Boom and Bust:

The Effect of Entrepreneurial Inertia on Organizational Populations *

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Abstract

Although recent public attention has focused on boom-and-bust cycles in industries and financial markets, organizational theorists have made only limited contributions to our understanding of this issue. In this chapter, I argue that a distinctive strategic insight into the mechanisms generating boom-and-bust cycles arises from a focus on *entrepreneurial inertia* – the lag time exhibited by organizational founders or investors entering a market niche. While popular perceptions of boom-and-bust cycles emphasize the deleterious effect of hasty entrants or overvaluation, I suggest instead that slow, methodical entries into an organizational population or market may pose far greater threats to niche stability. This proposition is explored analytically, considering the development of U.S. medical schools since the mid-18th century.

INTRODUCTION

What mechanisms explain the occurrence of boom-and-bust cycles in the development of markets and industries? Economic historians have argued that speculative bubbles will arise periodically in financial markets due to overconfidence in profits and subsequent bandwagon effects (Kindleberger 1996; Galbraith 1997). Organizational ecologists have found that many industries – such as automobile manufacturing (Hannan 1997), brewing (Carroll and Wade 1991), telephony (Barnett 1997), and credit unions (Barron 1999) – have been subject to similar boom-and-bust cycles during their histories, characterized by rapid increases in the number of entrants followed in short order by abrupt consolidation. Their explanations for this phenomenon, however, emphasize structural constraints rather than irrationality. For instance, Carroll and Hannan's (1989) density delay argument suggests that organizations founded under conditions of intense competition are likely to suffer a subsequent liability of scarcity. This implies that boom periods in the development of organizational populations, featuring large numbers of entrants scrambling for scarce resources, often lay the foundation for subsequent shake-outs of frail organizations (see Ruef [2004] for a review of other ecological mechanisms). More recently, management scholars have noted that the introduction of new types of services and products – e-commerce, video games, or integrated circuits, to name a few -- are especially susceptible to boom-and-bust cycles (Paich and Sterman 1993). They attribute these cycles to a combination of structural constraint and bounded rationality, examining the poor strategic decision-making of entrepreneurs who enter complex and uncertain niches.[1] Naturally, misperceptions of feedback can also generate market instability for products that are well-understood, as Sterman's (1987) experiments in supply-chain management demonstrate.

A common thread across this diverse research in sociology, economics, and strategic management is that boom-and-bust cycles arise when investors, managers, or organizations engage in behavior that is either overly confident about future outcomes (as in managerial accounts of faulty decision-making on the part of entrepreneurs) or strongly imprinted by previous experience (as in ecological arguments about density delay). Both conditions imply a strategic failure on the part of the economic actors involved, who are either undersocialized forecasters or oversocialized victims of social context (Granovetter 1985). In this chapter, I argue to the contrary that neither assumption is required to generate a boom-and-bust cycle. In fact, I will suggest that it is the most methodical – and in certain respects "rational" – market entrants and entrepreneurs who may pose the greatest threat to the stability of markets and organizational populations. By slowly assembling resources and planning market entry, these actors help to ensure their own success (cf. Dixit 1992), while contributing to collectively irrational outcomes.

This chapter explores the effects of this micro-macro disconnect on boom-and-bust cycles in organizational populations. Boom-and-bust cycles are conceptualized in terms of the changing prevalence – or *density* -- of organizations serving a specific market niche. I begin with a theoretical framework that underscores the importance of lags in the initial stage of market entry, a mechanism that I refer to as *entrepreneurial inertia* (see Lomi, Larsen and Freeman 2005 for a parallel discussion of delayed adjustment within a simulation framework). The effects of this mechanism are then assessed empirically for the population of U.S. medical schools, observed from their origins in 1765. By the late 19th century, medical schools were being founded at an unprecedented rate, spurred by the legitimacy offered through licensing laws and the quest for profits among entrepreneurs creating proprietary institutions (Starr 1982: 112). Between 1870 and 1900, the number of American medical schools nearly doubled (peaking at 174 in 1898), before going into an equally dramatic tail-spin over the following thirty years. By the beginning of the Great Depression, the schools again numbered fewer than they had during the Civil War.

To account for this boom-and-bust cycle, I argue that existing explanations, emphasizing either exogenous influences (e.g. the impact of the famous Flexner Report), ecological influences (intense intraindustry competition at the end of the 19th century), or irrational contagion, must be qualified by attention to the founding process of individual organizations. I show that the mechanism of entrepreneurial inertia improves upon existing explanations at an aggregate level and provides further insights when the process of market entry is studied for individual medical schools. The chapter concludes by considering how micro-level studies of entrepreneurial strategy can be integrated with macro-level studies of dynamics in organizational populations and markets.

THEORETICAL AND SUBSTANTIVE BACKGROUND

Since the inception of ecological analyses of organizational populations, two ideas have played a central role in explaining trajectories of population development. One is that formal organizations tend to be characterized by structural inertia (Hannan and Freeman 1977, 1984). Due to internal rigidity – resulting from sunk costs in specific resources, bounded rationality, political resistance to change, and habituation – most organizations are unlikely to engage in major transformation. Moreover, those organizations that do change core features often face selection pressures, at least in the short term, as stakeholders question their reliability or accountability (Barnett and Carroll 1995; Péli et al. 1994). Resistance to change is exacerbated by external conditions, such as market uncertainty and divergent metrics applied by different stakeholders. For organizational theorists, the analytical consequence is that much is to be gained from focusing on processes of entry into (and exit from) organizational populations, as opposed to adaptation on the part of incumbent participants.

A second idea follows from this insight. If most of the meaningful variance in population development can be accounted for in terms of entry and exit processes, then organizational scholars ought to study how the intrinsic rates of these processes vary by the demographic composition – size and distribution – of organizational populations (Carroll and Hannan 2000). In principal, demographic composition should explain both secular trends in the growth and decline of organizational populations, as well as short-term fluctuations, such as boom-and-bust cycles. A number of extensions to organizational ecology have appeared that may accommodate such fluctuations, of which density delay (Carroll and Hannan 1989) is one of the more prominent.

One irony in research on the development of organizational populations is that the idea of structural inertia, which largely gave rise to the demographic perspective on population trajectories, is analytically absent from population-level modeling. A number of studies have examined the emergence of inertia in young ventures (e.g. Baron, Hannan and Burton 1999) and the dangers that radical or frequent change holds for established organizations (Ruef 1997; Amburgey et al. 1993). But these empirical variations at the level of individual organizations have not been traced back to the population level. To some extent this reflects a more general theoretical ambiguity as to whether structural inertia is a feature of specific organizations or a property that accumulates in organizational populations (Péli, Pólos and Hannan 2000). Moreover, structural inertia seems a convenient background assumption in explaining away micro-level mechanisms leading to boom-and-bust cycles. If speculative bubbles are created by entrepreneurs who rush foolishly to enter new market niches or to adopt novel innovations (Aldrich and Fiol 1994), then selection pressures will quickly eliminate these actors for their lack of reliability and accountability, at least in certain logical formulations of structural inertia theory (e.g. Péli et al. 1994). As a result, organizational ecology suggests that sustained boom-and-bust cycles cannot arise from the actions of individual entrepreneurs or firms, but must arise due to properties of industries.

In contrast to the prevailing interpretation, this chapter proposes that inertia on the part of individual entrepreneurs or incumbent organizations can be a principal cause of boom-and-bust cycles. This is especially true when new ventures evidence "entrepreneurial inertia" – long lags between the time when entrepreneurs become committed to the idea of founding an organization and its operational startup. Entrepreneurial inertia has opposing implications for the focal venture being founded and the population whose niche it seeks to occupy. For the focal venture, the delay between preoperational and operational startup allows founders to carefully assemble resources, study competitors, and plan their entry into a market. Provided that the nascent venture survives this preoperational phase, it will emerge as a stronger competitor than organizations that rush into an emerging niche. At the population level, on the other hand, the prevalence of entrepreneurial inertia can destabilize an industry, for two reasons. First, entrepreneurs and incumbents tend to form expectations about the competitive pressures they see arising from other operational entities. When a large number of preoperational ventures are unobserved, this translates into poor forecasts regarding the evolution of an industry over time (Lomi, Larsen and Freeman 2005). Second, when ventures with long periods of gestation do become operational, they reflect an unusual competitive intensity, as noted above. Again, entrepreneurs and incumbents fail to accurately forecast the threat posed by these (ostensibly) fledgling organizations.

I now proceed to ground these intuitions concerning entrepreneurial strategy in an analysis of U.S. medical schools. A short case study of the founding process of the Johns Hopkins Medical School proves instructive in understanding the implications of entrepreneurial lags on population dynamics. This case study is followed by quantitative examinations of the development of the medical school population.

Case Study: The Johns Hopkins Medical School

The topic of a medical school at Johns Hopkins was already raised in June of 1874, when Charles Eliot, president of Harvard, came to Baltimore to confer with the trustees of the newly-chartered University. Eliot emphasized that:

"... your opportunity ... for the founding of a proper medical school in this community is a very precious one. I hope it will be one of the earliest departments of the University organized; and that it will be founded in such a way as to greatly influence for good, medical education in this country. No medical school already organized has anything like your opportunity; for medical schools everywhere are exceedingly poor." (quoted in French 1946: 107)

The "opportunity" that Eliot referred to involved the sizable endowment that the institution's namesake, Johns Hopkins, had bequeathed in his will prior to his death.

Pursuing this idea, the University's first dean, Daniel Gilman, studied European medical schools in a trip abroad the following year, where he sought to recruit faculty and analyzed the organizational forms of foreign universities (Hawkins 1960). When Gilman came back to Baltimore, he echoed Eliot's sentiments and, during his inaugural address, declared plans to found a department of medicine.

Gilman's announcement, in February of 1876, was followed in short order by several efforts at resource mobilization. In March, the University's board of trustees accepted an endowment for a medical professorship and, in May, it purchased land for the school. These activities proved premature. The income generated by Hopkins endowment could not yet satisfy Gilman's ambitions and the first medical professor (William Welch) was not recruited until 1885 (Hawkins 1960: 146-147). When Welch began instruction in the 1886-87 term, his course was limited to existing practitioners, rather than medical students. In a subsequent 1889 report, Gilman was forced to acknowledge that, although the University and its newly created hospital could offer some courses to professionals who had already received their medical degrees, a major financial endowment was required to create a proper medical school (French 1960: 111).

It was not until December of 1892 that the requisite endowment of half-a-million dollars had been secured from philanthropists. In October of the following year, the school opened with eighteen first-year students, four faculty, and William Welch as dean. Announcing the opening of the school, Welch stressed the small number and high quality of graduates it would turn out. His prediction could not be evaluated until 1897, when the school finally had its first "product", fifteen graduates with doctoral medical degrees. The graduates were indeed imposing – four went on to become medical faculty at Johns Hopkins and one was a pioneering female physician (French 1960: 425-26); the medical school's alacrity, on the other hand, seemed less impressive -- it had taken over twenty years to get from Gilman's initial founding announcement to the first graduating class.

Two points about the founding of the Johns Hopkins Medical School are worth emphasizing. First, entrepreneurs often make strong commitments to a nascent organization long before it is able to function as an operational venture. Some of these commitments involve material investments, such as the land that the Johns Hopkins trustees procured after Dean Gilman publicly announced his plans to create a medical school. Other commitments are cognitive in character, such as the European models that Gilman studied in 1875 and adopted as the organizational form of the new university in Baltimore. When the lag between the initiation of an organization and operational startup is substantial, there is no guarantee that the environmental factors driving those commitments will be consistent with the environment that the organization ultimately competes in.

This does not imply, however, that entrepreneurial inertia necessarily handicaps a nascent organization. Admittedly, the long incubation period of Johns Hopkins was driven partially by mishaps in fundraising and strategic miscalculation on the part of Gilman and the trustees. But much of the delay was also due to the founders' ambition in institution-building, as they sought to conform to the standards of an emergent "dominant design" (Anderson and Tushman 1990) for medical education in the United States. The result seemed to justify the delay – Abraham Flexner's influential (1910) report on medical education identified Hopkins in the top echelon of medical schools. As Starr noted, "here were the glimmerings of the great university-dominated medical centers of the next century" (1982: 116). In the two decades following the report, the population of U.S. medical schools exhibited severe decline, as other schools failed to meet up to the dominant design. This suggests a paradox in entrepreneurial inertia. For a startup, a prolonged founding process can allow for more extensive resource mobilization, organizational design, and role socialization among members – factors that are likely to improve the survival chances of the venture once (and if) it becomes operational. At the same time, the delay tends to deceive other entrepreneurs as to the true nature of competition in an ecological niche. Indeed, American medical schools were being founded at an unprecedented rate in the 1880s, based on a competitive landscape that did not yet include Johns Hopkins.

