Paper to be presented at the

35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19

Persistent Advantage, Cohorts, and Industry Evolution

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Abstract

Juxtaposing competing theories of industry evolution, this paper investigates differences in the rates at which firms? profit advantages persist or converge following a fundamental change to the rules of competition in an industry (institutional change). After such a change, two cohorts of firms emerge, entrants that lack experience in the industry and incumbents with a history of competing in the industry before the change. Our findings show that the profit advantages developed by these cohorts persist (converge) at different rates. Thus, after a fundamental shift in an industry?s development, differences in firm?s histories are critical to understanding the temporal dimension of advantage. The results demonstrate that superior performing incumbent firms sustain an advantage longer than superior performing entrants, albeit only temporary. This result is counterintuitive since entrants are not constrained by a legacy of competing under the prior rules of competition. Overall, the findings indicate that stages of a firm?s development and an industry?s development explain heterogeneity in the rates at which relative or abnormal profits persist or converge.

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PERSISTENT ADVANTAGE, COHORTS, AND INDUSTRY EVOLUTION

ABSTRACT

Juxtaposing competing theories of industry evolution, this paper investigates differences in the rates at which firms' profit advantages persist or converge following a fundamental change to the rules of competition in an industry (institutional change). After such a change, two cohorts of firms emerge, entrants that lack experience in the industry and incumbents with a history of competing in the industry before the change. Our findings show that the profit advantages developed by these cohorts persist (converge) at different rates. Thus, after a fundamental shift in an industry's development, differences in firm's histories are critical to understanding the temporal dimension of advantage. The results demonstrate that superior performing incumbent firms sustain an advantage longer than superior performing entrants, albeit only temporary. This result is counterintuitive since entrants are not constrained by a legacy of competing under the prior rules of competition. Overall, the findings indicate that stages of a firm's development and an industry's development explain heterogeneity in the rates at which relative or abnormal profits persist or converge.

Keywords: abnormal profits, persistence, industry evolution, incumbents, entrants, deregulation

"So if you really want to understand the way the market system and the feedback from the marketplace provides the selective force that operates to shape what is actually happening, the examples that are really powerful are examples from a historical context of relatively early stages in industry evolution or, of course, later stages where there is some innovation which renews the whole process." Winter, S. 2003. Journal of Management Inquiry, The Progress of Evolutionary Thinking in Economics and Management.

A fundamental objective of firms is to sustain profits superior to those of competitors (e.g. Barney, 1998, 1991; Porter, 1985; Lippman & Rumelt, 1982). Many scholars have studied whether firms' superior profits (profits above an industry's norm) tend to converge or persist (e.g. Mueller, 1977, 1986; Cubbin & Geroski, 1987; Dosi, 2005; Dosi et. al., 2010; Jacobson, 1988; Knott, 2003; McGahan & Porter, 1999, 2003; Roberts, 2001; Rumelt, 1991; Schmalensee, 1985; Waring, 1996; Wiggins & Ruefli, 2002). Few studies, however, investigate how the profit differences among competing cohorts of firms, such as incumbents and entrants, evolve following a major disruption to an industry. Yet, if a firm's history influences its ability to develop superior profits and an industry's stage of evolution affects competition, then considering both firm and industry history is critical to understanding the conditions under which superior profits are sustained or dissipated.

A major shock in an industry may induce firms to become more concerned about their abilities to sustain a profit advantage over rivals. In addition to reshaping how firms compete, such shocks split the industry into two cohorts, incumbents that entered before the change and entrants that started up after it. The effects of such shocks on profitability are more uncertain when they not only disrupt incumbents' business models but also open the door to new entrants. As a consequence, these differences are likely to transform an industry's existing trajectory of profit persistence or convergence (McGahan & Porter, 1999). For example, Walker, Madsen and Carini (2002) have shown that after a shock, entrants have greater variability in profitability than incumbents.

Neoclassical economics suggests that competition and free entry will make profit differences temporary rather than enduring or persistent (e.g. Hopenhayn, 1992; Schumpeter, 1934, 1950). Yet, we have ample evidence to the contrary (e.g. Mueller, 1977, 1986; Cubbin & Geroski, 1987; Dosi,

2005; Jacobson, 1988; Knott, 2003; Madsen & Leiblein, 2010; McGahan & Porter, 1999, 2003; Roberts, 2001; Villalonga, 2004). One explanation for this opposing evidence lies in the interaction between the histories of firms competing in the industry and the stage of an industry's evolution..

