rank-Order test of Size of Entrant i, i before demand is revealed

A. Atlantic City: The data from Atlantic City does not support either model for this test of firm size.

The minimum efficient scale is 500 rooms (by law) and the maximum built so far is 1300 (currently the largest hotel; Bally's). Of the 13 hotels built, only the Trump Taj Majal entered at or near he maximum efficient scale. Bally's opened with 500 rooms in 1979, but it expanded to 1300 rooms in 1989. Seven of the thirteen hotels were built at or near (≤518 rooms) the minimum scale. There is no pattern of the first twelve hotels built at maximum efficient scale; clearly contradicting the predictions of the herd-like equilibrium. On a weaker level, firm size is *not* monotonic with time.

The non-updating equilibrium did not perform very well on this test either as shown below:

Correlation=-.11, Significance = .76

Rank Order Statistic=1.023, Significance = .36

The non-updating model would predict this correlation to be negative, so neither model does well in this market.

B. Orlando: The data from Orlando does not support either model for this test of firm size.

For this large market (where hotels range in size from 167 to 2112 rooms), the hotels were broken up into groups. In none of the groups, however, did the pattern predicted by the herd-like equilibrium prevail. In none of these groups were the early entrants all (or mostly) near the *observed* maximum efficient scale. The weaker test of monotonicity does not hold in any of the three groups either.

The non-updating equilibrium's prediction of a negative correlation does not hold here either, in any of the three groups.

All	Correlation = .06, Significance = .86
	Rank Order: Statistic=1.02, Significance = .37
Upscale	Correlation = -.18, Significance = .80
	Rank Order: Statistic = 1.05, Significance = .32
Low-price	Correlation = .40, Significance = .60
	Rank Order: Statistic = 1.00, Significance = .24

C. Philadelphia: Since 1986, seven hotels have entered the market ranging in size from 96 to 366 rooms. The pattern of chronological hotel sizes by room numbers (366, 96, 185, 170, 114, 155, 290) clearly does not lend support to this point in the herd-like model. A pattern of monotonicity is also clearly not seen.

The non-updating model correctly predicts a negative correlation between hotel size and date of entry only for the upscale hotels. Both of these results, however, would be stronger with more observations.

All	Correlation = .027, Significance = .95
	Rank Order: Statistic = 1.05, Significance = .32
Upscale	Correlation = -.38, Significance = .53
	Rank Order: Statistic = 1.00, Significance = .28

2. L types' stopping rule *once demand is revealed*: The non-updating model predicts the L types to continue to enter until their *myopic* stopping time for entry. Their myopia does not allow them to realize that the C types will continue to enter even beyond $Q_{nL}*(\Delta)$. The herd-like L types do consider short-run profit (due to exogenous cohort size) and stop entering before their *myopic* stopping time.

Tests:

Strong test: Do the locals stop entering before occupancy falls down to 68%?

Weaker test: Is the distribution of the locals' entering times before that of the chains?

Also of interest: Regressions of the number of L or C types entering in year i versus occupancy in year (i-1).

A. Atlantic City: The L types never began entering here. This would lend support to the herd-like model.

B. Orlando: There is strong support for the herd-like model in this market. The L types (local hotels) have not entered the market since the area occupancy was 82%. Since that time, industry occupancy has dropped to 74%. During that time, seven chain hotels had opened and more are currently in the building process.

The weaker t-test was also used to compare the entry times of the local and chain type firms, but it is only significant for the set of all hotels:

All	t-statistic = 2.3	Degrees of freedom = 16	Significance = .04
Upscale	t-statistic = .38	Degrees of freedom = 8	Significance = .72
Low-price	Not enough data to run tests		

The results of the regressions of entry versus previous occupancy rate are shown below:

All	Chain:	Constant = -7.6	Probability = .04
		$Occupancy_{i-1}$ = .115	Probability = .02
	Local:	Constant = .18	Probability = .95
		$Occupancy_{i-1}$ =.002	Probability=.96
Upscale	Chain:	Constant = -2.19	Probability = .54
		$Occupancy_{i-1}$ = .04	Probability = .44
	Local:	Constant = -1.44	Probability = .61
		$Occupancy_{i-1}$ = .022	Probability = .55
Low-price	Not enough data to run tests		

C. Philadelphia: The strong test can not be run because demand has not been revealed yet, so the locals' stopping time for entry is unknown.

The weaker test was insignificant on the small data set available in Philadelphia:

All	t-statistic = -.52	Degrees of freedom = 5	Significance = .63
Upscale	t-statistic = .37	Degrees of freedom = 3	Significance = .74

Although there is not much data, the lack of significant results gives some validity to the non-updating model.

The results of the regressions of entry versus previous occupancy rate are shown below:

All	Chain:	Constant = 6.2	Probability = .18
		$Occupancy_{i-1}$ = -.08	Probability = .23
	Local:	Constant = .60	Probability = .26
		$Occupancy_{i-1}$ = -.40	Probability = .43
Upscale	Chain:	Constant = 1.44	Probability = .74
		$Occupancy_{i-1}$=-.014	Probability = .82
	Local:	Constant = .60	Probability = .26
		$Occupancy_{i-1}$ = -.40	Probability = .43

3. Distribution of entering firms *before* demand is revealed (excluding the first entrant):

When both types are attempting entry before demand is revealed,[82]:

All of the herd-like firms of *both types* display "herd-like" behavior and attempt entry until demand is revealed. Therefore, in each entry position, there is an equal probability of an L type being

[82]There are *some* cases in which neither type exceeds its break point in the first position, but this is the trivial case of herd-like "no entry". There is also a small probability that only the C types will exceed their break point in position 1.

chosen for entry. The non-updating firms will cease attempting entry when industry supply exceeds their demand estimate for industry saturation. The L types' saturation points are smaller than their C counterparts, so they will cease attempting entering earlier. Since the size of the group of L types attempting entry is decreasing faster than the C group, the probability of an L type being chosen by nature as entrant i must decrease with i.

Tests:

Herd-Like: Correlation (entrant i's type, i) = 0

Non-Updating: Correlation (entrant i's type, i) > 0.[83]

A. Atlantic City: There is always a 100% proportion of C types entering, as only the chains have opened in Atlantic City. Since both types do not enter in this data set, this particular test is irrelevant.

B. Orlando:

All	Correlation = .17, Significance = .63
Upscale	Correlation = -.23, Significance = .63
Low-price	Correlation = .80, Significance = .20

[83]The "entrant i's type" term is a 0,1 variable for C and L type respectively.

The inconsistent and insignificant results here lend support only to the herd-like model.

C. Philadelphia: The number of entrants (seven) since the announcement of the Convention Center is too small to show any conclusive evidence, but the data results appear below:

All	Correlation = .06, Significance = .89
Upscale	Correlation = .40, Significance = .51

Although the numbers are not significant, they are leaning to the prediction of the non-updating model.

4. Entry Rate before Demand is Revealed: After the first entry position in the herd-like model, either:

    a. No more firms attempt entry until demand is revealed or

    b. *All* firms of at least one type always attempt entry until demand is revealed.

    Therefore, in all cases in which there is some entry, entry will not stop at least until demand is revealed. In the non-updating model, entry stops as soon as industry supply exceeds the industry saturation level of all firms. This *can* occur before demand is revealed.

Test:

Herd-Like: Entry continues until demand is revealed

(or exactly one firm enters)

Non-Updating: Entry *may* stop before demand is revealed

Weaker test: (done in a previous test) Does entry rate decline over time?

If entry continues until demand is revealed, it is impossible to lend specific support to either prediction.

A. Atlantic City: Twelve hotel/casinos opened in the 11 years before the revelation. Only one of these properties opened in the three years prior to the demand shock and only three of these properties opened in the 7 years before demand was revealed. Although the entry rate definitely slowed down, it is hard to lend support to either model because there was entry one year before demand was revealed (Showboat; 1987).

B. Orlando: There was definitely no stopping time immediately preceding the demand revelation in 1988. In fact, two upscale properties opened in 1988 and one low-price property opened in both 1987 and 1988. This supports the non-updating model's prediction.

C. Philadelphia: This market is still in the pre-demand shock entry stage, but no hotels in any price range have opened in 1991 or yet in 1992 (June). If this pattern continues until the demand revelation, the non-updating equilibrium will gain some credibility.

5. A World of only C types: It is possible that only C types will attempt entry after the first position in the economically rational model because the "break point" was only exceeded for C types in the first position. When this happens, only the C types will attempt entry thereafter until demand is revealed. The non-updating L types will only cease attempting entry when industry supply exceeds the estimate of industry for all remaining potential entrants. There will then be L types continuing to attempt entry before demand is revealed, although the number of L types attempting entry will decrease (eventually to 0) in each succeeding position.

<u>Test:</u>

Herd-Like: Only C types as entrants 2, 3, ... , n before demand is revealed is a distinct possibility.

Non-Updating: Almost always, both L and C types exist.

It should be noted that a pattern of both C and L type entrants will not specifically lend support to either model.