Theoretical Formalization: Population-Level

To further understand the implications of structural inertia for boom-and-bust cycles, we can consider a set of highly simplified models of development in organizational populations. These models are not intended to be realistic, but to allow the impact of inertia on population stability to be diagnosed in a fairly transparent fashion. In particular, these models rely on the assumptions that: (a) all organizations in a population exhibit an identical level of structural inertia; (b) the organizations are identical in all other salient aspects (i.e. there is no unobserved heterogeneity); and (c) there is a fixed carrying capacity for the population (i.e. the number of organizations that can be supported by the environment is constant over time). The latter assumption is particularly helpful in eliminating exogenous explanations for boom-and-bust cycles, as well as those linked to the psychological valuations imposed by entrepreneurs, managers, or investors.

Employing these assumptions, the classic model of growth in organizational populations is Hannan and Freeman's (1977: 941) logistic model:

$$\frac{dN(t)}{dt} = rN(t)\left\{1 - \frac{N(t)}{K}\right\} \quad (1)$$

where *N(t)* is the number of organizations in a population at time *t*, *K* is the (fixed) capacity of the environment to support the population, and *r* is the intrinsic growth rate of the population in the absence of resource or institutional constraints. The functional form of the model is motivated substantively by the insight that the cognitive legitimacy (and thus growth) of an organizational population tends to increase linearly with existing population density, but that competition attenuates this growth as the population approaches carrying capacity. Notably, the model does not take structural inertia into account – organizational startups and exits are, more or less, instantaneous reactions to the level of legitimation and competition in a population.

Abundant evidence indicates support for this model, both in its original population-level form (e.g. Nielsen and Hannan 1977) and in subsequent specifications that disaggregate the startup and exit processes contributing to population growth (Carroll and Hannan 2000: Chapter 10). However, the variance explained can be quite limited when a population exhibits a boom-and-bust-cycle (Ruef 2004). Consider the density of U.S. medical schools, as shown in Figure 1. Fitting the logistic model to the population trajectory of all schools between 1766 and 1999, we find that it explains only 1.8% the variation in annual rates of net growth (see Table 1).[2] This suggests that at least some of the simplifying assumptions made in the model may be untenable.

[Insert Figure 1 and Table 1 About Here]

One simple extension to the logistic model incorporates structural inertia for entrepreneurs wishing to enter and incumbents seeking to abandon an organizational population. In both cases, internal and external constraints contribute to delays in entry and exit processes. For instance, organizational founding often proceeds through a series of stages, including resource mobilization, legal establishment, social organization, and operational startup, that can take years to complete (Hannan and Freeman 1989; Ruef 2005). Even in high-tech sectors, such as semi-conductor production, where time-to-market speed is seen as critical, the waiting time until first product delivery can approach two years for a startup (Schoonhoven et al. 1990). The entrepreneurial lag can be even more pronounced for organizational forms such as medical schools (Kimberley 1979), as the case of Johns Hopkins illustrates. For this population, the delay may also be exacerbated by institutional barriers to entry, such as medical boards and societies seeking to license the activities of schools (Starr 1982).

Though less obvious, it is also possible that exit processes may be subject to similar delays. Students of strategic bankruptcy (Delaney 1992) and failing organizations (Meyer and Zucker 1989) find that the organizational dissolution is often not a rapid reaction to adverse market conditions, but a carefully planned process in which managers seek to appease external stakeholders, minimize personal losses, and leverage legal protections. Similarly, economists describe a process of "optimal" disbanding, in which the exit of an incumbent firm is not viewed as a sudden failure but, rather, as a strategic, profit-maximizing response in the face of new challengers or technologies (see Dew et al. in this volume). As with startup events, delays may also increase when outside authorities impose barriers to exit (as in the case of state legislators who believe that regional medical schools are desirable, despite an absence of local market demand).

When processes contributing to growth or decline in an organizational population exhibit temporal lags, a modification of conventional ecological models is required. The simplest specification advanced for this purpose is the *delayed logistic model* (Turchin 2003: 56-57). It assumes that the effects of population density are subject to a constant fixed delay τ. When this delay affects both legitimation and competition, the growth of an organizational population can be determined as:

$$\frac{dN(t)}{dt} = rN(t-\tau)\left\{1 - \frac{N(t-\tau)}{K}\right\} \qquad (2)$$

Aside from incorporating a term to represent the effect of structural inertia, the delayed logistic model also has the analytical advantage that it permits qualitative differences in trajectories as an organizational population approaches its carrying capacity. These qualitative differences are illustrated in Figure 2, as: (a) a trajectory in which a population approaches its carrying capacity without significant fluctuations (*stable* steady state); (b) a trajectory in which a population approaches its carrying capacity with boom-and-bust oscillations (*stable* steady state *with cycles*); and (c) a trajectory in which a population never converges to its carrying capacity (*unstable* steady state, exhibiting ongoing boom-and-bust cycles).[3] It is worth emphasizing that, in the absence of inertia affecting startup or exit processes, the trajectory for the model necessarily falls in the first category – i.e. stable steady state without oscillations.

[Insert Figure 2 About Here]

How well does the delayed logistic model perform when applied to the trajectory of the medical school population? Before any given medical school graduates a cohort of students, outsiders have limited information as to the quality of the school or its competitive intensity. To estimate the model, I therefore calculated the average lag time between the initial organization of U.S. medical schools and the dates when they had their first graduating classes. The delay between preoperational startup and operational startup, averaging almost 2 years, serves as a basic indicator of entrepreneurial inertia. Since entrepreneurs also typically have imperfect information on other organizations being initiated at the same time as their venture (and which organizations are simultaneously failing), the indicator was lagged by one additional year. Therefore, inertia (τ) $\approx$ 3.0.

As seen in the second column of Table 1, the delayed logistic model explains far more variance (about 6.4% of the total) than the logistic model. The revised estimates for the model parameters suggest a lower carrying capacity for medical schools (about 137 for the entire U.S.), but a higher intrinsic growth rate (with the organizational population increasing by 4.3% of its lagged density each year, in the absence of resource or institutional constraints).

Considering the hypothetical population trajectories plotted above, it is also of interest to consider how well the model does qualitatively in accounting for the boom-and-bust cycle among U.S. medical schools. A diagnostic procedure allows us to determine the stability of the model on the basis of the product of the constant term for structural inertia (τ) and the intrinsic rate of population growth (r). Although the mathematics of this procedure are somewhat involved (see Nisbet and Gurney 1982 and *Appendix* for computational details), the intuition behind it can be conveyed in a simple verbal fashion. Fluctuations arise in the delayed density model when there are temporal lags in density dependence *and* when the intrinsic rate of population growth is high. In organizational populations marked by especially fast growth (e.g. electronic commerce during the 1990s), even modest delays in entrepreneurial activity or the dissolution of failing incumbents may be sufficient to produce a boom-and-bust cycle. Conversely, organizational populations characterized by slow growth (such as American medical schools) are only likely to witness boom-and-bust cycles when structural inertia is high, at least within the delayed density specification. Using the terminology advanced by Hannan and Freeman (1984), the crucial determinant of instability in a population is therefore not structural inertia, but *relative inertia*, the extent to which organizational activities evidence delays relative to the intrinsic rate of population change.

Further insights into population development can be gained by diagnosing the joint occurrence of inertia and high intrinsic growth rates for any given population. A stability analysis of the delayed logistic model reveals that the steady state of any population trajectory can be categorized based on relative inertia, assessed via the product $r \times \tau$. The model has a stable steady state without oscillations when $0 < r \times \tau < e^{-1}$, a stable steady state with oscillations when $e^{-1} < r \times \tau < \pi/2$, and an unstable steady state with oscillations when $r \times \tau > \pi/2$ (*Appendix*; see Tuma and Hannan 1984 for a general discussion of stability analysis with deterministic nonlinear models). For the population of U.S. medical schools, $r \times \tau = 0.043 \times 3 \approx 0.13$, which falls well below e^{-1} (0.368). Given the assumptions of the delayed logistic model, the stability analysis provides no support for a boom-and-bust cycle among U.S. medical schools.

Several critiques might be raised to account for this result. One is that the underlying assumptions of the population-level model (e.g. identical structural inertia) cannot be maintained. I return to this concern shortly. Another critique is that the particular functional form of the density delay model is wrong. In particular, many organizational theorists may argue that inertia is especially prevalent for the entrepreneurial process – as exemplified by the case of Johns Hopkins medical school – but that selection pressures have a far more immediate impact on organizational survival. This argument echoes a common consensus in bioecology, which contends that only "birth" processes are plausibly linked to delayed density dependence (Turchin 2003: 58). The solution is a hybrid specification that represents entry processes in terms of a delayed logistic model and exit processes in terms of a classic logistic model:

$$\frac{dN(t)}{dt} = r_1 N(t-\tau)\left\{1 - \frac{N(t-\tau)}{K}\right\} - r_2 N(t)\left\{1 - \frac{N(t)}{K}\right\} \qquad (3)$$

where r_1 is the intrinsic startup rate, r_2 is the intrinsic exit rate, and τ is the delay that applies specifically to startup activities (i.e. entrepreneurial inertia).

Estimating this model for the evolution of U.S. medical schools yields the best model fit thus far, accounting for almost 20% of the variance in aggregate patterns of population growth and decline (see Table 1, third column). This suggests that inertia may operate asymmetrically for processes of organizational startup and exit. Further diagnosis of the model requires that we consider population stability over the response surface of all parameter combinations. As suggested by previous work in mathematical ecology (Nisbet and Gurney 1982), two indicators of relative inertia are crucial in this respect – inertia relative to the intrinsic startup rate in an organizational population ($r_1\tau$); and inertia relative to the intrinsic exit rate ($r_2\tau$). Although no analytical solution is available to characterize the response surface for model [3], Monte Carlo simulation allows us to explore population stability numerically over a large number of these parameter combinations (see Figure 3).

[Insert Figure 3 About Here]

The qualitative behavior of the hybrid model with entrepreneurial inertia exhibits all three patterns observed in the simpler delayed logistic model. Thus, there are parameter combinations leading to a stable steady state with no oscillations (lower-left corner), a stable steady state with boom-and-bust cycles (middle-left), and an unstable steady state with cyclical behavior (upper-middle-left). In addition, large parts of the response surface reveal the possibility of extinction for the entire organizational population, given sufficiently high levels of inertia, startup rates, and/or exit rates.

Based on the results presented in Table 1, we can locate U.S. medical schools on the Y-axis at $\log_{10}(0.215 \times 3) \approx -0.190$ and the X-axis at $\log_{10}(0.180 \times 3) \approx -0.268$.

Consistent with the stability analysis reported for the delayed logistic model, this suggests that we should not expect a boom-and-bust cycle for this organizational population, based on these structural parameters alone. However, as the figure makes clear, the population is located in a rather tenuous position of the phase space. Even small deviations from the idealized assumptions noted at the beginning of this section may be sufficient to generate boom-and-bust cycles around a stable steady state or contribute to the extinction of the schools altogether.

Theoretical Formalization: Organization-Level

If entrepreneurial inertia (τ) is a crucial driver of instability in organizational populations, as the previous analyses suggest, then it is worth considering what consequences arise if there is heterogeneity in inertia and what the causes of such heterogeneity may be. As shown in Figure 4, the assumption of a fixed lag time between preoperational and operational startup is not warranted for U.S. medical schools. The histogram is based on 309 medical schools that became operational before 1930, the nadir of the "bust" in school density (see JAMA 1901-1930, esp. 1908, Vol. 51(7): 594-602). The lag is calculated as the time between the date when the school was officially organized and when it graduated its first class of students. 76 medical schools with missing information on entrepreneurial lag times are excluded.