For the most part, empirical work on the persistence of superior profits overlooks how entrants and incumbents differ in the durability of profit advantages. Such a difference is important, however, given competing perspectives on the evolution of heterogeneity in an industry. On the one hand, several authors have argued that the profitability among firms differs the most during the initial stages of an industry's development (Abernathy & Utterback, 1978; Klepper & Graddy, 1990; Klepper, 1996) and slowly erodes as firms converge on common practices. In this view, when an industry experiences a dramatic shift in the rules governing competition, the first cohort of entrants to the industry is central in this convergence (e.g. Geroski, 1995; Madsen & Walker, 2007). An alternative view is that superior profits persist as firms accumulate unique bundles of resources via path dependent learning (Dierickx & Cool, 1989) and defend these resources against imitation (Demsetz, 1973; Mueller, 1977). For instance, after a break in an industry's history, incumbents and entrants may vary in their resource stocks and competitive experiences and, in turn, in their abilities to defend against imitation.

We explore these competing perspectives – convergence vs. persistence - by comparing the profit patterns of different cohorts of firms following a major change in the institutional environment of the U.S. trucking industry: the deregulation of pricing and entry.[1] Examining how abnormal profits (profits above or below the industry norm) evolve requires that we identify a set of firms that lack experience in an industry. Our initial hypotheses therefore focus on the first cohort of firms to enter the trucking industry after deregulation. We label these firms Cohort One to

1. This form of industry deregulation was common in the United States at both the national and state levels in the early 1980's. Six major industries deregulated from 1978 to 1985: airlines, natural gas, railroads, telecommunications, trucking and interstate banking.

distinguish them from firms that enter later. One pattern of industry evolution, convergence, is observed when the profit heterogeneity of members of Cohort One erodes over time. The alternative pattern is that profit differences among members of Cohort One persist. Next, we compare the rates at which profit heterogeneity converges (or persists) for the incumbent and entrant cohorts separately (the latter includes all firms that entered the industry after deregulation). If incumbents are unable to overcome the legacy of competing in the earlier regime, compared to entrants that do not have this constraint, we would expect to find differences in the persistence of heterogeneity of incumbent and entrant profits over time.

The trucking industry is an excellent example of an industry where an institutional change, aimed directly at the rules of competition, threatened incumbent firms' performance and viability (see also Boyer, 1993; Tye, 1987). Deregulation occurred in 1980. Figure 1 shows that, during the first ten years of deregulation, the exit rate of incumbents is substantially greater than the rate for entrants; by 1991, less than 50% of the incumbent cohort remained in the industry, indicating substantial differences in viability.

[Insert Figure 1 about here]

COHORTS, PERSISTENT ADVANTAGE, & INDUSTRY EVOLUTION

Cohorts. A cohort is a group of firms that enter an industry at roughly the same time or during the same era in an industry's history, where an era is defined by distinct historical, institutional, technological, and competitive conditions (Haveman & Rao, 1997; Walker et al., 2002). A central theme of cohort analysis is that the environment encountered at entry shapes the capabilities that entering firms must build in order to compete. These capabilities stamp the cohort with a common imprint based on its initial experiences (Carroll & Hannan, 2000; Stinchcombe, 1965). In addition to this imprint, the firms in a cohort encounter roughly the same opportunities

and constraints after the period of entry and thus are likely to have similar developmental patterns (Madsen & Walker, 2007). Cohort effects thus explain part of the competitive heterogeneity in an industry, analogous to the influence of birth cohorts on life outcomes studied in demography (Ryder, 1965; Knoke & Hout, 1974; O'Brien et al. 1999).

Convergence of Abnormal Profits. Research on the convergence (persistence) of abnormal profits has a rich history in strategy and economics (for example: Cubbin & Geroski, 1987; Dosi, 2005; Dosi et. al., 2010; Jacobson, 1988; Knott, 2003; Madsen and Leiblein, 2010; McGahan & Porter, 1997, 1998, 1999;, Mueller, 1977, 1986; Roberts, 1999; Roberts & Dowling, 2002; Rumelt, 1991; Villalonga, 2004; Waring, 1996; Wiggins & Ruefli, 2002). These studies examine whether the relative profitability of firms tends to a common value in the long run. The focus is on the gap between a firm's profits compared to competitors rather than on absolute (non-relative) profits per se. Although some support for the convergence hypothesis exists (Jacobsen, 1988; Wiggens and Ruefli, 2002, 2003), numerous studies demonstrate that superior profits tend to persist (Geroski & Jacquemin, 1988; Goddard and Wilson, 1999; McGahan & Porter, 1999; Mueller, 1990; Powell and Reinhardt, 2010; Cubbin & Geroski, 1987; Geroski & Jacquemin, 1988; Goddard, Molyneux and Wilson, 2004; Jacobsen, 1988; Mueller, 1977, 1986; Waring, 1996).[2] Studies also largely find that persistence rates vary among firms (Cubbin & Geroski, 1987; Dosi, 2005; Geroski & Jacquemin, 1988; Goddard, Molyneux and Wilson, 2004; Jacobsen, 1988; Mueller, 1977, 1986). In other words, firms vary in how long they can sustain a profit advantage over rivals.