A. Atlantic City: Twelve hotel/casinos currently exist in Atlantic City and they are all chain operated. This is very strong evidence supporting the herd-like equilibrium. It should also be mentioned here that all of the firms operating hotel/casinos in Atlantic City previously operated at least one other *casino*.

B. Orlando: Most of the hotels (19 of 23) in the Lake Buena Vista area are currently chain-operated, but there is still a non-trivial (15% of total rooms) group of local hotels. In both the upscale and low-price markets, two local hotels still operate. Since the demand shock in 1982, only two of the 17 entrants have been local hotels. Although most of the hotels are chain-operated, this is not evidence in support of either model.

C. Philadelphia: Seven of the 19 currently operating hotels are locals. Since the demand shock announcement, five of the seven entrants have been chain-operated. It should also be mentioned that three of the current chain hotels were opened originally as locals and one current local property (The Penn Tower) originally opened as a chain hotel. These numbers do not strongly support either model.

IV.3.2 Consistency Across Tests:

1. Atlantic City: The data here did not allow all of the tests to be run, but the data generally pointed toward following the economically rational model.

2. Orlando: Some of the tests supported the herd-like model, others supported the non-updating model, while others supported neither. Neither model could therefore be objectively considered a good predictor of the behavior in this market.

3. Philadelphia: Although demand has yet to be revealed, the data so far strongly supports the non-updating model. More data and waiting for the Convention Center to open would likely strengthen these results.

Neither model holds for all three data sets. The Atlantic City firms were more "herd-like" than those firms in the other cities. This might be explained by their former experience in similar gambling markets, the stringent rules of the New Jersey Gaming Commission concerning the openings of new casinos, or the public access to profitability data.

The hotels in Orlando did not really follow either of the models, but the Orlando market is still not saturated (even though, demand is revealed). Only in this market did demand increase faster than hotels were built. Even recently with the Orlando market so strong, builders are still somewhat cautious.

Philadelphia still has a few years before its demand is revealed. If the Convention Center is successful, the recently built hotels (which are struggling to survive) should become quite profitable. At this time, the Philadelphia hotels are following the non-updating model, but this result will only be significant if this continues at least through the opening of the

Convention Center.

IV.3.3 Non-Testable Differences

The asymmetric model considers some data that is not available including demand estimates and the number of firms attempting entry in each position. Because of this, some differences between the herd-like and non-updating firms could not be tested directly, including:

1. Before demand is revealed, the number of firms available for entry stays constant when the firms are economically rational. The set of available entrants decreases over time when the firms are the non-updating type.
2. The herd-like firms base their strategies on the proportion of their type attempting entry in the previous period before demand is revealed. On the other hand, the strategies of the non-updating firms is only a function of their original demand estimate during this time.

V. Case Study Analysis[84]

The previous models were not exceptional in explaining behavior in the three chosen hotel markets. Another way to analyze a problem like this is to consider all of the strategic variables affecting the chosen market. This type of "glorified case study" is shown in this chapter for the Philadelphia market.

Between March 1990 and November 1991, there was an unprecedented surge in the luxury hotel market in Philadelphia. Four new luxury hotels opened adding 731 luxury hotels rooms (more than doubling the total to 1092) to the Center City area of Philadelphia (Belden; 1990b). Although there is no specific definition of what constitutes a luxury hotel, people in the business do agree that a luxury hotel must supply the maximum amount of amenities to cater to the business traveler. All of the AAA-rated 5 star hotels and some of the better 4 star hotels are the only ones classified as "luxury." Below this classification of "luxury" lies first class, mid-priced and budget. Many factors are contributing to this current growth and are discussed throughout the paper.

The outlook on the luxury hotel business in Center City, Philadelphia (an area of approximately 250 square blocks) has not always been bright. The hotel market in general had gotten so poor in Center City that during

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[84]A revised version of this chapter appears in *The Cornell Hotel and Restaurant Administration Quarterly*, Volume 33, #2, pp. 33-42.

the three years from 1974-1977 there was a loss of 1500 rooms (out of 6300) due to hotels shutting down (Belden; 1990a.) In fact, between 1981 and 1986, The Ben Franklin (the largest hotel ever in Philadelphia with approximately 1400 rooms), Penn Center, and The Bellevue-Stratford all closed down; a loss of over 2000 hotel rooms.

In 1983, The Four Seasons Hotel opened with 361 rooms (still the largest luxury hotel in the city.) Success quickly came to the Four Seasons. In fact, the Four Seasons consistently had over an 80% occupancy rate (depending on the hotel and market, breaking even implies an occupancy rate usually between 62% and 67%).

Philadelphia, the country's fifth most populous city (U.S. Department of Commerce; 1991), had only one luxury hotel as of 1989. This number paled in comparison to other Northeastern cities like Boston and Washington D.C. which each supported more than ten luxury hotels in a population less than half that of Philadelphia. In their group of hotels, including 34 located in cities of the United States, *The Leading Hotels of the World* (1991 edition) does not include any hotels in Philadelphia.[85] In fact, Philadelphia was the only city in the top nine in the United States (by population) without at least one hotel in this publication.

[85]Hotels apply to join this elite group and can be dropped from the group for lowering standards.

The recent expansion of the luxury hotel market in Philadelphia began in 1989 with the openings of the Rittenhouse with 114 rooms and the Hotel Atop the Bellevue (formerly the Bellevue-Stratford) with 170 rooms. The year 1990 saw the opening of the Omni with 155 rooms and The Ritz/Carlton with 290 rooms (Belden; 1990b.)

The expansion in the luxury hotel market is probably not through, as the Rittenhouse is currently adding 20 rooms, other hotel chains have investigated sites in Center City, and there is ample real estate in the Old City area around Vine and Market Streets near the historic area and the proposed Convention Center. Both the consultants and the Convention Center representatives agree that nearly every major hotelier will get involved in this expansion.[86] Philadelphia Magazine reports 20 hotels in the preliminary stages of building as of March 1991. Felix Rappaport, president of the Greater Philadelphia Hotel Association, predicts that the hotel industry will be the largest employer in the Delaware Valley (consisting of the tri-state area of Southeastern Pennsylvania, Delaware, and Southwestern New Jersey) by the year 2000.

Pricing policies in the five currently operating luxury hotels seem quite similar. Single rooms generally range from $150-200/weekday night

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[86]Marriott has already publicized the opening of a 1,100 room hotel (the 2nd largest hotel ever in the city of Philadelphia) next to the Convention Center.

depending on the view, size of the group, corporate savings, etc.[87] Each hotel has a corporate rate which lowers the bill approximately $10/night as well as group discounts lowering the base even more. The weekends see much lower rates among all hotels.

The amenities provided by the respective hotels are almost exactly alike. Three of the hotels have some type of "membership deal": The Omni, The Four Seasons and The Rittenhouse. Of these three, only The Omni gives deals to the people making the reservations (secretaries, travel agents, etc.) instead of the actual hotel guests. Omni officials claimed that this membership policy has been "effective" in other cities, but it is still too early to decide on the effectiveness of this policy in its Philadelphia location. The Omni differs from the other hotels in that its Philadelphia property is a luxury hotel in a chain of mainly first class hotels (39 of 42.) The Four Seasons offers a free bathrobe and a room discount after 10 visits while the Rittenhouse only offers room discounts for repeated visits. A Four Seasons manager recently said that the robe idea is to make business people feel as if they are part of an exclusive club. Since The Four Seasons had a virtual monopoly for its first six years of existence, the effectiveness of this policy may be hard to judge.

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[87]This compares with an average room rate of $87.16 for all full service hotels (luxury and first class) in New England and the Middle Atlantic States (Pannell Kerr Forster; 1991).

V.1 Conventions Impacting Business/Critical Mass

In July of 1986, the city of Philadelphia announced the building of a large convention center downtown to be completed by 1993. With the opening of this convention center, civic leaders hope to make Philadelphia a leading convention city. It is commonly accepted that major convention cities must have a large convention center, easy access to the city, and ample accommodations. The Philadelphia Convention Center will be the second largest on the East coast if completed on time. The Philadelphia International Airport is easily accessible to most major cities in the United States. For Northeast corridor traffic, Philadelphia's 30th Street Station receives both northbound and southbound Amtrak trains hourly. Philadelphia's accommodations of 7000-8000 hotel rooms in the metropolitan area pale in comparison to other major convention cities like Atlantic City with 18,000 rooms in the area.

There were 5088 hotel rooms in Center City as of December 31, 1989 and 630 of these were luxury rooms (Belden; 1990a.) The increase in hotel demand caused by the Convention Center was estimated in 1990 by L. Clarke Blynn, a principal at Pannel Kerr Foster (an accounting and consulting firm that represents some of the Center City hotels), at 4000-5000 rooms in Center City alone by 1994. This was not an unrealistic estimate as conventions are a large part of the hotel business nationwide.[88] Blynn went further to say that five more convention oriented hotels with 500-600 rooms each will be needed between 1995 and 2000. Peter Tyson, a former partner at the now bankrupt Laventhol and Horwath, thought the hotel market should be more conservative and take a "wait and see" attitude.