[Insert Figure 4 About Here]

While the modal school graduates its first class only one year after being organized, some require as much as twenty-six years and others require only a matter of months. The figure excludes the lag time for right-censored cases (N=2 at the end of the observation window) and schools that never graduated a class of medical students (N=85). Notably, some of the inoperational schools exhibit extremely high levels of entrepreneurial inertia, with one organization reporting a forty-four year lag between preoperational startup and dissolution.

The heterogeneity in entrepreneurial lags may contribute to population dynamics through three mechanisms: (a) the rate of preoperational startups among new entrants; (b) the delay (and, therefore, disbanding risk) experienced by preoperational ventures before they achieve operational status; and (c) the exit rate of incumbent organizations.

Preoperational Startup

With respect to the first mechanism, our previous population-level models assumed that density-dependent effects evidence a lag in their influence on the startup rate in an organizational population. This lag reflects the fact that entrepreneurs tend to judge the attractiveness of a niche based on operational incumbents within it, rather than the total density of operational and nonoperational organizations (see Lant and Baum [1995] for a discussion of biases in competitor definition). Partially, this results from simple measurement error – just as researchers experience great difficulty in enumerating nascent organizations that may not yet produce output, have an established address, and/or hire permanent employees (Aldrich 1999; Kalleberg et al. 1990), so do other entrepreneurs. The problem is compounded by the fact that some founders tend to be fairly secretive about their activities at this nascent stage.

Another reason why the attractiveness of an organizational population is judged based on operational incumbents is that the survival of preoperational ventures can be highly precarious. Moore and Cain (2004) have suggested that the strategic myopia of some entrepreneurs is explained by their neglect of fellow entrants. As organizational ecologists point out, this myopic logic also leads investors, regulators, and incumbents to discount the preoperational ventures, in favor of more tangible evidence regarding competition and legitimation within an arena of organizational activity (Carroll and Hannan: Chapter 15). As a result:

Hypothesis 1. The density of operational organizations in a population has a stronger impact on the rate of entry than does total density (preoperational and operational).

Two caveats concerning this hypothesis need to be considered. The first is that entries into a market niche are often subject to bandwagon effects. Indeed, much of the literature on financial boom-and-bust cycles emphasizes this aspect of investor psychology (e.g. Kindleberger 1996). Among organizational founders, similar bandwagon effects may arise with respect to the activities of other preoperational startups with which an entrepreneur is acquainted. In some cases, knowledge of these startups is transmitted by interpersonal networks among entrepreneurs in a region (Sorenson and Audia 2000). In other cases, a single entrepreneur (or entrepreneurial team) simultaneously initiates multiple startups of a particular organizational form. For instance, Johann Malok, a fraudulent medical practitioner in Chicago, personally organized six medical colleges in 1891 and 1892. Clearly, we want to separate such instances of local contagion in startup activity from the aggregate effect of entrepreneurial inertia.

A second caveat pertains to competition with other entrepreneurs for resources when the founding rate is especially high. If investors, philanthropists, or regulators have recently backed the founding of a number of medical schools, can new entrepreneurs expect to approach those stakeholders again with requests for further endowments? Research in organizational ecology suggests that high founding rates in a given year depress founding rates in the following year, even when those entries involve preoperational ventures (Carroll and Hannan 2000). Again, it is important to separate this process (emphasizing intense competition among new entrepreneurs) from the lagged density dependence implied by Hypothesis 1.

Entrepreneurial Inertia and Organizational Form

Boom-and-bust cycles become more likely when there is historical variation in the match between the operational density of incumbents and the total density of incumbents and nascent ventures. One factor that may predict this historical variation is the extent to which entrepreneurs are organizing around a *dominant design* (Anderson and Tushman 1990; Tushman and Murmann 1998). The existence of a dominant design has two, somewhat opposing implications for entrepreneurial inertia. On the one hand, the existence of a dominant design means that entrepreneurs have to "get it right", in the sense of organizing according to the normative standards of an externally-prescribed architecture. Baron (2004) describes such organizational forms as involving sharp identities, insofar as they impose a large number of prescriptions that delineate them from other organizational forms. Entrepreneurs adopting these identities for their startups must engage in the time-consuming process of satisfying technical, structural, and personnel constraints, increasing startup lag times in the process.

The dominant design that emerged among 19th century medical schools was that of the university-based, regular school. Many entrepreneurs hoping to start these medical schools felt that they had to invest time in setting up clinical laboratories, adopting prescribed curriculum standards, forming linkages with universities, establishing affiliated hospitals, and developing rigorous entrance exams (see Bevan [1908] on the features of this dominant design). The emergence of a dominant design in the field thus created a cultural barrier to entry for orthodox entrants. Founders who organized on the basis of less sharp criteria, such as those creating non-university based or sectarian medical colleges, had greater flexibility in choosing what administrative elements to incorporate and which ones to drop. This suggests that:

Hypothesis 2. Entrepreneurial inertia increases when a venture is organized on the basis of a dominant design (e.g. university-based, regular schools).

An opposing implication of the existence of a dominant design is that it often (though not always) implies that there are a large number of convenient organizational exemplars from which nascent entrepreneurs can draw ideas and inspiration. Mimetic processes may then simplify the adoption of organizational features and encourage conformity to prescribed features of the design (DiMaggio and Powell 1983). As a consequence, when a normative organizational design also becomes numerically prevalent -- and resonates with the identities of potential participants and stakeholders (Baron 2004) -- entrepreneurial inertia should decrease.

Again, an example from the medical school domain serves to illustrate this mechanism. When Daniel Gilman was conceiving his plans for Johns Hopkins medical school, he had to travel to Europe to synthesize features that he saw in a variety of German universities. A few decades later, newly-founded medical schools such as Duke, Rochester, and Vanderbilt could readily emulate the (far more proximate) Johns Hopkins, as well as each other. By the same token, founders of eclectic institutions in the late 19th century could engage in selective imitation of regular schools, while also attending to the substantial number of sectarian organizations that blossomed during the period. In summary:

Hypothesis 3. Entrepreneurial inertia decreases when entrepreneurs are able to draw on a large number of operational exemplars featuring a dominant design.

Taken together, Hypotheses 2 and 3 imply that boom-and-bust cycles tend to appear just as organizational populations are shifting to a dominant form, but before that form is sufficiently widespread to alleviate entrepreneurial inertia. This corresponds to the state of American medical education at the end of the 19th century, where new prototypes such as Johns Hopkins were admired in some professional circles (e.g. the AMA), but a large number of sectarian medical colleges – including homeopathic, eclectic, physiomedical, and other alternative forms – continued to thrive.

Organizational Exits

Even as entrepreneurs shifted their efforts to the founding of university-based, regular schools, it might be argued that another mechanism accelerated the bust that was already evident at the beginning of the 20th century. Specifically, when a large number of entrepreneurs initiated founding efforts employing this dominant organizational form, they competed intensively over resources – financing, philanthropy, staff, public goodwill -- that could support the creation of any medical school at early stages of development. A likely consequence was attrition among schools that had yet to become operational; or, stated more generally:

Hypothesis 4. Preoperational failure increases when there are a large number of organizations entering a population concurrently.

The challenges of initial entry, entrepreneurial inertia, and preoperational failure are likely to filter many would-be organizations from ever appearing on the landscape of active participants in an organizational population. For those nascent ventures that do make it to the operational stage, though, our earlier discussion suggests that there may be benefits to an extended period of gestation. Some of these benefits may appear in tangible features of the organization's form – such as the extent to which it corresponds to the dominant design in an industry – or in the scale of the newly-operational enterprise – predicated on its ability to attract a large staff (or, in the case of medical schools, a large number of potential students) during its period of incubation. As IO economists have pointed out, delays in committing sunk costs to a venture can also allow investors to obtain more information in uncertain environments (leading to investment theories of "optimal inertia" [Dixit 1992]). Finally, the argument for the organizational benefits of entrepreneurial inertia extends to less tangible capabilities, such as the reliability and accountability developed by a nascent organization during a prolonged founding process (see Hannan and Freeman 1984). Net of organizational form and scale, I propose that:

Hypothesis 5. Operational organizations with long periods of pre-operational gestation (i.e. entrepreneurial inertia) increase their likelihood of survival.

This empirical claim may be challenged on the grounds that some unmeasured properties of entrepreneurial ability or resources may be correlated with both the duration of the pre-operational lag and subsequent organizational survival, leading to a spurious association. However, omitted variables will typically contribute to *underestimation* of the effect of entrepreneurial inertia. On average, the unmeasured human capital of a medical school's founding team, for instance, is likely to reduce the pre-operational lag time, but improve the survival of the operational school. By the same token, the personal funds and philanthropic donations raised by a school ex ante (prior to pre-operational initiation) will usually reduce the time needed to achieve operational startup, while improving subsequent survival chances. Given these assumptions, empirical tests of the effect of entrepreneurial inertia for individual organizations tend to be conservative.

A second critique of the hypothesis may arise from its superficial similarity to the *liability of newness* argument, which argues that the disbanding risk of an organization declines monotonically with age (see Carroll and Hannan 2000 [Chapter 13] and Ruef 2002 for reviews of this literature). How can the effect of entrepreneurial inertia be disentangled from age-dependence? As shown in Figure 5, the predictions arising from the two mechanisms are actually quite distinctive. For the sake of simplicity, we will assume that the liability of newness is evidenced as the same monotonic decline across the organizational lifecourse -- i.e. whether an organization is at a pre-operational or operational stage. Consider the disbanding risks, then, of two organizations, where the second evidences a longer period of pre-operational gestation (**B** > **A**). Upon becoming operational, the second has a lower disbanding risk than the first did when it became operational, merely as a consequence of being further down the liability of newness curve. In addition, however, Hypothesis 5 posits that the second organization will enjoy further survival benefits upon becoming operational, as a discrete function of the differences in pre-operational gestation **f(B − A)**. Moreover, these benefits subsequently accrue to the second organization independently of the age-dependence curve. Stated another way, the impact of age dependence is *contemporaneous*, affecting organizations immediately at certain points in their lifecycle. Entrepreneurial inertia, by contrast, represents an *imprinted* effect, influencing organizational viability long after the startup cycle has been completed.

[Insert Figure 5 About Here]

A final critique of the entrepreneurial inertia thesis warrants attention. Perhaps the most important counter-argument in the strategy literature concerns markets with first-mover advantages (Lieberman and Montgomery 1998). If there are considerable benefits for an organization that first enters a market, how should this be weighed against the putative advantages to entrepreneurial inertia? In the case of medical schools, in particular, first-mover benefits were likely to accrue when a school was the first in a regional market. Historically, legislatures were eager to provide funding and legitimacy to the first medical schools that opened their doors within state boundaries. First-mover advantages may have also accrued geographically with respect to local philanthropists, faculty, and students. Consequently, my analyses of organizational viability control for potential benefits from early movement into unserved markets, while also addressing the conflicting demand for a careful and deliberative startup process, as postulated by *Hypothesis 5*.

DATA, MEASURES, AND METHOD

Data

My sample includes all medical schools in the United States, in existence between 1765 and 1930. The ending year for the analysis is based on two substantive considerations. First, in terms of numbers, 1930 represents the nadir of the medical schools, following the upsurge of the late 19th century. Analyses conducted through this year thus capture the full boom-and-bust cycle in the early history of American medical education. Second, it could be argued that the viability of medical schools after 1930 becomes increasingly subject to exogenous conditions, including the Great Depression, the development of regional health insurance markets, state funding for training programs, and NIH and private (foundation) funding for research (see Starr 1982: 352-359). Given the lack of comparability between the resource environment of early medical schools and the postwar years in particular, it seems appropriate to end analysis at this stage.

Data were collected from several archives, including William Norwood's (1944) *Medical Education in the United States Before the Civil War*, Nathan Davis' (1877) *Contributions to the History of Medical Education and Medical Institutions in the United States*, John Rauch's (1891) Report on Medical Education, JAMA's (1901-1930) listings of contemporary and extinct medical schools in their annual series on medical education, and Frederick Waite's (1946) history of sectarian medical schools. Supplemental information on the environment of medical schools was obtained from the *Historical Statistics of the United States* (1975). I have summarized the descriptive statistics for all operational schools and their environment in Table 2. Note that the units of analysis here are organizational spells (periods of observation with no change in covariates) and, consequently, these statistics may differ from those that are assessed cross-sectionally (cf. Figure 4).