Studies in this stream also show that the firm effect (a regression constant) is critical in representing the persistence of superior profits (see Cubbin and Geroski, 1987; Jacobsen, 1988: 428; for a review, see Dosi, 2005). In this line of inquiry, the firm effect represents a firm's unobserved

2. Applying a different methodology, more recent work finds that a small portion of firms enjoy persistent superior profits but not for long periods of time (Wiggins & Ruefli, 2003).

and enduring bundle of resource and capabilities (Rumelt, 1991). [3] Despite the relative importance of this effect, few empirical studies examining the persistence of superior profits analyze the firm effect in order to understand what contributes to differences in persistence rates among firms (Roberts and Dowling, 2002; Madsen and Leiblein, 2010) or across industry sectors (Villalonga, 2004). Even fewer studies consider whether a firm's history, such as whether it is an incumbent or entrant, matters (but see Walker et. al., 2002). Yet, if cohorts differ in their competitive strengths and these differences affect their performance (Klepper, 1996, 2002; Madsen and Walker, 2007) then cohorts may partly explain differences in the firm effect and therefore in the rates at which superior profits persist. Consistent with this view, recent work emphasizes that understanding 'how' and 'when' such heterogeneous "identities" affect relative performance may advance our understanding of persistent heterogeneity (Dosi, Lechevalier and Secchi, 2010; Dosi and Nelson, 2010).

Persistence Studies and Industry Evolution. Two characteristics of research on profit persistence are relevant to our inquiry. First, empirical studies have assumed that the influence of unique industry events on the persistence of superior profits is captured by two parameters, a generic industry effect and a temporal or year effect. While this approach seems reasonable, particularly for studies spanning multiple sectors over time (McGahan and Porter, 1999; 2003; Villalonga, 2004), it may obscure how shocks affect the persistence of superior profits in an

3. We use the term firm to designate a single business. In some earlier studies, notably Schmalensee (1985), firm referred to the corporate parent of a business. We are not concerned with corporate effects here.4. Early work applied a narrower definition for persistence that excluded permanent or stable effects, focusing attention on the percentage of the transient or incremental component of abnormal profits (see Mueller, 1986; McGahan and Porter, 2003; Waring, 1996). In this approach, abnormal profits consist of two components: a permanent or stable component representing the portion of abnormal profits that is unchanged over time and a transient or incremental component, representing the portion of abnormal profits that are unique to a given year and thus, temporary. Scholars argued that it was necessary to focus on the incremental portion of abnormal profits that persists rather than the total percentage of abnormal profits that persists in order to overcome potential issues that might arise due to arbitrary starting points for analyses. This approach also required special interpretation of the effects. In contrast with prior work, the starting point for our analysis is not arbitrary but, instead, defined by a fundamental institutional change. As a result, and given our interest in understanding whether firms within a cohort are able to sustain a profit advantage, persistence is defined as the percentage of total abnormal profits in any period before t that remain in period t.

industry. For instance, recent work shows that fundamental institutional change in the form of deregulation is associated with an increase in short run volatility of firms in an industry (Comin and Philippon, 2006) and thus fuels heterogeneity. In addition, when competition is dynamic, long run heterogeneity in an industry tends to increase (Thomas and D'Aveni, 2009). The increases in volatility and heterogeneity stem from a variety of factors such as the continued entry of new and potentially diverse competitors, uncertainty associated with how a new institutional (regulatory) or technological regime will unfold, and variance in the reactions of incumbents.

Second, since most studies investigating persistence leverage large datasets spanning multiple industries or sectors, the starting points for analysis are rarely tied to a particular event or stage of industry evolution. This approach illuminates differences in persistence rates across industries but is less informative regarding whether unique industry events, and an industry's stage of evolution, affect the persistence of profit heterogeneity (e.g., persistence of profits above or below the industry norm). The variance in timelines also make it difficult to compare persistence results across studies since doing so may result in comparing industries over different life cycle stages. Ignoring industry life cycles is patently inconsistent with research on industry evolution that demonstrates substantial heterogeneity among firms across stages of the industry lifecycle (Abernathy & Utterback, 1978; Klepper & Graddy, 1990; Klepper, 1996).