Officials from each of the five hotels felt that when the convention center opens, larger conventions will come to Philadelphia. Currently, small conventions are held at convention-oriented hotels and "mid-sized" conventions are held at the Philadelphia Civic Center which hosted 11 conventions over 29 days in 1990 with 105,722 guests (Civic Center; 1991.). Unfortunately, the Civic Center is across the Schuykill River in West Philadelphia and provides no easy walking access to the Center City hotels.[89]

Both Linda Boyle and David Orsini, public relations officials at The Ritz-Carlton and The Four Seasons respectively, felt that the combination of the new hotels and the convention center will make Philadelphia competitive with major convention cities like New York, Chicago and

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[88]20% of all nationwide hotel patrons are attending conferences (American Hotel and Motel Association; 1990).

[89]There are bridges to these hotels, but they are all at least one mile from the Civic Center.

Dallas each of which has large convention centers. This view was supported by Susan Ely, an Administrative assistant of the Philadelphia Convention and Visitors Bureau. Ely said that the new convention center would be the second largest on the east coast (The Jacob Javits Center in New York City) and has already begun to book larger conventions. Ely's statement is, however, based on no other convention centers opening or expanding.[90]

Conversations with officials at The Four Seasons and The Ritz/Carlton demonstrated that conventions are generally 750-800 people, but some conventions or large events like the Army-Navy football game or World Cup soccer championships bring in over 20,000 to the city. Hoteliers generally consider the Olympics Games the largest event for hotels as evidenced by the 85,000 visitors and economic impact of $60 million for the Mexico City games of 1968 (Bradley and Whiteman; 1985). Currently, the largest scheduled convention for the Philadelphia Convention Center is the 1997 Lions Club International which will come with 30,000 conventioneers over a ten day period. By conservative estimates, the conventioneers will spend $29 million in the Philadelphia area (Belden; 1992).

Although these numbers sound staggering with the limited number of hotel rooms in the city, the conventions take place over a number of days.

[90]In fact, Atlantic City is planning a new Convention Center to be opened in 1993 or 1994 which will be larger than Philadelphia's.

During the month of May, 1994; the largest strain will be placed on the city's hotels. During that month, Instrument Society of America will demand an average of 4280 rooms for 5 nights and The American Psychiatric Association will further demand an average of 5400 rooms for 6 nights. The Convention and Visitors Bureau estimates that these two conventions alone will generate more than $14.7 million for the city. Currently twenty-three conventions have been booked for the new Convention Center with 252,690 hotel room nights and an estimated economic impact of $76,112,300 (Pennsylvania Convention Center Sales PACC; 1991).

With the expected increase in the number of conventions held in Philadelphia after 1994, these hotels might expect many new customers. Each of the hotel officials feels that the convention center will increase their proportion of patrons that are conventioneers. The estimate of these increased proportions range from 15-20% at The Rittenhouse to over 40% at the Bellevue. Since authorities from the Convention and Visitors Bureau have stated that the number of conventions in Center City has increased the past few years these hotel officials were also asked to estimate the percentage of conventioneers they have as current customers. Estimations from these officials came in the same order (by hotel) as before, but with smaller proportions in each case. With such large conventions coming into the city, one might assume these estimates are low; however, many hotels are expected to be built in the next three years to host conventioneers including an 1100 room Marriott next to the Convention Center.

Currently, the Convention and Visitors Bureau groups the city's hotels by geographic clusters. A convention planner will be given a cluster (more clusters for larger conventions) in which to choose their hotels. The planner will also be told the respective prices and number of available rooms of the hotels in the cluster(s). In this manner, the planner and bureau decide on hotels to host the conventioneers.

This sets up a strategically interesting situation for the hotel managers who must decide on how many rooms for conventioneers to gain certain future profits (at a reduced room rate) versus facing the uncertainty of demand at the time of the convention. Obviously these managers must consider the days of the week for the convention, as they would expect to see more business travelers on the weekdays. Occupancy rates being seasonal with the Winter months showing the lowest occupancy in the Northeast (Pannell Kerr Forster; 1990) would seem to indicate that rational managers would allow more rooms available at a low rate for conventions in the Winter or on weekends. When the convention center opens in 1993, this idea can be analyzed in more depth.

V.2 Occupancy Rates

Current occupancy is very important to this study, as 61.9% of hotel revenues come from room sales (Pannell Kerr Forster; 1990), but it is probably too early to make a judgement on the occupancy rates of the hotels that entered during the recent boom. Philadelphia Magazine reports that the Four Seasons and Sheraton Society Hill (a first class hotel) have the highest current occupancy rates in Center City as of March 1991. Some data on occupancy rates appears in Pannell Kerr Forster's annual hotel industry brochure, *Trends*. From this publication the seasonality of hotel bookings is seen in Philadelphia (and the Northeast, in general). The greatest occupancy occurs during the Spring and Fall months and the lowest occupancy during the Winter months. Even with the seasonal demand variations, only The Omni (of the five luxury hotels being studied) prices vary according to the season.

During seasons (or days) of high demand hotels must consider policies of over booking to account for cancellations. Lambert et. al (1989) ran a simulation to devise the optimal over booking policy for the 371 room St. Ignatius hotel in the Southeast. Before the simulation ran, St. Ignatius' policy was to never over book; but the simulation showed that over booking by up to 15 rooms per night was the optimal policy.[91] Of the five luxury hotels in Center City, only the Four Seasons does not allow any over booking. Each of the other luxury hotels allows over booking on a day-to-day basis. Some of the factors used by these hotels in deciding how many rooms to over book are no-show rates, time of the year, and number of guarantees.

The hotels' policies on over booking at first glance seem risk-averse as both the Four Seasons and the Hotel Atop the Bellevue have not turned

[91]Incorporating a high loss for turning away booked customers.

away any reserved guests from November, 1990 to June, 1991 (the other hotels did not release this information). Another explanation may be that turning guests away may incur a much higher proportional cost than the nearly three times room rate used in the St. Ignatius simulation. This explanation is strengthened by the comments of a Four Seasons front office manager who said "The cost (of turning guests away) is too high when you have businessmen traveling 200 days a year."

It may also be the case that hotel occupancy is too low to make over booking a major concern. Ray Skaddan of Pannell Kerr Forster feels that the luxury hotel market is "... maxed-out ..." and that the existing hotels will fight for their profits. His view is supported by Pannell Kerr Forster records which show that:

1. Philadelphia hotels had a drop in occupancy in every month comparison between 1989 and 1988.
2. Downtown Philadelphia hotels had a significant drop in occupancy from 69.0% to 65.0% from 1989-1990.[92]
3. Expensive hotels (more than $85/night) in the Philadelphia area lost occupancy (67.3% to 66.4%) during the same time period.

[92]Downtown occupancy was down to 59% in 1991.

4. In month-to-month comparisons, the first 3 months of 1991 achieved 9.0%, 10.3%, and 17.2% less occupancy than in 1990 falling to levels of 46.5%, 56.1% and 57.3% respectively.

Comparing the above numbers with the following national numbers, it is easy to notice that Philadelphia's hotel market has been moving against the national trend, but in the same direction as the New England and Mid-Atlantic regions:

1. Overall occupancy increased 1.2% from 1988 to 1989 reaching a 67.2% occupancy rate nationwide.
2. Full service (luxury and 1st class) hotels in the New England and Mid-Atlantic region had a 4.1% occupancy drop from 1988 to 1989 to 65.3%.

An official of the hospitality group of Coopers and Lybrand Inc. in Philadelphia "seriously doubts" any of the four recently built luxury hotels is consistently getting over 50% occupancy. Front office managers from The Ritz/Carlton and The Hotel Atop the Bellevue disagreed. They claimed that The Ritz/Carlton achieved a 65% occupancy rate for April and a 70% rate for May 1991 while The Hotel Atop the Bellevue averaged 58.6% occupancy for fiscal year 1990 and has thus far (June 10, 1991) averaged 61.2% occupancy for 1991. Further analysis of occupancy rates must begin with a method to acquire specific and correct rates.

V.3 Supplier Externalities

Supplier's economy of scale was first checked by considering all of the suppliers to these five hotels for daily items such as soap, shampoo and towels. None of these companies supplies for more than one hotel. Since there were four hotels built in little over one year, builders' economies of scales were examined; however, no builder nor architect was employed in more than one project.

V.4 Impact on Other Businesses

These new hotels may have thought that their presence in the city could influence business customers to stay overnight instead of taking a late train or plane. Amtrak's metroliner service carries approximately 60% business travelers. Unfortunately, Amtrak does not compile data on specific services (like the Metroliner) originating from different cities nor times of travel. As the chart below shows, Northeast corridor and Metroliner service decreased modestly in 1990, but the number of riders coming in and out of Philadelphia increased dramatically (6%). This increased traffic into Philadelphia may be partially explained by addition of new hotels that bring new patrons with them (see section IX.)