[Insert Table 2 About Here]

Measures

Entrepreneurial Inertia. One key dependent variable of interest is entrepreneurial inertia, or the lag time between the date when a public announcement is made that a school is being organized and the date when it is recognized as an operational enterprise (see Figure 4). Since students are perhaps the most recognizable "output" from medical schools, I code operational startup as the year when the first students graduate. Initial public announcements regarding the organization of a medical school are also coded by year.

Pre-Operational Entry and Exit Events. Entries by pre-operational medical schools are recorded when the organization of a new school is first announced, either as a *de novo* startup or as an equal-status merger of two or more pre-existing schools. Starting events were not registered when a school resumed operation after an extended hiatus (e.g. following a war).[4] Exploratory analyses suggest that the startup process tends to occur more expeditiously for schools based on a prior educational infrastructure, with a significant negative correlation between equal-status mergers and entrepreneurial lag times ($r = -0.11$, $p < 0.05$). Consequently, I control for mode of entry in models of both entrepreneurial inertia and exits among operational schools.

Organizational exits subsume a variety of events, including voluntary dissolution, bankruptcy, removal of a legal charter, acquisition by another school, and declaration that a school is fraudulent by a state board of health. Equal-status mergers are excluded under this definition. For schools that never achieved operational startup, voluntary dissolutions and bankruptcies are the most common outcome, although a substantial number of these cases (40%) were declared to be fraudulent by state boards of health or other regulatory bodies.

Organizational Form. The form of early medical schools can be differentiated according to two major characteristics: (a) autonomy (i.e. whether the school was an independent institution or if it was affiliated with a college or university); and (b) the type of medical education being offered (i.e. whether the organization is a "regular" school, offering training in allopathic medicine, or a "sectarian" school, offering training in eclectic, homeopathic, physiomedical, botanical, or other form of medical practice). As suggested above, the dominant design that emerged among 19th century medical schools was that of the university-based, regular school. The eclectic schools represented one significant deviation from this model. Although two of these schools -- the Lincoln Medical College of Cotner University and the University of Nebraska Department of Eclectic Medicine -- had external affiliations, most were free-standing organizations. Eclectic schools promoted empirical training that sought to combine the best practices of other clinical approaches. They accepted much of allopathic medicine, but fought against the practice of drug-intensive treatment, particularly when it relied on non-naturally occurring substances.

Homeopathic schools represented a more radical alternative to the dominant model of regular medical education. The homeopathic educators advanced a different philosophy of clinical treatment (the "Law of Similars"), emphasizing the uniqueness of each patient (the principle of individualization) and the use of serially-diluted drug doses ("potentization") (Ullman 1988). Despite the recurrent conflict that flared between the homeopaths and regular practitioners throughout the 19th century, homeopathic organizations enjoyed considerable legitimacy, with some half-dozen schools featuring university affiliations. Consequently, I code the homeopathic schools as an organizational form that is distinct from both the regular and eclectic organizations. [5]

Other Organizational Characteristics. The analyses of organizational failure control for the size and age of the schools. Size is assessed via the number of enrolled medical students at each school. Age corresponds to the number of years that have passed since operational startup.

I also control for the first-mover status of each medical school. A school is defined as a 'first-mover' if it was the first to become operational in a given state. In one state (Illinois), two schools simultaneously graduated the first cohort of medical students from the state. Since neither school had clear precedence in this case, neither was coded as a first-mover.

Environment. My analyses incorporate three contextual variables, addressing the influence of war, state-level licensing of physicians, and industry-specific period effects. State-level licensing presents one viable exogenous explanation for the boom-and-bust cycle among medical schools. Between the 1870s and early 1900s, all states witnessed the passage of medical practice acts that allowed licensure of physicians only when they presented medical school diplomas and / or were examined by independent state boards (Starr 1982). The establishment of the independent state boards presented the greatest dilemma to marginal or unorthodox medical schools, since their graduates sometimes lacked training in a core curriculum of surgery, physiology, pathology, and the like; these school's diplomas could even be rejected outright by state board examiners. To account for this contextual factor, I collected information on all state-level medical practice acts passed in the United States (see JAMA 1901; Wilder 1901: 775-835; Rauch 1891) and distinguished those that created independent boards of examiners.

A second possible exogenous explanation for the severe decline in U.S. medical schools was Abraham Flexner's (1910) report on *Medical Education in the United States and Canada*, which condemned the large number of organizations that failed to conform to the university-affiliated, regular school form. In the aftermath of the report, Flexner himself suggested that "schools collapsed to the right and left, usually without a murmur" (1960 [1940]). Medical historians have been less willing to ascribe many of these failures to the report. Based on self-identified reasons for school closure, Hiatt and Stockton (2003) suggest that only 7 percent of the schools evaluated may have closed as a direct result of the report; the reasons for merger or dissolution are unclear in another 35 percent of cases. To examine this impact more definitively, I include historical period effects in my models, distinguishing between (a) the era before the professionalization of medical practitioners in the United States (through 1846); (b) the era of early professionalization, beginning with the formation of the American Medical Association (1847-1910); and (c) the consolidation of professional authority for regular physicians, initiated by the Flexner Report (1911-1930).

A number of other contextual variables were considered but are not featured in the following analyses, either because they provided very limited improvement in model fit or introduced problems of multicollinearity. To control for broad business cycles, I introduced a dummy variable for economic depressions. As suggested by a previous analysis (Ruef 2004), the effects of this covariate fail to reach statistical significance in any of my models. I also examined a per-capita measure of physician density as a demand-side variable. Not surprisingly, this variable was highly correlated with the density of operational medical schools and was therefore dropped from further analysis.

Missing Data

Problems with missing data primarily affect the entrepreneurial inertia metric, which is unavailable for 76 schools that ultimately became operational. In analyses where the metric serves as an independent variable (i.e. as a predictor of medical school survival), there is no threat to internal validity (Berk 1983). Nevertheless, I want to minimize attrition from the sample that could affect estimates of other covariates and, consequently, use imputation procedures to replace these missing cases (Little 1992).

The issue is more worrisome for the analyses predicting transitions to operational startup (per *Hypotheses 2* and *3*). Here, the cases have been dropped based on the dependent variable, raising serious concerns about selection bias. To assess the degree of potential bias, I ran a Heckman (1979) sample selection model. I reasoned that I was more likely to observe the startup lags for medical schools that (a) subsequently achieved large student enrollments; (b) were regular schools with university affiliations; and (c) existed (or were founded) after 1900, when the AMA instituted more systematic data collection efforts.

Using logit selection, I found that there was strong evidence for (a) and (c) – large and recent medical schools were far more likely ($p < 0.001$) to have data on startup lags. The evidence for (b), on the other hand, was modest – regular schools were slightly more likely than sectarian schools to have lag data ($p < 0.05$), but there was no substantive difference between schools that were affiliated with universities and those that were not.

Since selection is driven primarily by variables (school size and recency) that are not featured as predictors of startup lag times, these results provide some preliminary support for the intuition that sample selection bias is not a severe problem in the following analyses. Further evidence was gleaned by comparing the results of OLS regression on the observed portion of the sample, with and without corrections for selection. The findings that include statistical corrections for selection effects are virtually identical to the standard OLS model (with one minor difference that is noted below in the discussion of findings). As a result, we have some confidence that the models which feature entrepreneurial inertia as a dependent variable do not suffer from significant selection bias.

Statistical Methodology

The statistical model of organizational founding and failure involves four distinct stages (see Figure 6). In the first stage (**A**), potential founders decide whether or not they wish to initiate the founding of a new medical school. Since the risk set of potential founders is unobserved, this is modeled as an entry process generating annual event counts at the level of the entire organizational population. The count variable is overdispersed (i.e. its variance exceeds it means), reflecting the possibility of contagion in entries in particular years. Accordingly, the following negative binomial model (Cameron and Trivedi 1986) is applied to predict pre-operational entries:

$$P(Y_t = y_t) = e^{-\lambda(t)u_t}\left(\lambda(t){u_t}^{y_t} / y_t!\right) \qquad (4)$$

where Y_t is the estimated entry count in year *t*, y_t is the corresponding observed entry count, $\lambda(t)$ is a linear function of the independent variables, and u_t reflects specification error or contagion.

[Insert Figure 6 About Here]

Following pre-operational entry, schools may either transition to operational startup (**B**) or pre-operational disbanding (**C**). Both processes reflect entrepreneurial inertia, although the latter can be characterized as a right-censored case of it. A competing risks model (Blossfeld and Rohwer 1995) is used to represent the rate with which pre-operational medical schools transition into one of these alternative destination states. Because pre-operational exits, in particular, are duration-dependent (with exit rates being especially high prior to the second year of an entrepreneurial effort), a piecewise exponential model was applied to capture this temporal variation:

$$r(t) = \exp(\gamma_n + A'X) \qquad \text{if } t \in n \qquad (5)$$

where *r(t)* is the transition rate for the medical schools; *t* indexes the entrepreneurial lag time; *n* indexes time periods corresponding to early-stage (< 2 years) and late-stage (2+ years) entrepreneurial efforts; and γ_n is a constant coefficient associated with the n'th time period. Other independent variables of interest (e.g. organizational form) are represented within the *X* matrix.

For those medical schools that manage to graduate students, a final process of interest concerns the risk of disbanding, conditional on having achieved operational startup (**D**). Exploratory analyses reveal a classic liability of newness pattern in this risk over the lifetime of a medical school, with risks being highest during the first three decades of operation, declining during the following three decades, and dropping to very low levels thereafter. As in the case of pre-operational exits, a piecewise exponential model can model this temporal variation, while accounting for age-independent effects arising from entrepreneurial inertia.

RESULTS

Preoperational Entry

Table 3 summarizes factors influencing preoperational entry among American medical schools through 1930. The first specification (see Model 1) corresponds to a classic density-dependence model in organizational ecology, in which the decision of entrepreneurs to initiate a school is driven by both operational incumbents in the niche, as well as schools that have yet to graduate students. Consistent with ecological theory, the log-linear term is positive and highly significant. The total density of schools initially serves to legitimate these organizations as a preferred form of medical education, as opposed to such earlier alternatives as medical apprenticeship or reliance on foreign medical graduates from Europe (Kaufman 1976). The squared density term, on the other hand, is statistically insignificant. While ecological theory proposes that competition tends to increase geometrically, deterring entry at high levels of organizational density (Carroll and Hannan 2000), the model appears misspecified when preoperational ventures are included in the density variable.

[Insert Table 3 About Here]

Following the logic of *Hypothesis 1*, an alternative model predicts startup events exclusively on the basis of operational incumbents, the most visible participants in an organizational population (Model 2). Using this measure, the density-dependence account proves to be more satisfactory, with the startup rate increasing as a log-linear function of density (the legitimation effect in ecological theory, $p < .01$) and decreasing as a quadratic function of density (the competition effect, $p < .05$). These ecological effects are accompanied by two notable institutional processes: (a) the medical practice acts passed by most states in the late 19th century tended to generate sociopolitical legitimation for medical schools, spurring their formation; and (b) the curricular reforms called for by the Flexner Report served to depress medical school foundings after 1910.

As noted in my theoretical discussion, the impact of density dependence on entries should not be conflated with either the bandwagon effect surrounding recent foundings nor with the competition these foundings may unleash for resources supporting preoperational ventures. To guard against this conflation, a final model includes covariates for the number of entries preceding any given year (Model 3). As identified in some previous ecological analyses (see Aldrich 1999: 268-270 for a review), local contagion contributes to positive autocorrelation up to a point, but large numbers of entries may consume many of the resources available for launching new ventures, deterring subsequent entrepreneurs. My findings concerning density dependence (based on operational ventures) continue to be robust in light of these processes.