EVOLUTION OF PROFIT ADVANTAGES: COMPETING VIEWS

Profit Convergence in Cohort One. Institutional change, analogous to its technological counterpart, alters the rules governing how firms compete (North, 1990). Such a change stimulates the entry of new firms and sets an industry on a new path of development. During the early stages of this new period of development, substantial buyer uncertainty exists regarding the benefits of new products and services (Adner, 2002). Correspondingly, early startups search for and experiment

with diverse strategies to attract demand and exhibit wide variance in their resources and capabilities (Tushman & Anderson, 1986; Mitchell, 1989; Dosi, 1982; Henderson & Clark, 1990).

As the industry ages, however, differences among early entrants may decrease as customers' preferences become more well-formed, weaker firms exit, stable market segments emerge, innovations become more incremental, and the surviving entrants become more similar in their operations, typically focusing more on price competition (Klepper & Graddy, 1990). As entrants' idiosyncratic differences in routines and practices erode, so do their differences in profitability. It follows that any profit advantages developed by the first cohort will be short-lived. These arguments lead to the following prediction:

H1: After deregulation, heterogeneity in profitability in the first cohort of entrants, Cohort One, will attenuate over time.

Profit Persistence in Cohort One. An alternative argument is that inimitable firm-level characteristics prevent convergence from occurring. If firms evolve through path dependent learning, their idiosyncratic contributions to performance differences should persist or endure over time (Dierickx & Cool, 1989). When the causal relationships underlying these contributions are unobservable, rivals have difficulty identifying the sources of a competitor's superior profits, limiting imitation and factor mobility (Lippman & Rumelt, 1982). Under these conditions, imperfect imitation will give rise to differences in profits among firms (Lippman & Rumelt, 1982). These conditions are likely to persist as leaders continue to refine their positions and rivals proliferate their imitation efforts.

This argument depends on industry conditions as well as firm characteristics. The conditions necessary for uncertain imitability are typically present in industries where the rules of competition have changed (Lippman & Rumelt, 1982). For example, in the trucking industry, the removal of price and entry constraints from governmental control required that entrants and incumbent firms

adopt production and service techniques that differed from those used under regulation. Moreover, because buyers have little experience with the new services offered, predicting customer preferences is quite difficult. Entrant strategies therefore proliferate, reflecting uncertainty regarding what customers will ultimately want. At the same time, incumbent firms must develop strategies that cope with this uncertainty as well as the wide range of challenges presented by entrants (Hedberg, 1981).

In this contentious domain, early entrants are motivated to accumulate resources and capabilities that are not readily imitable or mobile. In the trucking industry, this included a variety of factors. For example, deregulation removed power from the industry's rate bureaus – cartels that established price and service terms for trucking firms under regulation. This opened the door for firms to experiment with different sales and service activities focused on gaining and retaining customers (Johnson & Schneider, 1990). Firm also varied in their stocks of logistics and communications technologies and in their abilities to leverage these resources to improve reliability and quality. . The tacit properties of these factors coupled with the organizational constraints that slow incumbent firms' abilities to adjust to the new competitive conditions suggest that the first cohort's most successful members might accumulate and maintain a performance level exceeding that of rivals'.

These conditions lead us to predict that profit advantages developed by the firms in Cohort One will endure after deregulation:

H2: After deregulation, heterogeneity in profitability in the first cohort of entrants, Cohort One, will persist.

Entrants vs. Incumbents. In a seminal article, Stinchcombe (1965) showed that an organization develops and retains routines that are matched to the environmental conditions present in the early part of its history. Firms align their practices with these conditions in order to reduce

costly conflict regarding compliance mandates and to improve the organization's performance and viability through heightened legitimacy and reliability (Meyer & Rowan, 1977; North, 1990). Moreover, when these practices are central to an organization's functioning, they are likely to change slowly on average, typically lagging shifts in environmental opportunities and constraints (Hannan & Freeman, 1984).

An incumbent's attachment to the practices it developed under regulation contributes significantly to the dilemma it faces regarding how to compete in the new deregulated regime. A firm may maintain its existing operating routines because doing so is less risky than exploring alternatives. Yet only some of these practices may be useful in the new institutional environment; the rest are rendered obsolete by the onset of price and entry competition. Over time, this self-reinforcing bias toward existing routines may inhibit an incumbent firm's adaptation to the new industry requirements (Levinthal & March, 1993). These conditions lower the likelihood that an incumbent firm will achieve profits superior to those of entrants, who do not have a legacy of competing under regulation.