Year	All Metroliner Service Number of Passengers	% change
1988	1,901,887	--
1989	2,062,683	8.5
1990	1,986,258	-3.7

All Northeast Corridor Service (Washington to Boston)

Year	Number of Passengers	% change
1988	11,228,610	--
1989	11,114,792	-1.0
1990	11,185,322	-0.6

All Philadelphia Service

Year	Number of Passengers	% change
1988	3,473,709	--
1989	3,448,632	-0.7
1990	3,655,696	6.0

Source: Howard Robertson; Amtrak Public Relations, New York, NY.

Another result of the increasing number of luxury hotel rooms would be the increased business for upscale retailers and restaurants. This may help to explain the explosion of new upscale retail stores (Tiffany, J. Crew, 1 Liberty Place, etc.) in Center City. At this time, it has been impossible to obtain data from airlines, taxi companies, rental car agencies and other businesses that would be affected by a hotel demand surge.

V.5 Takeover of First Class Hotels/Trickling Down Effect

A possible concern is the "16% rule of thumb" proposed by Peter Tyson. His study in the mid 70s of "comparable" cities to Philadelphia showed that luxury hotels could only capture 16% of the combined business of luxury and first class hotels. Currently luxury hotels take up 33% of this market in Philadelphia (Werner; 1991.) Most industry experts, including Tyson, admit that demand patterns have changed since that time, but none feel that luxury hotels can yet capture near 33% of this market. According to this theory, two scenarios could develop:

1. Some luxury hotels will exit the market; most likely The Rittenhouse or The Hotel Atop the Bellevue because of their financial structure and lack of national name recognition.
2. Some of the luxury hotels or luxury hotel rooms will discount room rates to steal business from the first class hotels. This may lead to a "trickle-down" effect throughout the industry.

According to an official of Coopers and Lybrand, the second scenario is exactly the current situation in the industry. These luxury hotels have already begun to discount room rates especially on the weekends. Philadelphia Magazine reported that all of the luxury hotels offer a weekend special rate between $99-$135/room to compete with the first class hotels who generally offer weekend special rates of $89-$99. Five of the cities' six first class hotels are actively preparing for expected competition from the luxury hotels. These preparations include renovation, redoing rooms, sprucing up and advertising. Only The Barclay Hotel has resisted preparation, as it has been up for sale since May of 1989.[93]

Recently, the behavior of the luxury firms has made their assault on the first class market obvious, but it may also be that these luxury hotels entered the Philadelphia market with this intention. They may have viewed the first class hotels in the city as exploitable. A possible explanation may lie with the preferences of the first class customers who

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[93] Its asking price dropped from $30 million to $15 million in two years.

may be quite willing to gain significant quality (stay at a luxury hotel) with a marginal increase in price (pay the reduced luxury price). This may be especially true during a recession. In a recent article, Sean Hennessey points out that "many people tend to trade down when choosing a hotel in a recession" (Hennessey; 1991).

This trickling-down may be occurring, but it is apparently not the official policy of these hotels to affirm this. Officials from each of the five hotels denied making an effort to attract first-class customers. In fact, none of these hotel officials considered the vulnerability of the first class market in Philadelphia as a significant factor into their entry decision into the market. Neta Van Der Gaast , a public relations official of The Omni, seemed to capture the most important factor in these hotels' entries by stating "... the major factor was the deficiency of luxury hotels in Philadelphia."

Price wars could occur in any industry although in this industry it is unlikely because a drop in price might signal to the consumer a drop in quality. These hotels cater almost exclusively to business people who care tremendously about quality and little about price. In his article Hennessey states "some luxury hotel managers believe their clients are price insensitive, but few hotels actually fit into this profile."[94] None of the officials of the five hotels claimed that their customers were totally price insensitive, but a few interesting points were made:

i. Due to the recession, customers are more concerned now than a year ago about price.
ii. Customers are not concerned at all with price because their companies pay the bill, but their companies do negotiate.
iii. Guests can be classified into different types including corporate transient, groups, walk-ins, and weekend travelers who each have different levels of price insensitivity.

The hotels seem to be acting quite rationally (and legally) by using business discounts, weekend specials and other rate deals to price discriminate among each of these different customer types. As long as no Antitrust suits get brought against hotels, one would expect this practice to continue.

[94]Hennessey's point contradicts the actual industry development of the late 1970s where luxury hotel prices increased faster than inflation, but occupancy was not affected. In fact, the demand for luxury hotels increased.

V.6 Multi-Market Contact

In some industries, multimarket contact increases competition while in others it helps aid in collusive activity. Bernheim and Whinston (1990) have considered this idea in a theoretical paper under different assumptions that could be specified as the Philadelphia luxury hotel industry. Much of the assumed information in their paper is impossible to quantify for this industry, but a reasonable attempt is made to analyze at least the degree of multimarket contact among the five hotels.

The Rittenhouse and The Hotel Atop the Bellevue are not affiliated with any other hotels in the world while the other three are parts of large hotel chains. The Canadian based Four Seasons is one of 27 of its kind throughout the world including 17 locations in the United States. There are 35 Omnis in the United States and two in Mexico City, while there are Ritz/Carltons operating or being built in 34 major cities.[95] For each of the three hotel chains, the major city hotels are generally corporate owned and the minor city ones are privately owned.

V.6.1 Old Combinatorial Measure of Multimarket Contact

Scott (1982) developed some measures for multimarket contact. Mester's (1987) use of one of these measures showed no strategic multi-county contact between California bank branches.

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[95]Other luxury hotel chains in the United States include the European based Intercontinental and Hotel Sofitel with 11 and 6 U.S. properties respectively.

Computation seen below shows that none of the hotel chains seems to be strategically making excessive multimarket contact. In fact, in all three cases the number of contacts is strictly less than the expected number that Scott's method calculates. In the case of The Ritz-Carlton and The Omni, the statistics are strong enough to show that they *are actually avoiding each other*.

This method begins by counting the total number of possible markets, n. For a specific market one considers the two largest firms and computes the probability, p(f), that these two firms will have contact in exactly f of the other n-1 markets in the following manner:

$$p(f) \quad = \quad (C_{s2-1,f} * C_{n-s2,s1-1-f})/(C_{n-1,s1-1})$$

where s1= the number of markets in which the largest firm competes

where s2= the number of markets in which the second largest firm competes and where $C_{x,y} = x!/([y!(x-y)!]$

If one calls A the number of markets in which the firms actually meet, one can compute the probability of observing less contact (PMMC) than A by summing the p(f)'s from f = 0 to A-1. To be complete, it is imperative to compute ADEV (the difference between the observed number of meetings in other markets and the mean of the probability distribution, measured in standard deviations):

$$ADEV = (A-u)/(\Sigma(f-u)^2 * p(f))^{1/2} \quad \text{where } u = \Sigma f * p(f) \quad \text{for } f = 1,2, \ldots, A-1$$

If this computation leads to a high PMMC and a positive ADEV, the hypothesis of a random distribution is not credible implying some strategic action on the part of the firms. Using this method, interactions in 32 large national hotel markets are shown below.[96]

<u>Multi-Market Contact of The Ritz-Carlton and The Four Seasons</u>

s1 = 17 (Ritz-Carltons) s2 = 11 (Four Seasons) n = 32

Actual number of meetings besides Philadelphia = 5

Expected number of meetings besides Philadelphia = 5.16

Probability(≤ 5 other meetings) = .60

Probability(< 5 other meetings) = .31

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[96]The following cities constituted our sample of 32. They were chosen by size and, hotel activity in the areas:

Atlanta,Baltimore, Boston, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Hawaii, Houston, Indianapolis, Jacksonville, Kansas City, Los Angeles, Memphis, Miami, Minneapolis, New Orleans, New York City, Orlando, Philadelphia, Phoenix, Portland, Providence, Richmond, San Diego, San Francisco, Seattle, St. Louis, Tampa, and Washington D.C.

Multi-Market Contact of The Ritz-Carlton and The Omni

s1 = 21 (Omnis) s2 = 17 (Ritz-Carltons) n = 32

Actual number of meetings besides Philadelphia = 7

Expected number of meetings besides Philadelphia = 10.32

Probability(≤ 7 other meetings) = .02

Probability(< 7 other meetings) = .001

Multi-Market Contact of The Omni and The Four Seasons

s1 = 21 (Omnis) s2 = 11 (Four Seasons) n = 32

Actual number of meetings besides Philadelphia = 4

Expected number of meetings besides Philadelphia = 6.45

Probability(≤ 7 other meetings) = .06

Probability(< 7 other meetings) = .01

The Scott (1982) method is quite useful as a benchmark but does not capture some important features. For instance, both chains have more than one hotel in some cities and the size of hotels differs across cities. Finally, this model considers each market as equal which is not an accurate assumption with cities in the hotel industry.