Entrepreneurial Inertia

Table 4 provides estimates from a competing risk model, predicting the transition rate of newly founded medical schools to either operational startup (Model 1) or preoperational exit (Model 2). I find support for the idea that entrepreneurial inertia increases when founders adopt a dominant design – in this case, that of the university-affiliated, regular medical school (*Hypothesis 2*). Transition rates to operational startup decrease by roughly one-third for those ventures seeking linkages with a university and another third for ventures adopting a curriculum rooted in allopathic medicine. The findings thus support the intuition that dominant designs carry many normative elements which entrepreneurs find difficult to develop (e.g. clinical laboratories, in the case of the idealized medical school form at the end of the 19th century). Among those schools that achieve operational startup, the entrepreneurial lag is reduced slightly in organizational forms that deviate from the dominant design (e.g. eclectic schools) and reduced even further in forms that develop with little regard for the norms of the dominant design (homeopathic, botanical, and physiomedical schools). It is worth noting, however, that the standard error for the regular school dummy variable may be slightly underestimated, given sample selection effects. More specifically, results from a Heckman model suggest that the t-ratio decreases by approximately 15% once corrections for sample selection are included. Nevertheless, this still places the significance of the effect at the 0.01 level (one-tailed test).

[Insert Table 4 About Here]

As suggested by *Hypothesis 3*, entrepreneurial inertia is reduced when a population has a large number of organizational exemplars that are both operational and which conform to the dominant design. This effect is pronounced for medical schools transitioning to operational startup, but not quite significant for those that experience preoperational exits.[6] A more decisive influence on exits involves concurrent entries, which tend to drain resources available for startup activities and thereby increase the risk of preoperational failure (*Hypothesis 4*).

Among environmental conditions, those related to the professionalization of the medical occupation have the most notable impact on entrepreneurial inertia. For the transition to operational startup, rates decrease significantly after the formation of the American Medical Association (and other professional societies) around the middle of the 19^{th} century. The passage of medical practice acts in various states also decrease startup rates, but this estimate is only marginally significant ($p < .10$). Arguably, both institutional activities generated new barriers to entry that had to be crossed for organizations seeking to define themselves as medical schools.

Exits among Operational Organizations

The preceding analyses have addressed how entrepreneurial inertia arises and how it may distort entrepreneurs' perceptions of an organizational population by camouflaging large numbers of pre-operational ventures. My final analysis addresses the effects of entrepreneurial inertia for those medical schools that experience operational startup (Table 5). As shown in the baseline model, a number of medical school characteristics are linked to exit events along lines consistent with previous organizational research (Model 1). Thus, medical schools exhibit a "liability of newness", with recently operational schools exiting at a rate 5.89 times higher than more established schools (with 60+ years of operation). Medical school exits decrease significantly as a function of school size (as measured by the number of enrolled students) and affiliation with established universities. I also find that schools adopting the hybrid, "eclectic" form have a higher rate of exit ($e^{0.57} = 1.77$) than either orthodox "regular" schools or their oppositional counterparts (e.g. homeopathic, botanical, and physiomedical schools). This result dovetails with research on organizational identities, which suggests that organizations that fail to conform to standard categorical expectations are likely to suffer from illegitimacy (Zuckerman 1999; Pólos, Hannan and Carroll 2002).

With respect to the effects of the social environment, my findings here are also consistent with previous research, particularly among historians. One external catalyst to the shakeout among U.S. medical schools can be attributed to the creation of examining boards in various states in the late 19th and early 20th century (see Starr 1982), which leads to more than a two-fold increase in school exit rates. The dissemination of the Flexner Report contributes to an equally dramatic rise in school closings and acquisitions after 1910. Finally, there is substantial first-mover effect for those schools that introduce medical education in a given state. The first movers reduce their odds of dissolution or acquisition by nearly 60%, reflecting their ability to secure ongoing support from state legislators and local philanthropists and to develop a regional identity that wards off potential challengers.

[Insert Table 5 About Here]

In Model 2, I add a covariate for entrepreneurial inertia, the number of years that elapsed between the initial organization of a medical school and operational startup. Consistent with *Hypothesis 5*, those schools exhibiting substantial lags in their founding process are significantly less likely to face subsequent closure or acquisition. For instance, a school with a four-year lag between initiation and startup is estimated to have an exit rate only half that of a school with no entrepreneurial lag. Medical schools with prolonged periods of founding were able to invest more time in resource mobilization, faculty recruitment, curriculum planning, staff socialization, and the development of clinical and teaching facilities. Inertia itself may also serve as a signal of the reliability and accountability of an educational institution (Hannan and Freeman 1984). Notably, the effect holds even after controlling for the liability of newness and opposing first-mover benefits.

A final model considers whether this finding holds up when covariates are added for a density-dependent specification of organizational exits (Model 3). Consistent with previous research on organizational ecology, the exit rate tends to fall with initial increases in population density and rise once competition intensifies. There is also evidence of a density delay effect. Medical schools that are founded during periods of high organizational density have persistently higher exit rates, supporting the ecological notion that adverse environmental conditions from the time of founding may be 'imprinted' on formal organizations (Carroll and Hannan 1989).

The estimate for entrepreneurial inertia continues to be significant in this specification, although its magnitude is slightly reduced. A reason that may be offered for this result is the substantive overlap between the mechanism underlying entrepreneurial inertia and those underlying density delay. As Carroll and Hannan (2000) emphasize, one process contributing to density delay involves a liability-of-scarcity, in which intense competition at the time of founding leads preoperational organizations to scramble toward operational startup. The consequence is that new ventures "cannot devote much time, attention, and resources to organization building" (2000: 241). Naturally, the same problem is implied by low levels of entrepreneurial inertia. It should also be noted that tolerance diagnostics suggest that there may be collinearity in this model, as evidenced by the fairly high condition index (90.18). As Belsey and colleagues (1980) have discussed, condition indices over 20 are often linked to possible problems of collinearity, including inflated standard errors. In light of these theoretical and methodological considerations, it is unsurprising that entrepreneurial inertia is only significant at the 0.05 level in this model.

DISCUSSION

The mechanism of entrepreneurial inertia suggests a basic paradox for the viability of organizational populations. On the one hand, careful planning and resource mobilization can enhance the survival of a nascent organization once it becomes operational. Entrepreneurs hoping to create sustainable ventures are thus advised to avoid rushing into startup activity. At the same time, the delay inherent in this process contributes to perceptual inaccuracies on the part of other organizations and entrepreneurs who want to forecast the competitive landscape in a niche. Depending on the amount of delay relative to intrinsic startup and exit rates in a population, entrepreneurial inertia can lead to a single boom-and-bust event, sustained boom-and-bust cycles, or even the extinction of an organizational population. Although a meta-analysis of multiple industries would be required to explore the value of these predictions more definitively, several preliminary insights can be gained from an observation plan that focuses on a single organizational population.

For U.S. medical schools, the paradox of entrepreneurial inertia finds empirical support in both population- and organization-level accounts. The population-level analysis provides a basic tool for diagnosing appropriate models of evolution in organizational populations. In this empirical case, the preferred model of population evolution is neither one that relies on classic density dependence (Hannan and Freeman 1977) nor one that attributes uniform inertia to both startup and exit processes. Instead, a hybrid model seems most appropriate, emphasizing the delays that often accompany startup activities and the relative immediacy of factors contributing to organizational exit.

A sensitivity analysis of this model suggests considerable potential for instability in organizational populations, given even small entrepreneurial delays. The level of relative inertia in a population (calculated as the product of average lag times and intrinsic growth rates) seems especially useful as a diagnostic parameter to identify when boom-and-bust cycles are likely to occur and when organizational populations are likely to converge to their carrying capacity in a stable fashion. In other respects, the population-level model requires relatively few substantive assumptions for the occurrence of cycles. As long as market entry decisions on the part of entrepreneurs are dependent on the density of operational incumbents *and* those decisions are not revised significantly as a consequence of changes in density during the startup process, the structural conditions are ripe for boom-and-bust outcomes.

An organizational model serves to flesh out the processes contributing to entrepreneurial inertia. One crucial process parallels discussions of structural inertia more generally. Inertia in organizational structure and routines tends to be favored by society, because it connotes reliability in performance and accountability on the part of management (Hannan and Freeman 1984). By the same token, entrepreneurs who take their time entering a market are thought to have invested time in ensuring reliable performance and documenting their activities for the sake of accountability. The resulting lag between organizational initiation and operational startup is also influenced by a number of structural factors, including the extent to which entrepreneurs seek to adopt the dominant organizational form in a population and the number of exemplars available for that dominant form.

Beyond the specific application of boom-and-bust cycles in organizational populations, the framework presented here may have more general implications for both organizational theory and economic sociology. With respect to organization theory, this empirical investigation helps to connect two previously disparate strands of research –

organizational ecology, which characterizes the evolution of industries in the aggregate (e.g. Carroll and Hannan 2000), and entrepreneurial strategy, which emphasizes the activities of individual entrepreneurs or entrepreneurial teams (e.g. Ruef, Aldrich and Carter 2003). In drawing micro-macro connections between these strands of research, scholars are confronted with the obvious question as to how the actions of ordinary entrepreneurs, assessed on a time scale of months or years, could possibly make any difference in the evolution of industries, assessed on a time scale of decades or centuries (Carroll and Khessina 2005). Surprisingly, analyses of entrepreneurial inertia imply that even relatively minute changes in the timing of founding processes can have profound implications for the vitality and composition of organizational populations.

For economic sociology, a broader implication concerns the relevance of rational actors for the existence of stable markets. It has often been assumed that speculative bubbles in markets tend to arise due to overconfident entrants or the irrationality of bandwagon effects (Kindleberger 1996; Galbraith 1997). On the other hand, if the culprits are methodical strategists, who carefully plan their entry into an industry or market so as to maximize their viability, then individual rationality and market instability may be ironic bedfellows. As Jovanovic (2004) demonstrates, markets tend to be most stable (in terms of price and output) when entrepreneurial lags are either zero or constrained to be equal. Heterogeneous lags, resulting from either structural constraint or entrepreneurial choice, lead to more complex market dynamics.

Adam Smith's self-interested “homo economicus” can therefore become the progenitor of a rather shaky “invisible hand”. This raises several general questions for future research in economic sociology. How debilitating is rational planning on the part of market participants for a market as a whole? Is the problem mitigated or exacerbated by stronger forms of rational planning, in which entrepreneurs consider both their opportunity costs – e.g. in terms of wages foregone during an entrepreneurial lag – as well as the benefits received from a long-lived organization? When is non-strategic social action crucial to the survival of economic markets or industries over the long-run?

[Insert Figure 7 About Here]

These issues are complicated by the fact that the number of levels at which inertia may be assessed are not two but three – individual, organizational, and population. Consider the basic paradoxes raised by structural inertia theory (Hannan and Freeman 1984, 1989) and the parallels that may be identified with respect to entrepreneurial inertia (see Figure 7). As suggested by both the classic theory of structural inertia and its logical reformulations (e.g. Péli et al. 1994, 2000), inertia may be a desirable property for specific organizations due to its association with the reproducibility of administrative structure and routines and, in turn, organizational reliability and accountability. At the same time, however, inertia is seen as problematic for the individual managers running such static organizations. It can serve as a signal of managerial conservatism – or even incompetence – and may lead stakeholders to question the usefulness of management more generally. Another paradox is apparent at the population level. Even though structural inertia can enhance the survival of individual organizations, its proliferation ultimately limits the evolution of entire organizational populations. This renders mature organizational forms vulnerable to displacement by novel arrangements.

A similar set of mechanisms apply when we turn to entrepreneurial inertia. For nascent organizations, inertia during an entry period allows for the careful development of capabilities and resources. The benefits of inertia for the entrepreneurs themselves are more questionable. From an economic perspective, they forego alternative opportunities to earn income or invest during this waiting period (Jovanovic 2004). An organizational population as a whole may also suffer from high levels of entrepreneurial inertia, not owing to interpopulation competition as in the case of structural inertia, but due to instability within the population and a propensity toward cyclical expansion and consolidation.

Inertia poses difficulties for organizational participants, social scientists, and policy makers, given inherent differences in its causal effects across levels of analysis. Moreover, there is often a strong inclination among observers to reinterpret the structural effects of inertia in psychological terms. Boom-and-bust cycles are thus characterized as arising due to overvaluation – i.e. investors' departures from “market fundamentals” – rather than delays in investment or entrepreneurial activity. Similarly, organizational inaction is often seen as a problem of motivating – and adequately compensating -- managers, rather than as an evolutionary by-product of organizational survival. For enlightened conceptions of strategic management, a central research task involves understanding the cultural conditions that encourage participants in modern society to analyze the effects of structural inertia along such individualist lines.