In contrast, entrants' initial practices are formed solely in the new regime and should therefore be more responsive than incumbent firms to the regime's more intense competitive conditions. This heightened responsiveness is produced by more effective search, decision-making and implementation processes, especially regarding projects involving cost reducing innovations, new business combinations, and quality improvement programs (Klepper & Graddy, 1990; Mitchell, 1989; Madsen and Walker, 2007). Thus, entrants may develop practices relevant to deregulation earlier than incumbents and be able to imitate rivals' practices sooner and more efficiently. Such imitation will lower the variation in behavior among entrants, contributing to convergence. As entrants with superior profits converge on common practices in advance of the

average incumbent firm, their profit advantages may erode at a faster rate (persist for a shorter time or lower rate) than those of incumbent firms. Formally:

H3: After deregulation, entrants' superior profits will persist at a lower rate (converge at a higher rate) than those of incumbent firms'.

The arguments above suggest that incumbents' histories may impede their adjustment to the new regime. Since the rules governing competition under deregulation differ dramatically from the regulatory regime, the competitive contests under these different regimes may be independent. If the resources and capabilities required to compete in the new regime also are, in large part, distinct from those required under regulation, incumbents that are entrenched in the past are likely to have profits below the industry average. Under these conditions, future profits, and their persistence, may depend more on a firm's capacity to adjust than its cumulative experience (Denrell et. al., 2012). Thus, if poor performing incumbent firms also are slow to adjust to changing market conditions, they may become locked into a path of poor performance. Thus, we predict:

H4: After deregulation, the below average profits of poor performing incumbents will persist.

THE U.S. FOR-HIRE TRUCKING INDUSTRY

Industry Background. Deregulation in the industry began in 1978, when the Interstate Commerce Commission (ICC) made a series of minor regulatory changes, and was formalized in the Motor Carrier Act of 1980. Deregulation dramatically influenced trucking firm operations and the industry structure by reducing regulatory restrictions on entry, eliminating operating authority restrictions, and reducing the rate bureau's power (Johnson & Schneider, 1990; Rakowski, 1990). The combination of geographic expansion, route restructuring and entry gave rise to excess capacity post-1980. Consequently, the exit rate of both small and large members of the incumbent cohort was quite high (Johnson & Schneider, 1990; Rakowski, 1990) and, by 1991, only 50% of the incumbent cohort remained (for the pattern of entrant and incumbent exits, see Figure 1). Trucking

is thus an excellent example of an industry where an institutional change, aimed directly at the rules of competition, threatened the viability of the incumbent cohort through the rise of entrants (see Boyer, 1993; Tye, 1987; Winston, 1998).

In addition, under regulation, service controls and collective rate-making by the industry rate bureaus, referred to as carrier cartels, provided trucking firms with the opportunity to earn above average profits. The rate bureaus published collectively defined tariffs that established prices and terms for carrier service. Deregulation removed the rate bureaus' power and created a market situation where negotiations for rates reflected the service mix provided. These conditions increased competition among trucking firms by allowing shippers to make tradeoffs in services and rates in the bargaining process. Shippers began to evaluate carriers on a number of dimensions (e.g. transit time, reliability, quality, financial stability, delivery service, willingness to negotiate) and became more involved in the carrier selection process. Firms responded by investing in, and developing, resources and capabilities associated with service promotion (Johnson & Schneider, 1990). These activities, aimed at customer acquisition and retention, were new ways of doing business.

In response to the increased competition and pricing pressure after deregulation, trucking firms invested in process innovations in order to maintain tight operational control. For instance, there was a steady increase in computer usage for traffic analysis, cost analysis, equipment scheduling and equipment maintenance. At the truck level, technologies new to trucking such as automatic vehicle identification, bar coding, EDI, in-vehicle navigation systems, on-board computers, and two-way communication systems helped firms reduce production costs and increase customer service (OECD, 1992). While some of these technologies were adopted in the early 1980s, others became more widespread in the mid to late 1980s. For example, on-board computer usage rapidly diffused across the industry beginning in 1987 (Baker & Hubbard, 2002) whereas the use of

automatic vehicle location (AVL) and long-distance, two-way communication technologies grew exponentially in the late 1980s. These technologies eliminated the costs associated with "frequent driver check calls" between drivers and dispatchers (OECD, 1992: 109). The technologies allowed firms to match loads with equipment more efficiently and to reduce the number of empty miles traveled by as much as 8 percent (OECD, 1992). As a result, they reduced the number of empty miles traveled by as much as 8 percent (OECD, 1992). In addition to cost savings, these process innovations enabled firms to provide more accurate delivery and service information to shippers.

On the surface, the service and operational investments needed for competing under deregulation seemed readily available to both entrants and incumbents. However, piecemeal plans made by the ICC in late 1970s coupled with the chance that the U.S. courts could step in and modify or reverse these plans, or that Congress could step in, created substantial uncertainty regarding how deregulation would ultimately roll out (Derthick & Quirk, 1985). Moreover, in general, incumbent firms often inaccurately estimate how deregulation would unfold (e.g. Leone, 1986).