V.6.2 *New Multimarket Measure*

This new measure deals with two more items than before; more than one chain firm in one market and relative sizes of markets. In the future, firm size should also be addressed. This new measure compares an expected measure of multimarket contact with the actual measure.

These expected number of meetings were compared with the actual number of meetings (which were computed by multiplying the number of hotel chain j firms by the number of hotel chain k firms in market i). Strategic multimarket contact would imply that the sum over the cities of the actual contact numbers would be higher than the expected. A summary of the results follows.

Before computing these measures, cities must be classified into market size. Cities were first assigned market sizes (ms_i) according to the following rule where populations are in terms of millions (henceforth referred to as Rule A):[97]

Population (p)	Market Size	Population (p)	Market Size
$p \leq .1M$	1	$1M < p \leq 1.5M$	7
$.1M < p \leq .2M$	2	$1.5M < p \leq 2M$	8
$.2M < p \leq .3M$	3	$2M < p \leq 3M$	9
$.3M < p \leq .5M$	4	$3M < p \leq 5M$	10
$.5M < p \leq .75M$	5	$p > 5M$	11
$.75M < p \leq 1M$	6		

[97]Populations are taken from the 1990 census figures.

In an effort not to appear strategic in rule choice, the following rule B is considered:

Population (p)	Market Size	Population (p)	Market Size
$p \leq .3M$	1	$1.5M < p \leq 3M$	4
$.3M < p \leq .75M$	2	$3M < p \leq 5M$	5
$.75M < p \leq .1.5M$	3	$5M < p$	6

For both rules, first the expected number of hotels from chain j ($E_{j,i}$) in city i was computed as such:

$$E_{j,i} = [ms_i/Av(ms_i)]*[N_j/n]$$

where $Av(ms_i)$ = average market size across all of the n markets and where N_j = number of hotel chain j's existing in all of the n markets

At this point, the expected number of meetings between hotel chains j and k in market i is computed below:

$$EM_{jk,i} = Rd(E_{j,i}*E_{k,i})$$

where Rd=rounding to the nearest integer function (this was done to account for the many 0's that would be used in the actual hotel calculations).

Rule A:	Hotels	Expected	Actual
i. Test of all 32 cities:	Ritz/Four	9	15
	Ritz/Omni	12	14
	Omni/Four	9	7
ii. Test of top 19 cities:[98]	Ritz/Four	12	14
	Ritz/Omni	12	13
	Omni/Four	10	7

Rule B:	Hotels	Expected	Actual
i. Test of all 32 cities:	Ritz/Four	6	15
	Ritz/Omni	13	14
	Omni/Four	11	7
ii. Test of top 19 cities:	Ritz/Four	13	14
	Ritz/Omni	13	13
	Omni/Four	12	7

[98]Of these 32 cities, the following 19 consisted of the most populous:

Baltimore, Boston, Chicago, Cleveland, Dallas, Detroit, Hawaii, Houston, Indianapolis, Jacksonville, Los Angeles, Memphis, New York City, Philadelphia, Phoenix, San Diego, San Francisco, Seattle, and Washington D.C.

The only significant differences appear in bold; that is for both rules when The Ritz/Carlton and The Four Seasons are compared across all cities. These computations generally go in the same direction as the original Scott model, but the results here incorporate more relevant factors and therefore are stronger.

Nationally, The Ritz/Carlton and The Four Seasons are operating in similar markets while The Omni seems to be avoiding The Four Seasons. At this point it is important to consider that all of The Ritz/Carltons and Four Seasons are luxury hotels, but most of The Omnis are only first class properties.

None of the measures considered in this section considered the market concentration across cities. Scott's original multimarket work claims that high concentration and contact are necessary for collusion. In the future, it would be helpful to consider concentrations including market shares, although this information is confidential and may be difficult to publish.

V.7 National Hotel Picture

As the table in the appendix shows, Philadelphia is not alone in its luxury hotel expansion and convention center activity. Six major cities besides Philadelphia have recently had or are planning new convention centers or major renovations on old centers.[99] The Dallas convention center's plan most closely parallel the time to Philadelphia's, but Dallas' hotel boom started four years earlier. Four of these six cities have experienced a luxury hotel boom probably at least partially due to their convention center. Only the two small midwestern cities (Cincinnati and Minneapolis) have not seen booms after making Convention Center plans. A probable explanation is that both cities are quite small (less than 1/4 of the size of Philadelphia) and have been losing population in the 1980's. Each of the other four cities (located in Texas and the Pacific coast) have been experiencing growths greater than the national average (10.21%) and all except Portland are quite large.

Many cities are experiencing strong hotel growth with a good percentage of this growth in the luxury hotel industry. In fact from 1980-1989, over one million rooms were added (an increase of 50% from 1980) to the national stock of hotel rooms while 1300 (-20%) hotel rooms were lost from the Center City Philadelphia market during the same time period (Werner; 1991). During roughly the same time period the United States' population (U.S. Department of Commerce; 1990) increased by more than 23 million (+10.21%) and the Philadelphia population decreased by over 102,000 (-6.1%.) Along with the hotel room number explosion, the hotel industry has experienced a room rate explosion. *Trends* shows that the CPI

[99]Cincinnati, Dallas, Los Angeles, Minneapolis, Portland, and San Diego.

increased 3.8 times while the average hotel room rate increased 5.1 times during the period 1967-1989.

It would be helpful to model the luxury hotel industry as a cycle of occupancy rates, but this has proven difficult thus far. Intuition leads to considering a city before, during and after the opening of a new convention center. The hotel industry as a whole has experienced some cycles during the twentieth century. These cycles typically begin with a period of extremely high occupancy rates (early 1920s and late 1940s), followed by a period of excessive (over) building, which is then followed by a shakeout period of low occupancy rates. Occupancy rates nationwide have reached as high as 95% in 1946, but as low as 51% in 1933. After the excessive building of the 1950s, occupancy rates fell during the next 15 years hitting a low between 55 and 57% in 1971. In fact, the Northeast was hit even harder than other areas as New York City lost hotel rooms in every year from 1961-1978 (Bradley and Whiteman; 1985).

Currently another building boom seems to be coming to a close nationwide. In a 1987 article, Glenn Withiam, executive editor of Cornell Hotel and Restaurant Administration Quarterly, wrote "...In virtually every U.S. city, there has been an over building of luxury hotels." Two years later, George Overstreet wrote in the same journal a two part case study on the over building of hotels in Charlottesville, Virginia. In this case, it was commonly known that Charlottesville could support another 200 hotel rooms in 1983, but eight different companies built 1116 rooms in the next six years forcing sales and bankruptcies. Nationwide hotel occupancy has dropped more or less steadily from 66.2% in 1984 to 63.3% in 1990 (Pannell Kerr Forster; 1991).

V.8 Hotel Size/Demand Uncertainty

With The Four Seasons performing so well, it may be hard to understand why no competitor entered the Philadelphia market for six years. Both Kimberly Barge of The Hotel Atop the Bellevue and Linda Boyle of The Ritz-Carlton said that there was too much uncertainty about the luxury market and that The Four Season's success resolved this uncertainty. Linda Millevoi explained that The Rittenhouse's delayed opening was the result of a twenty year project that had failed twice before.

Nationally, there is some evidence pointing to the greater efficiency of newer hotels (built in the last 15 years) as these hotels charge nearly 5% less per room than the national average for large (>200 rooms) full service hotels. This may also indicate that there was a larger net gain to first class hotels than luxury hotels between 1974 and 1989.

One way that hotels can hedge against demand uncertainty is by building small hotels, but this is confounded by the "liability of smallness" discussed by Singh and Lumsden (1990). Their survey paper details strong empirical support across industries showing smaller firms more likely to fail than larger ones. Further evidence is seen in *Trends* which shows higher occupancy in large and medium sized full service hotels than in small ones across the nation. As can be seen below, Omni hotels are generally larger than Ritz-Carltons and Four Seasons with greater variation than both of them.

	Omni	Ritz-Carlton	Four Seasons
Average Room Size	395	330	318
Standard Deviation	236	110	94

If demand uncertainty gets resolved over time one would expect the early entrants to be smaller than the later ones. From the timeline, one can see that (excluding the Four Seasons who entered before the "boom") the two smaller hotels opened in 1989 and the larger two opened in 1990. These size decisions seem to be more complicated than only being a function of demand uncertainty. In fact, *Trends* shows that large (>200 rooms) full service hotels have higher occupancy and higher prices than their mid-size (125-200 rooms) and small competitors. Of interest here is that larger hotels charge higher prices. One would expect the smaller hotels to charge more to cover fixed costs. This may imply that the luxury hotels are larger than their first class counterparts.

Both The Ritz-Carlton and The Four Seasons public relation officials explained that the size of their Philadelphia hotels were based on a general philosophy of medium size luxury hotels of 300-400 rooms. The Omni was made relatively small to appeal to the individual traveler. Another consideration is city size. As one would expect, full service hotels in the 25 most populous U.S. cities are much larger (343 room average) than other full service hotels (221 room average).