APPENDIX. STABILITY ANALYSIS

Following Nisbet and Gurney (1982: 287-289), I analyze the stability of the delayed logistic model through two simultaneous equations that prescribe the permissible behaviors of the model, given the controlling parameter for relative inertia ($r \times \tau$):

$$\mu' = r\tau \exp(\mu') \cos\omega' \qquad \text{(A1)}$$

$$\omega' = r\tau \exp(\mu') \sin\omega' \qquad \text{(A2)}$$

where μ' is the so-called *damping constant*, indicating whether the population trajectory is stable ($\mu' \geq 0$) or unstable ($\mu' < 0$), and ω' is referred to as the *natural frequency*, indicating whether the population is subject to predictable oscillations ($\omega' > 0$) or not ($\omega' = 0$). Cross-tabulating the two parameters leads to four qualitatively distinct types of population trajectories (Table A1). The first three (**A**-**C**) match the population trajectories displayed in Figure 1, while the last (**D**) corresponds to an outcome in which the average number of participants in a population or market cannot be predicted over the long-run, even in the absence of exogenous changes or population heterogeneity.

[Insert Table A1 About Here]

The simultaneous equations can be solved numerically for $r\tau$, thus indicating the levels of relative inertia leading to each of the population trajectories. Using the FINDROOT function in Mathematica, numerical solutions for μ' and ω' were obtained using values of relative inertia ranging from 0 (i.e. no entrepreneurial lag) to 2.5 (reflecting an extremely long lag and/or high intrinsic rate of population growth). Figure A1 illustrates the three distinctive types of population steady states corresponding to different values of relative inertia over the range.

[Insert Figure A1 About Here]

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Figure 1. Number of Medical Schools in the United States, 1765-1999

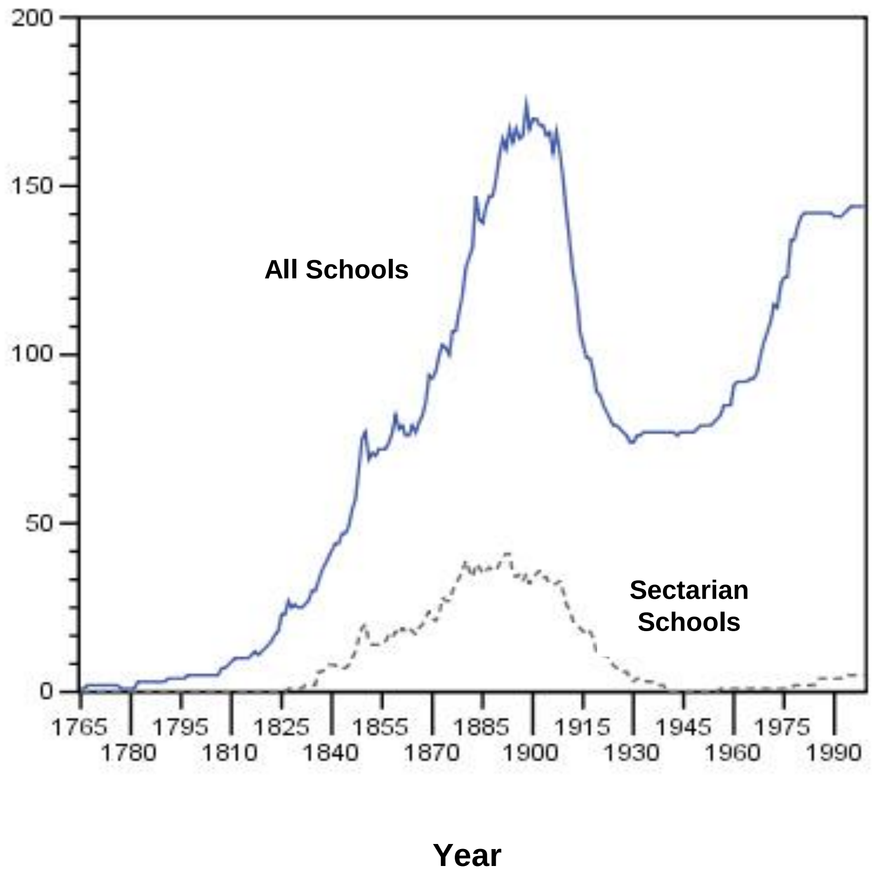

Figure 2. Trajectories of Organizational Populations under Different Parameterizations of Delayed Logistic Model

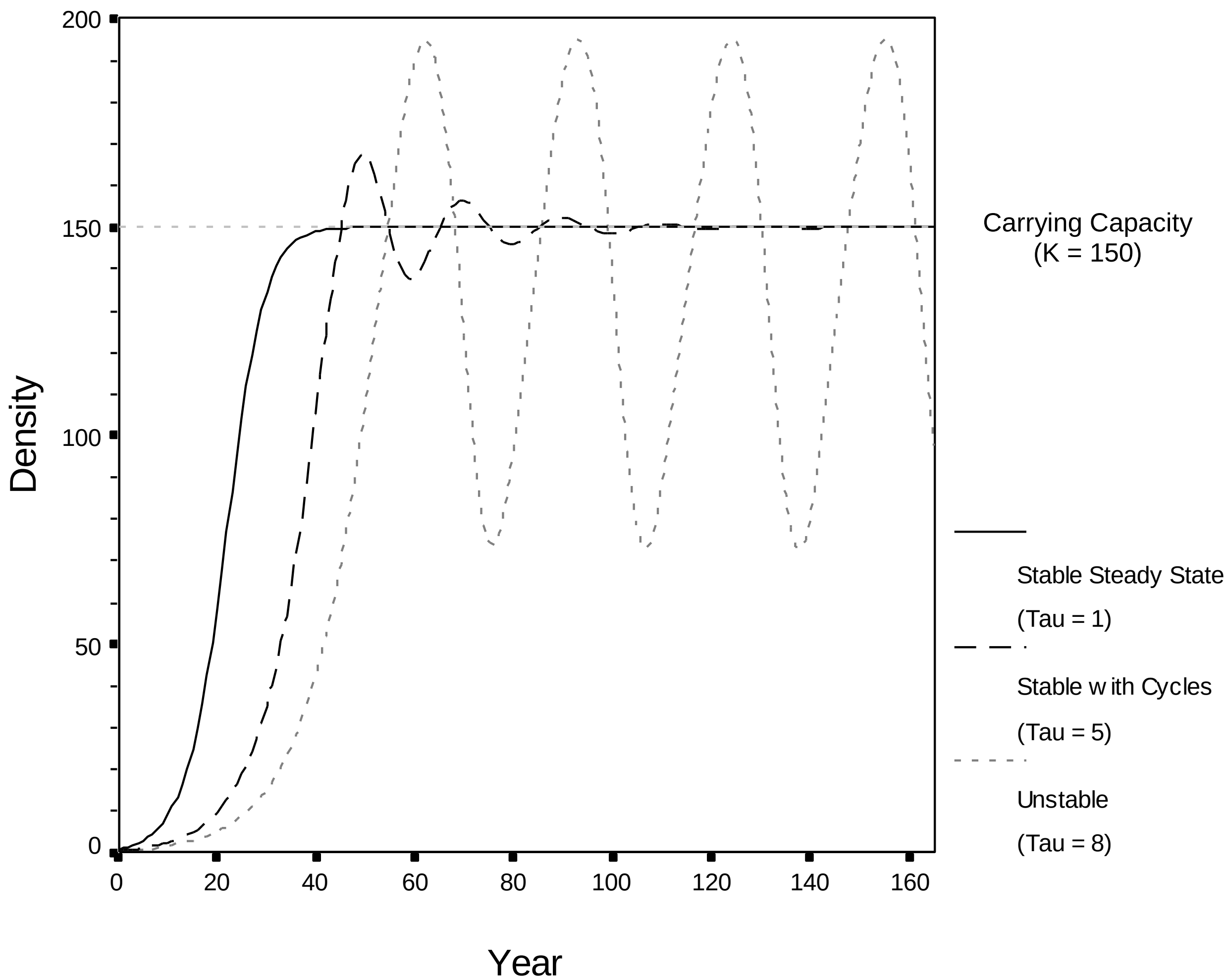

Figure 3. Steady States of Organizational Populations
in Model of Entrepreneurial Inertia