DATA

Data Sources

The data come from annual reports, or "Form M" reports, provided to the Interstate Commerce Commission (ICC) from 1976 to 1993. Since we are interested in the how abnormal profits of different cohorts evolve following deregulation, we focus on firms' histories from 1980 to 1993. Prior to 1980, all firms with revenues exceeding $500,000 (referenced as Class I and II) were required to file comprehensive annual reports. The reports include data on firm income, asset base, revenues, equipment, operating expenses, revenue from equipment, organizational relationships, general operations, and location. Carriers with revenues between $100,000 and $500,000 (Class III) were permitted to file less comprehensive reports. Data on firm age were provided separately by the

ICC and confirmed using archival sources. After 1980, the ICC's reporting threshold changed to $1,000,000. Even though the ICC's reporting requirements changed after deregulation, 5% of the firms we observe earned revenues less than $1,000,000. In the mid-1980s, a truck running at average productivity generated between $100,000 and $130,000 in annual revenues (Silverman et. al., 1997). The tail end of our size distribution thereby includes firms operating between 1 and 10 trucks. The core of the distribution however represents, on average, firms generating more than $1,000,000 in revenues. The generalizability of our findings is thereby limited to firms of a minimum size. This approach, however, is consistent with prior studies of profit persistence.

We take several steps to ensure the representativeness of our sample. First, the size floor must be considered when defining firm exit and identifying de novo entrants. It is possible that a firm that is missing from the ICC's database did not exit the industry but is still alive with revenues below $1,000,000. To verify our data, we examined the Verizon Yellow Pages by state for the existence of firms that had exited the ICC's database. If a firm did not exist in the Yellow Pages for two consecutive years, we crosschecked the Internet and trucking industry periodicals for postings in the firm's name. A firm was considered to have exited the industry when: 1) it was absent from the industry, based on these sources, for at least two years and never returned, and 2) when it had not been acquired by another firm. We also investigated merger activity in the industry following deregulation. Overall, the frequency of mergers was fairly low (Boyer, 1993; Rakowski, 1990). Firms chose to purchase bankrupt carriers' assets rather than acquire the carriers as organizations. When acquisitions did occur, the acquired firm tended to continue operations as stand-alone entities and continued to file separate Form Ms with the ICC. We include these stand-alone firms in our sample. As mentioned above, we used multiple resources to verify the event histories of the firms in our sample and in the case of entrants, to confirm that each new firm was de novo. The subsequent

paragraphs define the samples used for hypothesis testing, review our constructs, and specify our methods and robustness checks.

Defining Cohorts. As previously noted, our analysis focuses on three cohorts of firms: 1) incumbents: firms that entered before the institutional change and continue to compete in the new environment; 2) entrants: all firms that started up in the industry after the institutional change; and 3) Cohort One: the set of firms that entered the trucking industry during the early (first four) years following the institutional change (1981 – 1984). We use multiple years, instead of one year, to define Cohort One because research suggests that firms that enter during the early years of an industry's development play a crucial part in shaping future competition (Geroski, 1995; Klepper, 2002). We conducted sensitivity analyses to examine alternative cohort definitions using firms that entered a) in the first year after deregulation, b) in the first and second years, and c) during the first three years. The results using these other definitions are consistent with those reported here. We test hypotheses 1 and 2 using Cohort One, hypotheses 3 using the incumbent and entrant cohorts, and hypothesis 4 using the incumbent cohort.

MODEL SPECIFICATION AND ESTIMATION

We use two methods to test the hypotheses. Taken together, the two-method design allows us to offer a robust test of the theory while also suggesting alternative approaches for exploring whether superior profits are temporary or more enduring following fundamental industry change. We describe each method in turn.

Method 1

Following prior research on profit persistence, we estimate the rates at which superior profits persist (or converge) separately for each cohort using a first order autoregressive process as follows:

$$r_{it} = \alpha_0 + \rho r_{it-1} + \varepsilon_{it} \quad (1)$$

where the abnormal profit of firm i in period t, r_{it}, is defined as the return on sales (ROS) for firm i in period t minus the industry average ROS. Most work on firm level profit persistence uses average industry profitability as an indicator of an industry's 'norm' (e.g., McGahan and Porter, 1999, 2003; Mueller, 1986; Roberts, 1999; Roberts and Dowling, 2002; Villalonga, 2004). In equation (1), the coefficient on the lagged dependent variable, ρ, is the persistence rate. Since we are interested in the extent to which firms in a cohort are able to sustain a profit advantage, persistence is defined as the percentage of total abnormal profits in any period before t that remain in period t.[4] In other words, the coefficient ρ indicates the rate at which abnormal profits approach a common level (converge) or endure (persist) in the short run. A value greater than zero and less than 1 suggests the persistence of abnormal profits; a value less than zero and greater than (-1) indicates convergence. The intercept from equation (1), α_0, indicates the extent to which abnormal profits dissipate to a long run level defined as $\alpha_0/(1 - \rho)$. Consistent with prior work, we reference firms with abnormal profits greater than zero as superior, or above average, performers and firms with abnormal profits less than zero as poor, or below average, performers.