Another method developed recently to handle hotel demand uncertainty is the building of multi-use properties. On top of The Rittenhouse hotel, there are 30 floors of condominiums, so their hotel size was constrained. They have since converted the first three floors of these condominiums to extended stay suites that are attaining 100% occupancy. The former Bellevue-Stratford had nearly 800 rooms before its recent reopening as a multidimensional building.[100] By having a multi-dimensional building, the firm can relatively easily (and quickly) change its hotel size depending on the actual level of demand once it is resolved. Some industry analysts claim that the multi-dimensional building will be the wave of the future.

Since these hotels cater almost exclusively to business customers, it is important to analyze the geographic backgrounds of the businessmen staying in Philadelphia. Each of the hotel officials estimated that at least 75% of their (weekday) patrons are business travelers from between Washington D.C. and New York City. When looking at Philadelphia and the other three major cities in this Mid-Atlantic region, research has shown the hotel business growing especially in the two cities with the lowest real estate prices (Baltimore and Philadelphia). New York's real

[100]It opened as the Hotel Atop the Bellevue. In this building, bottom floors are retail stores, middle floors are offices, and the top seven floors are the hotel.

estate prices are higher than those in Washington D.C., but the recent rise in real estate prices has been highest in Washington D.C. of all.

V.9 Name Brands Creating Demand

Two similar situations to this luxury hotel explosion are urban real estate value and retail stores in malls. When one lot or a few lots are bought and renovated on an impoverished urban block these new lots will have little value due to the negative externality of the unrenovated lots; however, if the whole block is bought and renovated then the values of each of the lots increases. By the same token, consumers will not likely go to a mall for one or two stores as it is just as simple to shop at a specialty store nearer to them. However, when a mall is full of stores a consumer can do all their shopping in one place. In these situations, increasing the supply of firms increases the demand.

It may be that this supply of luxury hotels is creating its own demand by signaling to the country that Philadelphia is a hospitality leader as well as bringing in loyal customers from known luxury hotel chains. The hotel consultants feel that the openings of known luxury hotel chains in Philadelphia do help other hotels, but unknown luxury hotel openings such as The Rittenhouse may actually hurt other luxury and even first class hotels. Pannell Kerr Forster's records show that the opening of The Four Seasons in 1983 coincided with the reemergence of the nearby and nearly bankrupt Palace Hotel (recently bought by Radisson), but The Rittenhouse's presence has coincided with the decreased business of The Barclay Hotel only two blocks away. Interestingly, the officials of the name-brand hotels felt very strongly that name-brand hotels brought in hotel guests to the city, while one of the other officials (Rittenhouse) felt this was not the case and the other (Bellevue) saw this as "controversial, but ... (their entry) may portray the city better."

Hotels have been franchised since 1930 with the first Howard Johnson's franchise. Independent hotels began to confront the problem of chains with the Telequix reservation system for independent hotels nationwide implemented in 1960 (Bradley and Whiteman; 1985). Some 75 independent hotels continue to work together through a system called Preferred Hotels Worldwide to compete with the chains that currently control over 50% of American hotel business (Withiam; 1987).[101] A Coopers and Lybrand official felt that both The Bellevue and The Rittenhouse should consider becoming a franchise of a large hotelier.

V.10 Conclusion

Philadelphia's luxury hotel market seems headed for trouble in the future. Before the recent boom, Philadelphia's market was healthily supporting one 361 room national chain hotel. Some of the boom hotels will

[101] *Trends* computes an average franchise fee of 3.0% of total revenues for full service hotels in New England and the Mid-Atlantic states.

probably survive and prosper, but there should be a shakeout within a few years. It is true that a convention center will open in 1993 (or later), but few conventioneers will stay in luxury hotels, the convention center may be outdated even by 1993 and the lack of total hotel rooms in the Philadelphia area will deter large conventions and events from the city.

Although specific hotel occupancy numbers are difficult to infer, it is reasonable to conclude that at least some of the boom hotels are not achieving profitable occupancy rates. This is leading them to discount room rates which puts them into competition with the city's six first class hotels. If this trickling down is profitable for the luxury hotels, the current first class hotels may be forced to exit in the future. If the luxury hotels can not trickle down, there is little hope of 5 hotels surviving very long.

The research has shown once again a case of hotel over building like that of Charlottesville, VA. and nationally in the 30s, late 50s-early 60s, and recently. This analysis differs, however, in that one can only predict that over building has occurred. Hopefully, this analysis can prove helpful to both industry participants and scholars.

Appendix: National Hotel Picture

HOTEL MARKETS IN SELECTED MAJOR U.S. CITIES

City	Recently Built Convention Center/ Other Attraction	Hotel Growth	% Population Change: 1980-1990
Atlanta	1994 Super Bowl and 1996 Summer Olympics	Expected in the near future	-7.30%
Baltimore	Inner Harbor revitalized in the early 1980's	Steady growth recently	-6.40%
Boston	NONE	Early and mid 80's saw a boom; none will open before '93.	2.00%
Chicago	NONE	'89: Four Seasons Forum Hotels '90: Intercontinental Hyatt	-7.40%
Cincinnati	Expansion and renovation of Convention Center	Nothing in '89 and '90; Marriott in '91	-5.50%
Cleveland	NONE	Openings and Closings; In '90, Radisson and Ritz-Carlton open, Marriott, Hyatt in near future	-11. 90%
Dallas	Expansion of the Dallas Convention Center by '94	Much growth 85-88, '90 onward	11.30%
Hawaii	More of a corporate stayover for the Japanese	Much growth with 6 luxury hotels in '90; 8000 luxury rooms by 1993	0.10%
Indianapolis	NONE	Renovation of all hotels near Convention Center/Hoosier Dome	4.30%
Los Angeles	Convention Center expansion	Booming, but difficult development restrictions Over 15 luxury hotels in development. Rezoning has helped	17.40%
Minneapolis	Convention Center for 1992	Early growth until '87, little growth since	-0.70%
New York City	NONE	Luxury hotels opening in the Midtown West area	3.50%
Orlando	Universal Studios	Constant but heavy growth for many years	28.40%
Palm Springs	National Vacation Area	Boom from '85-'89 including 6 luxury hotels	24.70%

Philadelphia	Convention Center for '94 expected to continue throughout decade	Boom in '89,'90 and	-6.10%
Portland	Convention Center in '90	No growth yet, but is expected now	18.80%
San Diego	Convention Center open in late '80s	Six proposed luxury hotels for early '90s	26.80%
Washington D.C.	NONE	Much growth in late 80's has slowed due to increasing real estate prices.	-4.90%

VI. Conclusions and Future Research

This paper has considered the problem of over entry. It has focused on providing theoretical models that explain firms losing money from their entry into industries. The models were developed from the base of a previous model (Rob; 1990). Rob's model was merely a set of equilibrium calculations; these models specifically considered firm strategies. In addition to firm strategies, these models also described different levels of market saturation both when industry demand is known and unknown.

VI.1 Contributions

This research began with the optimistic goals of adding a significant model to the economics literature of entry (and exit) and providing a framework for actual firms to base their entry (exit) decisions. These models do provide an addition to the economics literature and should lead to more research in this area. The second goal, however, was met at a much more modest level. In its current state, this work can help serve as a framework for firms' decision making, but these results (equilibria) do not provide the actual answers for when to enter and exit.

Economics has seen a variety of entry models. These models looked at competitive entry with known or unknown demand, sequential entry, and asymmetric information. There has also been some research on exit strategies of firms in a saturated market. Modeling firm strategies that lead to industry saturation is an area that is still open to new research. This modeling can begin with the classification of markets into states by industry supply and (estimated) demand.

Possibly the single largest contribution of this work is the classification of markets based on supply and demand into states. By looking at these states in a Markovian sense, future research has a strong mathematical tool to perform further analysis. In these models, the third state is shown to be the only absorbing one because in this state, both attempted entry and attempted exit are dominated strategies. The second and fourth states define the times when demand is known and the dominating strategies are attempting entry and attempting exit, respectively. The first state provides the most interesting analysis, as demand is still unknown and a firm's strategy largely depends on assumptions concerning firm behavior. When demand is large, this state can continue to occur in period after period.[102]

The entry of firms in previous models was only shown to be unprofitable due to industry demand expectations exceeding actual demand. The entering firms in this paper's models lose money because of both demand uncertainty and their *specific behavioral traits*. Overconfidence, myopia, and herd-like behavior were some of the behavioral traits that led to over entry in these models. Overconfidence and myopia have been shown to be common human behavioral characteristics

[102]This appears to have been the case in the Orlando hotel market where the supply of hotel rooms has skyrocketed since the early 1980s, but the market is still far from saturated.

before in other contexts (experimental economics, hindsight case study analyses, etc.), but the study of herd-like behavior is still in its infancy. In fact, the type of herd-like behavior shown here (firms anticipating the actions of the firm with the median demand estimate) is unique to economic literature. Unlike overconfidence and myopia, herd-like behavior need not be economically *irrational*. In some contexts, herd-like behavior is actually the rational economic choice.[103]

The results of this research were intended to be used as a guide for actual firms contemplating entry into an industry with large fixed costs (like hotels). Although none of the models perfectly describe the hotel industries empirically, the framework of the models can still be useful to firms. It is prudent for firms to quantitatively understand the problems of overconfidence, myopia, herd-like behavior, demand uncertainty, locals versus chains, and demand estimate updating before attempting their own entry. The case study (Section IV) suggests a few more variables to consider before (and after) entry. With this combination of information, a firm may not be able to necessarily make optimal decisions; but its decision making ability should improve drastically.