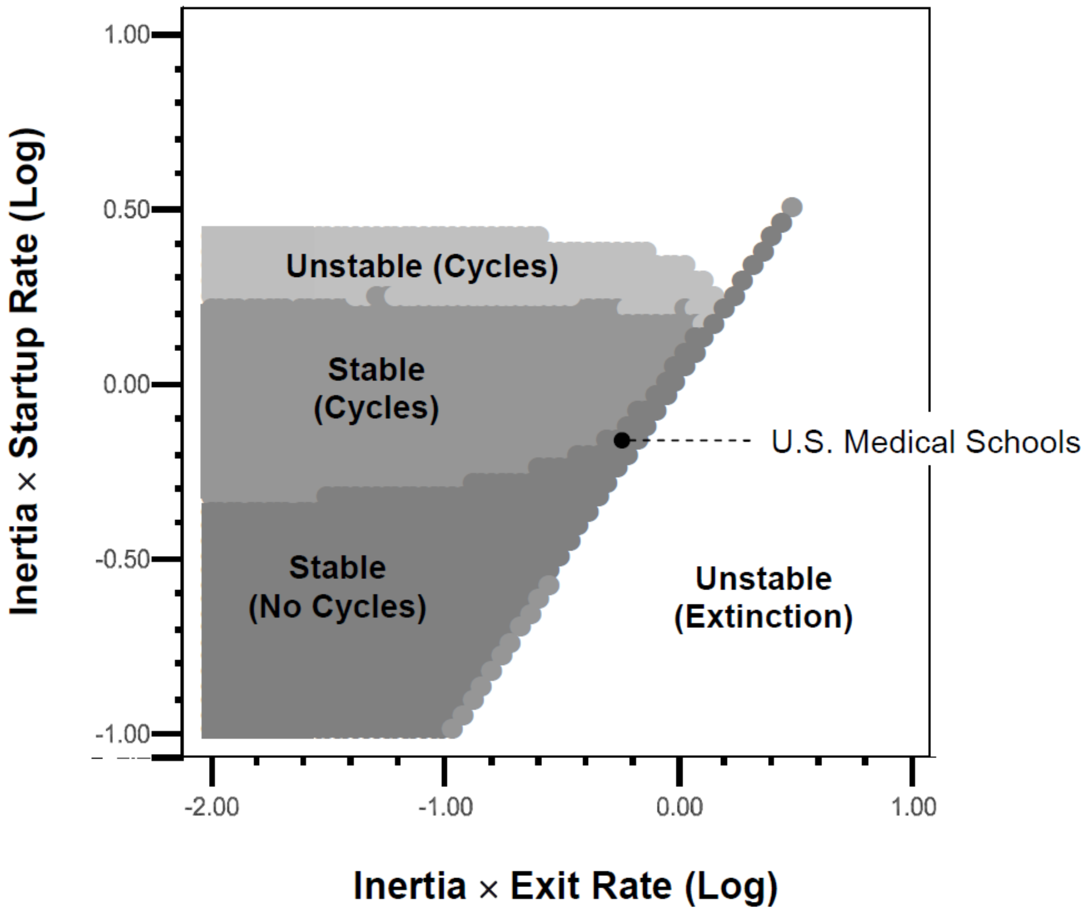

Figure 4. Distribution of Entrepreneurial Inertia among

U.S. Medical Schools, 1765-1930

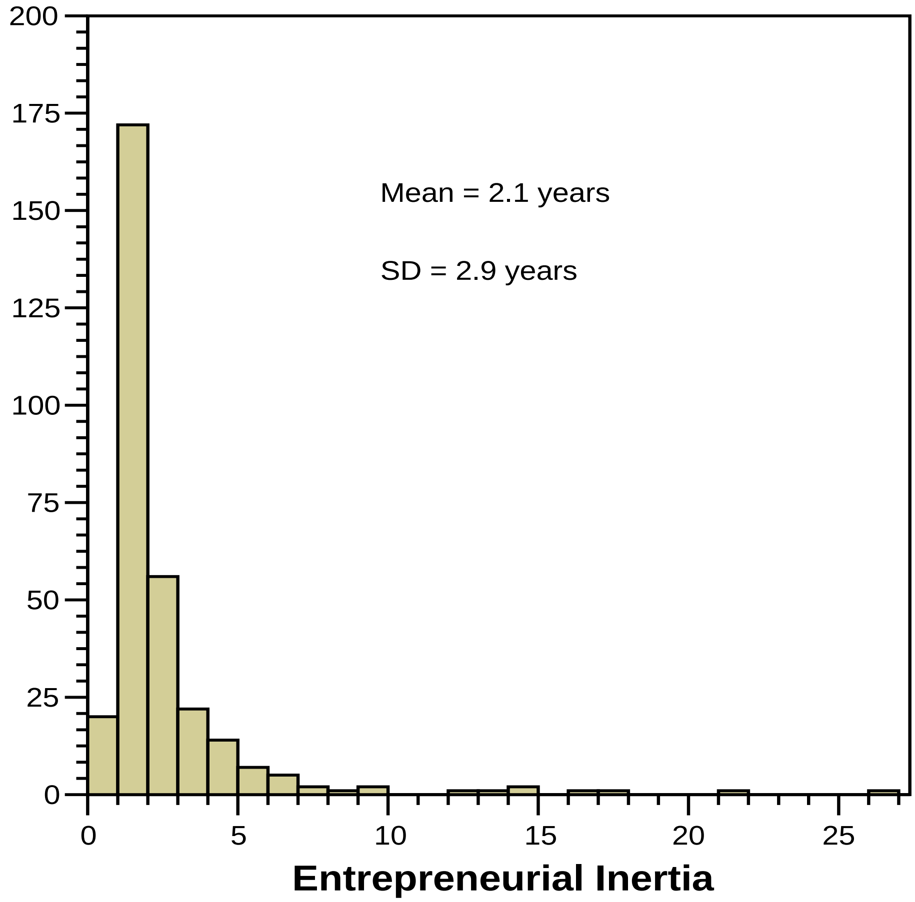

Figure 5. The Liability of Newness and Benefits of Entrepreneurial Inertia

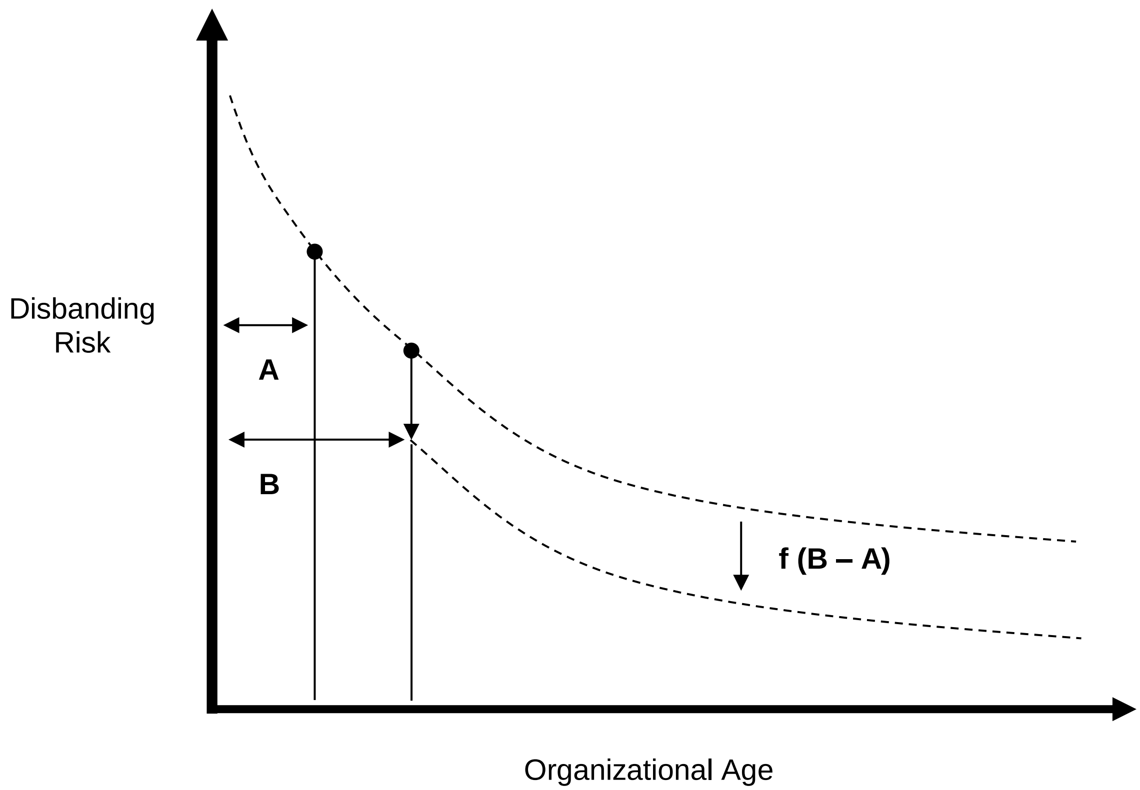

Figure 6. Model of Organizational Startup and Exit Processes

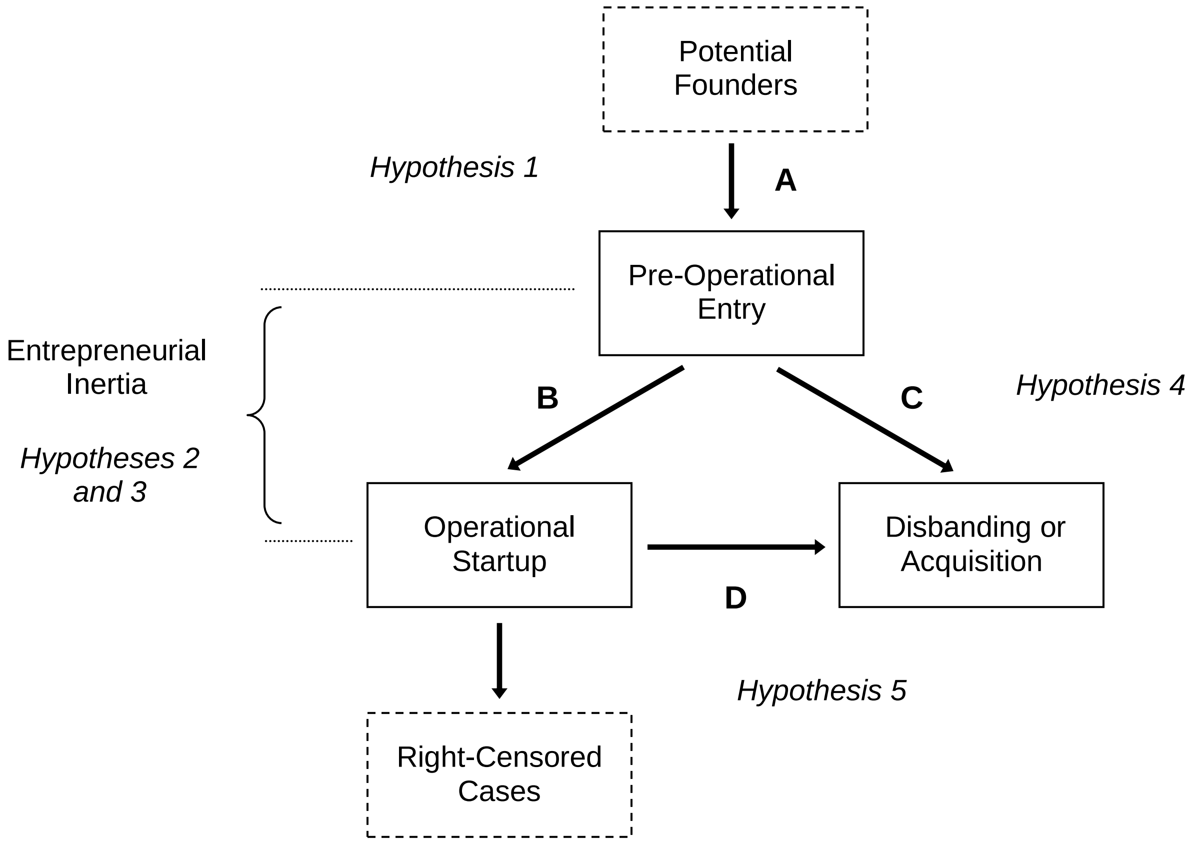

Figure 7. Hypothetical Impact of Organizational Inertia at Multiple Levels of Analysis

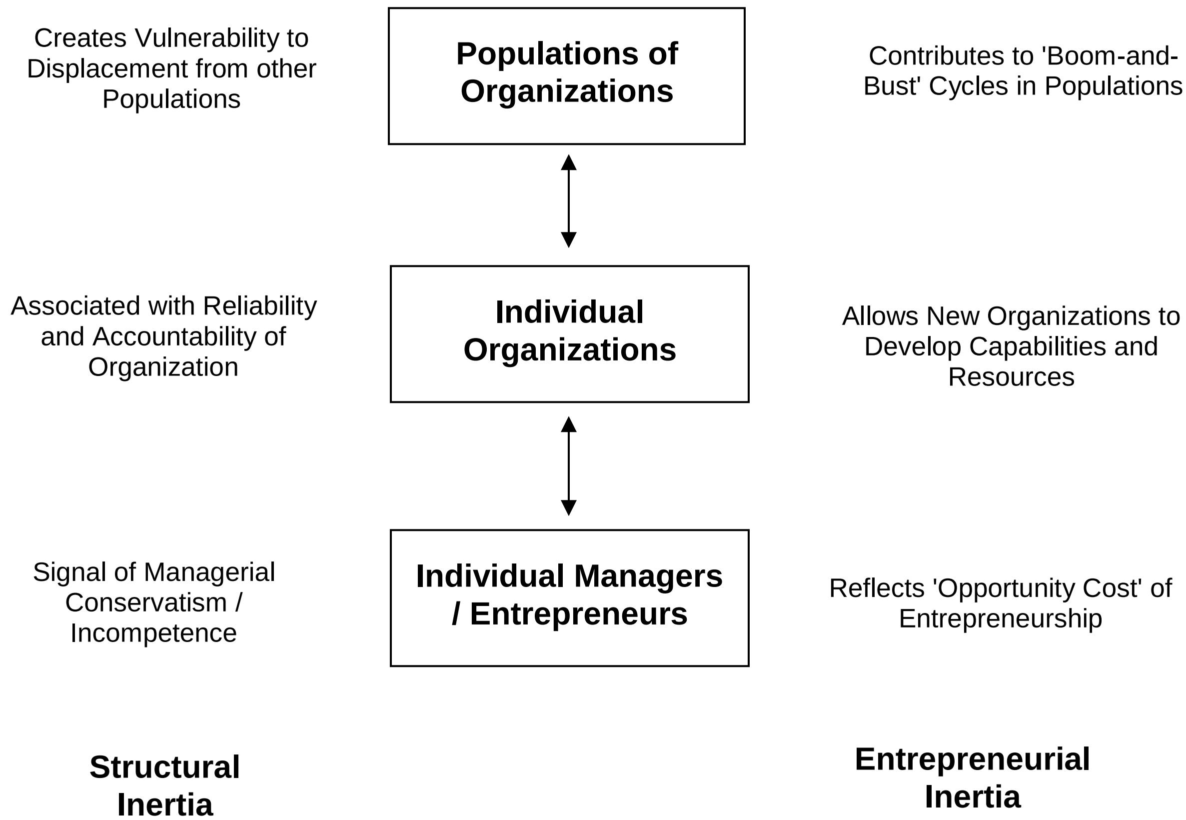

Figure A1. Steady States of Organizational Populations
in Delayed Logistic Model of Growth

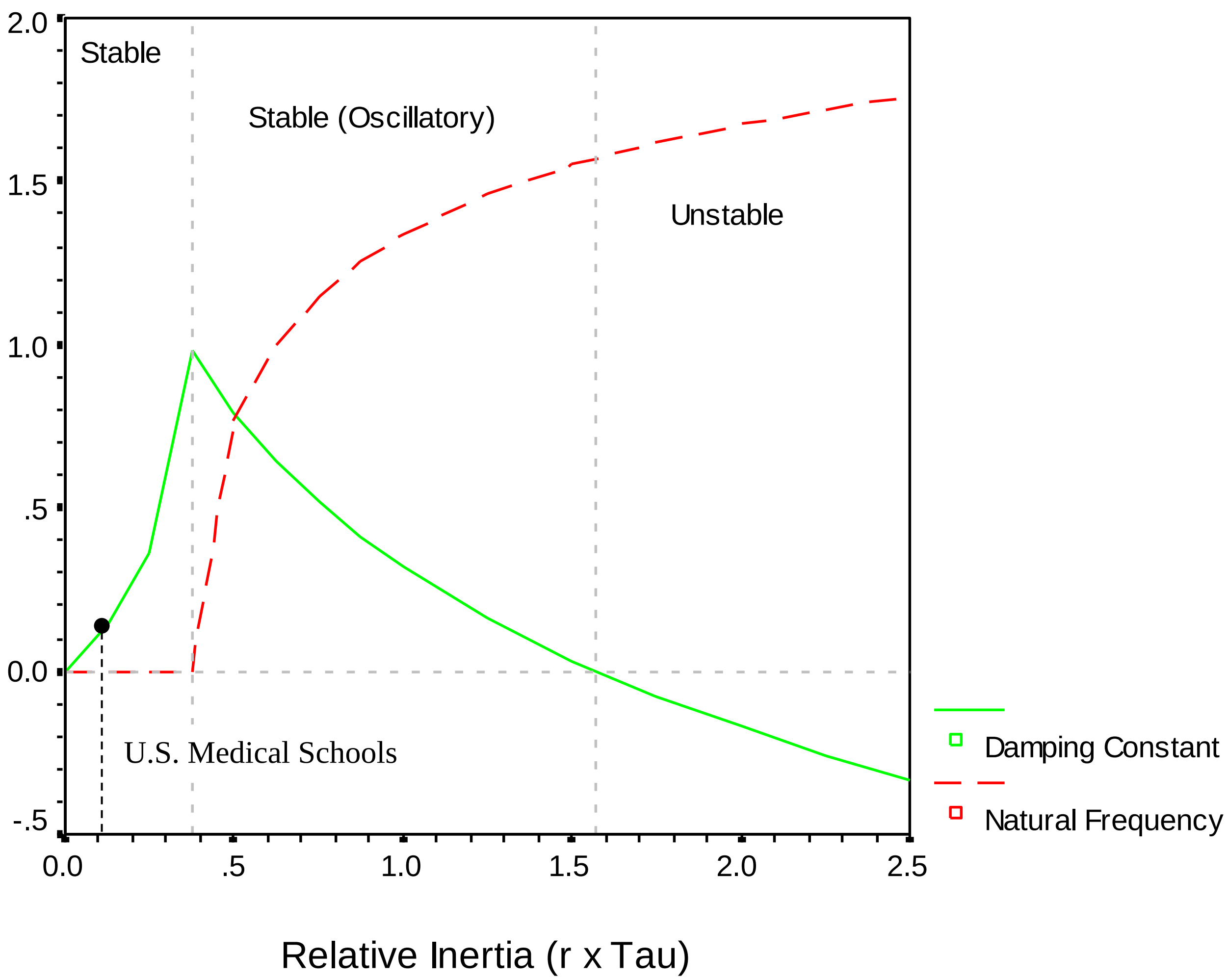

Table 1. Estimates of Growth in the Population of U.S. Medical Schools, without Organizational Heterogeneity (1766-1999)

Parameter	Classic Logistic Model	Delayed Logistic Model	Hybrid Delayed Model
Carrying Capacity (K)	150.4	137.5	129.1
Intrinsic Growth Rate (r)	0.030	0.043	---
Startup Rate (r_1)	---	---	0.215
Exit Rate (r_2)	---	---	0.180
Structural Inertia (τ) *	n/a	3.0	3.0
R-Squared	0.018	0.064	0.193
Number of Observations		234	

Note: Asterices (*) denote fixed parameters.

Table 2. Descriptive Statistics for Population of Medical Schools (Total N=4,690 organizational spells) †

Variable	Mean	S.D.	Minimum	Maximum
Organizational				
Age (years)	32.37	30.19	0	147
Size (students)	159.08	140.76	0	1055
Regular School ‡	0.84	---	0	1
Eclectic School ‡	0.05	---	0	1
University-Based	0.50	---	0	1
Equal-Status Merger	0.08	---	0	1
Inertia (years)	2.43	3.28	0.5 *	26
Environmental				
First-Mover	0.20	---	0	1
Total Density (lagged)	123.58	39.81	1	174
Operational Density (lagged)	107.66	36.84	0	154
War Years	0.06	---	0	1
Medical Practice Act	0.84	---	0	1
Examining Board	0.73	---	0	1
Organizational Mortality	0.04	---	0	1

† Organizational statistics are restricted to 321 operational schools.

‡ Homeopathic and other sectarian schools (e.g. botanical, physiomedical) represent the omitted category.

* Nineteen schools achieving operational startup in the same calendar year as their founding were coded as having a six-month lag time.

Table 3. Negative Binomial Models Predicting Pre-Operational Entries among U.S. Medical Schools, 1766-1930

Variable	Model 1	Model 2	Model 3
Constant	-2.439 (0.402) **	-2.379 (0.399) **	-2.341 (0.389) **
log (Total Density)	0.908 (0.139) **	---	---
Total Density Squared	-0.017 (0.010)	---	---
log (Operational Density)	---	0.971 (0.151) **	0.864 (0.142) **
Operational Density Squared	---	-0.037 (0.014) **	-0.037 (0.012) **
War Year	0.246 (0.188)	0.239 (0.179)	0.268 (0.180)
Medical Practice Acts †	0.097 (0.032) **	0.092 (0.032) **	0.058 (0.032)
Period 2 (1847-1910)	0.064 (0.287)	0.020 (0.284)	-0.225 (0.290)
Period 3 (1911-1930)	-2.167 (0.475) **	-2.276 (0.483) **	-1.951 (0.451) **
Prior Entries	---	---	0.193 (0.054) **
Prior Entries Squared	---	---	-0.009 (0.003) **
Overdispersion	0.158 (0.063) *	0.166 (0.065) *	0.094 (0.056)
Number of Observations	165	165	165
Condition Index	11.375	11.093	14.239
-2 Log Likelihood (df)	534.13 (7)	535.28 (7)	520.33 (9)

* $p < .05$; ** $p < .01$ (two-tailed tests)

† Combined number of new state acts passed in current and previous year.

Table 4. Competing Risk Models Predicting Transition Rate to Operational Startup among U.S. Medical Schools, 1766-1930

Variable	Operational Startup Model 1	Pre-Operational Exit Model 2
Duration (0 – 1 Year)	-0.823 (0.230) **	-2.852 (0.580) **
Duration (2+ Years)	-0.551 (0.246) *	-3.931 (0.651) **
Organizational Form		
Regular School †	-0.487 (0.177) **	-0.557 (0.285) *
Eclectic School †	-0.179 (0.261)	-0.756 (0.474)
University-Based	-0.348 (0.145) **	-0.803 (0.324) **
Equal-Status Merger	0.707 (0.252) **	-1.423 (1.020)
Organizational Ecology		
Concurrent Entries	-0.001 (0.016)	0.089 (0.023) **
Density (Regular Schools) ‡	0.013 (0.004) **	0.006 (0.007)
Environment		
War Year(s)	-0.017 (0.189)	-0.173 (0.411)
Medical Practice Act	-0.402 (0.221)	-0.314 (0.377)
Examining Board	-0.176 (0.196)	0.491 (0.323)
Period 2 (1847-1910)	-0.520 (0.234) *	0.477 (0.632)
Period 3 (1911-1930)	0.191 (0.406)	0.454 (1.178)
Number of Events	309	84
Condition Index	13.997	
-2 Log Likelihood (df)	1633.37 (13)	

* p < .05; ** p < .01 (one-tailed tests for hypothesized effects, two-tailed otherwise)

† Homeopathic and other sectarian schools (e.g. botanical, physiomedical) represent the omitted category.

‡ Limited to density of operational schools.

Table 5. Piecewise Exponential Models Predicting Exit Rate among Operational U.S. Medical Schools, 1766-1930

Variable	Model 1	Model 2	Model 3
Age (0 – 29 Years since Startup)	-3.064 (0.419) **	-2.689 (0.446) **	-2.300 (0.962) **
Age (30 – 59 Years)	-3.491 (0.460) **	-3.125 (0.484) **	-2.266 (0.990) *
Age (60+ Years)	-4.529 (0.659) **	-4.132 (0.677) **	-2.397 (1.135) *
Organizational Form			
Regular School †	0.041 (0.200)	0.100 (0.201)	0.053 (0.201)
Eclectic School †	0.570 (0.258) *	0.584 (0.258) *	0.569 (0.258) *
University-Based	-1.031 (0.191) **	-1.007 (0.190) **	-1.024 (0.194) **
Equal-Status Merger	-0.366 (0.354)	-0.504 (0.358)	-0.510 (0.359)
Organizational Features			
Size (# of Students) ‡	-0.133 (0.018) **	-0.131 (0.018) **	-0.128 (0.019) **
Inertia (Years) ‡	---	-0.334 (0.138) **	-0.255 (0.143) *
Organizational Ecology			
Total Density (Logged)	---	---	-0.950 (0.412) *
Total Density Squared	---	---	0.036 (0.020) *
Density at Founding (Logged)	---	---	0.894 (0.279) **
First Mover	-0.837 (0.308) **	-0.830 (0.307) **	-0.590 (0.313) *
Environment			
War Year(s)	-0.127 (0.251)	-0.087 (0.252)	-0.003 (0.260)
Medical Practice Act	-0.413 (0.256)	-0.459 (0.256)	-0.819 (0.298) **
Examining Board	0.696 (0.256) **	0.709 (0.256) **	0.420 (0.274)
Period 2 (1847-1910)	0.868 (0.386) *	0.867 (0.386) *	0.481 (0.654)
Period 3 (1911-1930)	1.747 (0.435) **	1.793 (0.435) **	1.392 (0.733)
Number of Events	200	200	200
Condition Index	17.165	18.656	90.182
-2 Log Likelihood (df)	1658.38 (14)	1651.74 (15)	1637.85 (18)

* p < .05; ** p < .01 (one-tailed tests for hypothesized effects, two-tailed otherwise)

† Homeopathic and other sectarian schools (e.g. botanical, physio-medical) represent the omitted category.

‡ To reduce skewness, these variables were transformed using a square root function.

Table A1. Analyzing the Stability of Organizational Populations

		Natural Frequency (ω') = 0	**Natural Frequency (ω')** > 0
Damping Constant (μ')	≥ 0	A. *Stable* (Overdamped)	B. *Stable* (Underdamped)
	< 0	D. *Unstable* (No Steady State)	C. *Unstable* (Limit Cycles)

Endnotes

[1] This micro-analytical research is supported by the work of economic historians, who find that stock market booms such as the 1929 bull market tend to be driven by firms using new technologies (Rappoport and White 1993: 551).

[2] Since the functional form of the logistic model is nonlinear, it is estimated using a Levenberg-Marquardt algorithm rather than OLS. The intrinsic growth rate (r) and carrying capacity (K) serve as model parameters.

[3] The trajectories are generated using model (2), with K = 150, r = 0.25, N(0) = N(1) = N(2) = 1, and τ varying as shown in the figure.

[4] Using this criterion, pre-operational entry necessarily occurs before operational startup, although an entrepreneurial "lag" of zero may be registered when a school is founded and graduates students in the same calendar year (19 cases). Previous research designs examining the effect of founding processes on population dynamics (e.g. Rao 2001; Carroll and Hannan 2000: Chapter 15) have not been able to rely on this strict temporal sequencing.

[5] Aside from the homeopaths, other medical sects – including the botanical and physiomedical forms – represented fairly radical alternatives to allopathic medicine in the early 19th century (Waite 1946; Starr 1982). These subsequently fed into the less "deviant" form of eclectic medicine.

[6] In separate analyses, I considered whether this effect may be curvilinear – i.e. if there is a point where the widespread prevalence of a dominant design actually inhibits the transition of schools to operational startup. No empirical support for this hypothesis was found.