VI.2 Choice of Model

Rob's model was originally chosen because its features were good

[103]In fact, with a few assumptions, the herd-like behavior of the firms in this model would be considered economically rational.

maps to the hotel industry. Specific features with nice maps to the hotel industry included large fixed entry costs, the announcement of demand shocks with unknown size, competitive entry, and periodic updates .

Hotels face huge fixed costs before opening. These costs usually include building (or renovating), hiring and training a staff and advance marketing. Hotels can get sold eventually for high profits, but this only occurs when the property has been a large success. Most often, failing hotels are sold for a small fraction of their initial outlay of fixed costs (refer back to the example of the Barclay Hotel in Philadelphia). This situation, both in the models and actual hotel markets, makes entry a risky proposition.

Demand shocks appear frequently in the hotel industry. For instance, weather affects short run hotel demand on a daily basis. Long run demand shocks, however, are not so common. Typically, these shocks are announced in some manner before their occurrence. In some cases, the shock happens in stages (i.e., the opening of Disneyworld followed a decade later by the opening of EPCOT Center), while in other cases the entire shock happens at one time (i.e., the opening of the Philadelphia Convention Center). Rob's model only considers single stage shocks, but his model can easily be extended into multi-stage shocks.

Competition was assumed throughout the Rob model. Firms only considered industry supply and their estimate of industry demand when making their strategy decisions. Actual hotel markets are also generally assumed to be non-collusive.[104] The closest that firms in these models get to colluding is when their behavior is herd-like; however, this practice is merely one of demand updating, not collusion. Collusion with information sharing and profit-splitting could be written into extensions of these model with little difficulty.

Yearly industry reports done by hotels consultant firms are also a close analogy to periodic updates of industry price and quantity in these models. The yearly publications report on occupancy rates by city, area, and hotel type. Graphs and analysis by industry experts also provide useful information to industry participants. There were a number of other models which I considered as a base for this work. In each case, the model could not pick up as many entry variables as the Rob model.

Two often cited case study type analyses that I considered as models were Porter and Spence's (1982) analysis on the corn wet milling industry and Sahlman and Stevenson's (1985) paper on the Winchester disk drive industry. In both cases, firms in these industry lost money, but for different reasons. The firms in the corn wet milling industry did not fully consider the actions of their rivals, while the Winchester disk drive firms suffered from myopia (although, the authors had the benefit of hindsight). These papers did not have a simple logical map to use as a basic

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[104]With the exception of one price fixing case in the 1960s, the Federal Government has no taken no Antitrust actions against the hotel industry.

mathematical model structure for entry, but both influenced my choices over decision maker behavior.

Scott (1982) proposed a way to measure if chains meet in more than an expected (through random placement of properties) number of markets, implying some strategic contact.[105] By incorporating market size and multiple firms of one chain in the same market, I could better explain multimarket contact between hotel chains.[106] Even after making numerous additions to the original Scott model, however, this model still only picked up a small portion of the *entry* process for hotels.

Romano's (1988) models assumed that each incumbent with a positive supply remaining had an equal chance to take the business of the next unit of demand. In both his endogenous and exogenous price model, there is sometimes an incentive for firms to push supply into excess because they will have a positive probability of selling their "excess". This concept was intriguing, but the game only involved capacity expansion (no entry) with perfect information and the entry process was not analyzed.

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[105]Scott did not address "strategic avoidance", which might also be a form of collusion. In some cases, the actual hotel chains met in so few markets nationally that strategic avoidance could be implied.

[106]these changes also produced very different empirical results of contact between the three hotel chains.

These points made this model illogical as a base for the hotel industry where capacity expansion (contraction) is both rare and difficult, but extensions of this model may be worth exploring in the future.

After I nearly completed the models, Bannerjee (1992) published a paper on herd-like behavior. Although the context of his herd-like behavior differed from mine, his model was useful in refining the behavior of my herd-like firms.

VI.3 Changes to the original model

Rob's model provided a good base to model the hotel industry, but some changes were necessary. Wherever the original Rob model did not have to be significantly altered, changes were made to adapt to the hotel industry. These changes included distinguishing two types of firms, asymmetric beliefs, and a choice of size. A simple modification was to distinguish two types of firms with different levels of industry saturation.[107]

Wherever the original Rob model did not have to be significantly altered, changes were made to adapt to the hotel industry. A simple modification was to distinguish two types firms with different levels of industry saturation. To keep that modification simple, it was assumed (like all firms in the Rob model) that all firms within type had similar abilities to

[107]In actual hotel markets, chains may have higher costs than locals due to advertising and franchise fees. Both types were assumed to have equal costs in my models.

attract demand. This assumption may not be perfect empirically,[108] but heterogeneity would have unnecessarily complicated the model.

To characterize the hotel industry, it was practical to separate the group of potential entrants into two groups; local and chains.[109] To keep that modification simple, it was assumed (like all firms in the Rob model) that all firms within type had similar abilities to attract demand. This assumption may not be perfect empirically, but heterogeneity would have unnecessarily complicated the model. This complicated the problem, but the equilibrium results were usually an intuitive extension of those proved by Rob. The chain firms could enter a more saturated market, and their presence merely as potential entrants, was often enough to deter the local firms from attempting entry.

By assuming asymmetric beliefs in the later models, very different equilibria resulted. Firms over entered when they did not update their beliefs *and* when their behavior was herd-like. In fact, the herd-like behaving firms would usually over enter more than those who did no (or

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[108]A striking example of this is the very successful Four Seasons Hotel operating across the street from the temporarily failed Radisson.

[109]In actual hotel markets, chains may have higher costs than locals due to advertising and franchise fees. Both types were assumed to have equal costs in my models.

only partial) updating.

Rob's model discussed industry size and saturation but left open the topic of firm size choices. My models gave firms a choice of size constrained by a minimum and maximum efficient scale. these scales are evident in the hotel industry, although they do vary by market. Of course, even within a market each potentially entering hotel faces a slightly different size choice (due to zoning, available land, etc.); but these models assumed a similar size choice for all firms.

A simple extension from the original Rob model would have included capacity expansion (contraction) as a possible strategy for firms. Hotels, however, rarely have the luxury of being able to expand or contract capacity by adding or deleting rooms.[110] For this reason, capacity expansion had no consideration in the models.

VI.4 Generalizing the Case Study

A case study approach was only performed on the Philadelphia market. In that market, a number of strategic factors influencing entry were analyzed. A few of these strongly impacted the entry and exit decisions of Philadelphia hoteliers. Market separation (luxury vs. first class, etc.) and multimarket contact were shown to be two significant factors influencing this market that the models did not consider.

[110]This has become *more* common with the advent of multi-use buildings, but most hotels can not change their initial size without great difficulty.

The Philadelphia hotels are currently actively trickling down to lower scale markets. Although industry analysts usually agree on the specific market of a hotel, it is not clear how separate these markets are in the eyes of *consumers*. Consumers are not exclusively luxury or first class hotel room seekers; they merely differ in their price sensitivity[111] (price was not considered in the theoretical models at all).[112] Consumers also do not usually make their hotel decisions with full information about hotel prices in a city. This decision making process may be as simple as using the same hotel as was used last time or going to a specific known chain hotel.

Revising a model of multimarket contact first proposed by Scott (1982), this study showed that multimarket contact is seen between the Ritz-Carlton and Four Seasons hotel chains in this country. The Omni chain, on the other hand, showed fewer than the expected number of contacts with either of the other chains. If strategic contact *or strategic avoidance* is happening, this is definitely affecting hotel entry rates in different markets.

Future work could include similar case studies of the Orlando and

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[111]Luxury hotels are relying on that sensitivity to lure otherwise first class patrons into their "higher quality" hotels for $10-$20 more per night.

[112]A small set of economic literature initiated by Edgeworth (1925) addresses the topic of capacity constrained price competition. Under most sets of assumptions, there is no pure strategy equilibrium.

Atlantic City markets. Although both markets have similarities to Philadelphia, there would need to be a different set of strategic variables to analyze in each case which would have to account for differences including:

1. Philadelphia hotels generally admit business people, while the Atlantic City and Orlando markets focus strongly on tourism.
2. Amtrak would have little effect in Atlantic City, and even less in Orlando.
3. The overwhelming proportion of a hotel's revenue in Atlantic City does not come from patrons paying for rooms.

VI.5 Decision Maker Differences Across Models

In both the symmetric and asymmetric models, equilibria were described under three different levels of decision maker sophistication. The levels in the symmetric model are easier to compare in terms of "rationality". For this reason, the comparison of decision makers begins with the symmetric model.

Economically rational decision makers simply behave as the traditional decision makers described by economists. They make all of the necessary computations (however complex) and the rational decisions (utility maximization) from the information available. In this entry game, they first compute the level of industry supply that is expected to saturate the market (different levels of industry saturation for the two firm types).

The chain firms (ERC in Figure VI.1) realize that no rational firm would continue to enter beyond their point of industry saturation; therefore, their best strategy is to attempt entry until saturation occurs. Local firms (ERL) realize the chains will supply the market beyond the local point of saturation, which keeps the locals from attempting entry *even if the industry's supply is currently below the point of local saturation.*

Myopia does not allow the firms to consider what might happen in the future. Firms base their decisions on the current conditions of the marketplace. In this model, this does not change the *actions* of the chain firms (MC) who will still enter until the industry is saturated. Myopic local (ML) firms, however, do not consider the future actions of chain firms. This allows them to attempt entry as long as industry supply does not exceed their level of saturation.

Overconfident firms will attempt to enter an already saturated industry because they incorrectly feel they can outperform other firms in their class. In this model, the firms were assumed to be both overconfident and myopia. Both the chain (OC) and local (OL) firms, therefore, would continue to attempt entry even beyond their point of industry saturation.[113]

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[113]The level to which this attempted entry will continue is a direct result of the "level" of overconfidence assumed.

The following figure summarizes the points to which both the chain and local firms attempt entry under the three levels of decision maker sophistication in the symmetric model.

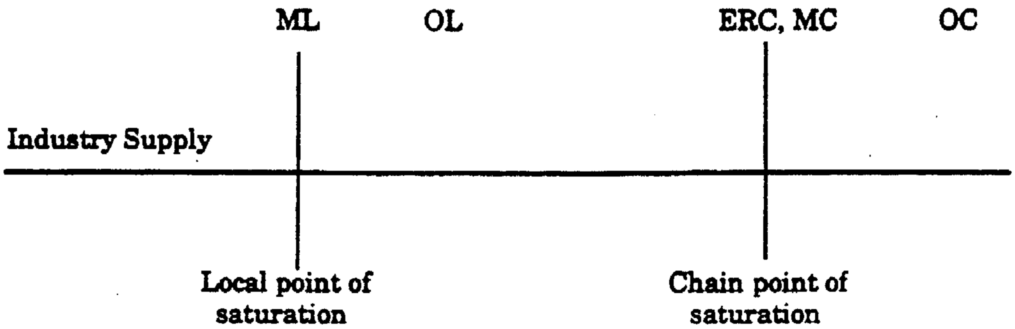

Figure VI.1

Three types of decision makers are also considered in the asymmetric model. These differences can not clearly be defined as more or less "rational" than one another. It is possible, however, to consider the herd-like behaving firms and the non-updating firms as the two behavioral extremes with the anchoring and adjusting firms defining behavior between the points.

Herd like behavior generally defines behavior in which a firm will follow the lead of other firms. In economics, this would imply that firms would mimic each other's current strategies. Unfortunately, firms usually do not know others' *current* strategies when making their *current* decisions. This leads herd like behaving firms to mimic the most recent behavior of other firms. Potential entrants in this model, therefore, merely mimic the behavior of the majority of firms in the most recent position.[114]

[114]This only happens when demand is uncertain.

The text shows that this will often lead to all firms attempting entry before demand is known, an intuitive result.

While the herd-like firms only consider the previous behavior of other firms when making their decisions, the non-updating firms only consider their initial information when making their decisions. In this context, the non-updating firms act as if their initial demand estimate is the actual demand (until actual demand is revealed). Each firm, therefore, computes its own level of industry saturation and will not attempt entry after that point. Unlike the herd-like firms, these firms do have a stopping limit on entry before demand is revealed.

Certainly, most decision makers are not as extreme as the herd-like nor the non-updating firms. Most decision makers would always consider their initial information (an anchor) and adjust this information based upon new information, including the previous actions of other decision makers. Firms in this model adjust their initial demand estimate toward *what would have been a lower bound for rational entry in the previous position*. Depending on how far these firms adjust, they can nearly mimic the non-updating firms (with little updating) or the herd-like firms (with nearly full updating).

Since one would assume that most firms would not act as extreme as either the herd-like nor the non-updating firms, empirical tests of these two models should not expect optimistic results. Hotel decision makers probably behave in both a herd-like and non-updating manner, but the tests are designed with the assumption that all firms in an industry show the same decision maker behavioral traits.

The most difficult part of the empirical tests is that one can not test how much firms update--only *actions* are observable. It is possible to get some information about demand estimates from old publications (not a full set of data) or interviews (subject to a hindsight bias if the decision maker is available), but this data is incomplete at best. Only where distinct differences in the model could be observed by the actions of firms are empirical tests run. This does limit the scope of this comparison, but future revisions to the model can lead to more empirical tests.

VI.6 Empirical Results

Neither the herd-like behaving nor the non-updating firm models was a great predictor of the firms' actions in the three hotel markets. The herd-like model had the most strength in the Atlantic City market while the non-updating model showed the most success in Philadelphia or other constraints.[115]

These models provided an initial insight to analyzing entry into hotel markets. Like all theoretical models, these models also had empirical limitations by not accounting for specific factors like tax law changes. A formal tax law discussion will be beyond the scope of this paper, but it is

[115]Possibly only a coincidence, Orlando was the market that has seen the least amount of over building.

important to realize that the tax law changes of the early 1980s increased incentive to invest in real estate (including hotels) and the 1986 tax law changes drastically reduced this incentive. Tax law changes are not a simple map into the theoretical models, but they may help to explain the empirical results.[116]

In actual hotel markets, investors are constrained by finances and available zoned land. Often, local investors must build a small hotel because they do not have access to the international financing of the chains. Especially in developed cities, zoning and land availability drastically reduce the choices for investors.[117]

To improve the external validity of the models, one would want to be able to explain entry in terms of the other variables affecting the industry. A best case scenario would be to maximize the R-squared term in a multivariate regression of yearly entry rate against variables including industry demand (market occupancy), industry chain supply, industry local supply, a 0/1 variable for the tax law status, demand shock time to

[116]Building in Atlantic City slowed down drastically after 1986 from its pace of the early 1980s. Orlando, on the other hand, experienced no noticeable drop off in hotel openings after 1986.

[117]This is particularly true when the hotel investors all want to locate near the site of the demand shock.

fruition, and an interaction term between the tax law variable and demand.[118] To account for lag time in building a hotel (nearly two years), the entry rate in year t might be best explained by the previous variables in year t-2.

Once the R-squared was maximized, one would attempt to alter the theoretical models to capture the significant terms that are not properly accounted for. This procedure might be useful in better explaining actual entry in the three studied markets, but the resulting complications to the theoretical models would likely detract from their robustness and usefulness to the field of economics.

The models attempted to describe the hotel industry as accurately as possible, but the models were not a perfect description of the hotel industry. To perfectly test these models, it would be necessary to control for all of the noise in the hotel markets. To test these models without noise, one could conduct simple controlled economic experiments. A set of experiments could show how much people (potential investors) update their estimates in a complicated problem and whether these techniques would add to or detract from over entry. Although the internal validity of these tests would be great for the models proposed in this paper, there would still exist the problem of explaining actual over entry in the business world. For external

[118]The list of possible variables is nearly endless: investor type in the market, variability of occupancy among incumbents, foreign exchange rates, etc.

validity, empirical tests would still be necessary.

Future revisions of the models might include a different mechanism for choosing the next entering firm, a social planner choosing the number of firms, and assuming larger fixed costs for chains than locals. An auction would seem the likely candidate and firms would probably over pay (the winner's curse) for the land or the right to the next hotel in the market. For industries that apply, a social planner could be used to insure that there is sufficient entry. Another modification could incorporate "strategic attempted entry"--announcing that one will enter the industry (build a hotel), but never executing this entry. This does occur quite frequently in actual hotel markets, but it is difficult both for mathematical modeling and empirical documentation. By assuming larger *costs* for chains than local firms, the model could also account for their national advertising costs.

In the future, it will be interesting to test these theories on other hotel markets in different stages of over building. The studied markets are either currently experiencing over building (Atlantic City), probably headed towards over building (Philadelphia), or trying to catch an underestimated demand (Orlando). Hotel markets that have already been through the over building process and have since stabilized like New Orleans and Denver would be good candidates for these tests. In these cases, one could more clearly see the actions of firms before and after the demand shock revelation.

The problem of over entry is very prevalent in the hotel industry and other industries today. Until this time, no papers had been written specifically addressing this topic. The models developed here do predict over entry, but their predictive success on three hotel markets was limited. From this beginning, these models can be refined (and others developed) to better predict the behavior of over entering firms.

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