Equation 1 is a dynamic panel model. Several econometric issues may arise when estimating equation 1. One, firm fixed effects may be correlated with the explanatory variables. The fixed effects are contained in the error term, which consists of the unobserved firm-specific effects and

4. Early work applied a narrower definition for persistence that excluded permanent or stable effects, focusing attention on the percentage of the transient or incremental component of abnormal profits (see Mueller, 1986; McGahan and Porter, 2003; Waring, 1996). In this approach, abnormal profits consist of two components: a permanent or stable component representing the portion of abnormal profits that is unchanged over time and a transient or incremental component, representing the portion of abnormal profits that are unique to a given year and thus, temporary. Scholars argued that it was necessary to focus on the incremental portion of abnormal profits that persists rather than the total percentage of abnormal profits that persists in order to overcome potential issues that might arise due to arbitrary starting points for analyses. This approach also required special interpretation of the effects. In contrast with prior work, the starting point for our analysis is not arbitrary but, instead, defined by a fundamental institutional change. As a result, and given our interest in understanding whether firms within a cohort are able to sustain a profit advantage, persistence is defined as the percentage of total abnormal profits in any period before t that remain in period t.

the observation-specific errors. Two, the presence of the lagged dependent variable may give rise to autocorrelation. Three, the panel data for each cohort has a large number of firms (N) and a shorter time dimension (T=14 years). Given these conditions, consistent estimation of equation 1 can be achieved using the generalized method of moments (GMM) estimator (Arellano and Bond, 1991). The method removes panel-specific heterogeneity (e.g., firm fixed effects) by first differencing the regression equation, accommodates unbalanced panel data, allows for the specification of endogenous variables, and is viewed as superior to alternative estimation methods for fixed effects models with a lagged dependent variable (see Villalonga, 2004: 218-219). Controlling for firm fixed effects also mitigates concerns about other firm-specific drivers of persistence. Consistent with GMM requirements, our data do not suffer from 2nd or higher order serial correlation of the idiosyncratic errors and all estimations pass the Sargan test (see Arellano & Bond, 1991).

To test the hypotheses 1 through 3, we estimate the model using data on the superior performing firms (abnormal profits >0) in each cohort. Regarding H1, support for convergence exists when $(-1) < \rho < 0$ for Cohort One. Regarding H2, support for persistence exists when $0 < \rho < 1$ for Cohort One. Next, to test H3, we compare the persistence rates for the entrant cohort and the incumbent cohort using a modified Wald statistic (the statistic adjusts for differences in sample sizes among the cohorts). H3 is supported if the persistence rate for the incumbent cohort is larger in magnitude than the persistence rate for the entrant cohort and the associated Wald statistic indicates that this difference is statistically significant. We test H4 using the sample of poor performing incumbent firms. H4 is supported if the persistence rate for the poor performing incumbents falls between 0 and 1.

Method 2

As a robustness check, we employ a second method to estimate how rapidly the cohorts adjust their abnormal profits following deregulation. A higher rate of adjustment will lower the deviations of firms' profits from the steady state. For instance, if firms, on average, adjust rapidly to deregulation, then one might expect to observe a convergence pattern, where profits above the industry norm decline towards it over time. This pattern would suggest that profit advantages are temporary or brief in duration. Lichtenberg (1994) suggests a conservative test for convergence that uses the coefficient on the lagged dependent variable and the partial adjustment model's R^2 (see also Carree and Klomp, 1997). Building on this work, we estimate firms' rates of change in ROS using a partial adjustment specification. We then test for convergence following Lichtenberg's approach. We begin with the theoretical representation of the model:

$$S_i(t + \Delta t) - S_i(t) = r\Delta t\,[S_i^*(t) - S_i(t)] \qquad (1)$$

where S_i is return on sales (ROS), S_i^* is a target ROS value toward which forces are impelling S_i, and r is the speed or rate of adjustment (Davidson and MacKinnon, 1993; Greene, 1993; Greve and Goldeng, 2004; Tuma and Hannan, 1984). In this model, a higher value of r indicates a faster adjustment process and suggests that past shocks have a lower impact on current performance. In equation (1), as $t \rightarrow 0$:

$$dS_i/dt = r[S_i^*(t) - S_i(t)] \qquad (2)$$

When r = 1, we observe full adjustment over t and, as r approaches 0, no adjustment occurs. The parameter r can be compared across populations or subpopulations such as cohorts (Hannan and Freeman, 1984). S_i^* in equations 1 & 2 can be specified as a linear function of firm and industry level observables, $\mathbf{X}_i$:

$$S_i^* = \beta\mathbf{X}_i(t) \qquad (3)$$

The firm level variables include the main components of Nelson and Winter's growth system (1982: ch. 12): size is defined as the natural log of a firm's assets; efficiency is defined using operating cost per revenue mile (this item is reverse scored); net income is a line item on the ICC's annual reports; and capacity expansion is defined as the change in number of trucks operated by a firm over time. Capacity expansion captures the extent to which a trucking firm has expanded its primary units of production relative to the prior time period. We also include the natural log of firm age as a control variable. We model competitive pressures using density and mass measures, the conventional approach in organizational evolution research (Hannan & Freeman, 1989). We define these effects separately for entrants and incumbents. The density of incumbent firms is defined as the number of incumbents competing in the industry minus 1 when the focal firm is an incumbent. Density of entrants is defined in a similar fashion. Variation in firm asset stocks also contributes to variation in the competitive strength of firms (Barnett & Amburgey, 1990). These differences might enable some firms to adjust their performance faster than rivals. Including a mass variable, defined as the sum of the sizes (log(assets)) of all firms minus the size (log(assets)) of the firm of observation, partially captures this heterogeneity in ability among firms. With the density effects included in the model, the mass variables indicate whether an increase in the average size of rival firms has a competitive effect on the focal firm's performance. We include mass variables for each type of firm, entrants and incumbents. The mass of incumbent firms is the sum of the sizes ((log) assets) of all incumbent firms minus the size of the incumbent firm of observation. For entrants, mass incumbent firms is simply the sum of the sizes of all incumbent firms. Mass entrants is defined in a similar fashion. The partial adjustment model also includes a selection parameter (see below). All variables are time varying and lagged one year.

Estimating the model requires substituting equation 3 into equation 2, $dS_i/dt = r[\boldsymbol{\beta}\mathbf{X}_i(t) - S_i(t)]$ and solving for S_i:

$$S_i(t + \Delta t) = e^{-r\Delta t} S_i(t) + (1 - e^{-r\Delta t})(\boldsymbol{\beta}\mathbf{X}_i(t)) \quad (4)$$

Equation 4 cannot be estimated directly. Following Coleman's (1968) approach and that of prior studies, we assume linear change in the independent variables and integrate equation 4 to generate an estimator that uses the level of each variable at t and its year over year change, Δt,. In our data, Δt is 1 year; as a result, we can further simplify by substituting α for $e^{-r\Delta t}$ yielding:

$$S_i(t + \Delta t) = \alpha S_i(t) + (1 - \alpha)(\boldsymbol{\beta}\mathbf{X}_i(t)) \quad (5)$$

Equation 5 can be restated in the general form:

$$S_i(t + \Delta t) = \alpha S_i(t) + \boldsymbol{\beta_1}\mathbf{X}_i(t) + \boldsymbol{\beta_2}\Delta\mathbf{X}_i(t) \quad (6)$$

We estimate weighted GLS coefficients in equation 6. Specifically, we use the GLS estimates to calculate the parameters in the differential equation form of the model as noted below.

$$r = -\ln(\alpha) \quad (7)^5$$

$$\boldsymbol{\beta} = -\boldsymbol{\beta_1}\, r / (\alpha - 1) \quad (8)$$

$$\boldsymbol{\beta} = \boldsymbol{\beta_2}\, r^2 / (\alpha - 1 - \ln(\alpha)) \quad (9)$$

Equations 8 and 9 define two approximations for $\boldsymbol{\beta}$ (Tuma and Hannan, 1984). Following Tuma & Hannan (1984: 344), we estimate $\boldsymbol{\beta}$ by taking the average of equations 8 and 9. The significance levels reported are based on joint F-tests on the $\mathbf{X}_i$ and $\Delta\mathbf{X}_i$ parameters from equation 6 (see Haveman (1993) and Henderson (1999) for a similar approach). This approach, however, does not yield standard errors for the estimated parameters.

We take several steps to ensure robustness. Given the dynamic nature of the model, OLS estimates may be biased due to correlation of the lagged dependent variable with a lag of the

5. If $\alpha = e^{-r\Delta t}$ then $r = -\ln(\alpha)$.

disturbance term. Following Nickell (1991), we correct for this potential bias by using a deviation from the firm means approach. The mean centering removes unobservable firm-level fixed effects (Greene, 1993; Nickell, 1981). We also control for heteroskedasticity in the error term by using a proportionality variable based on firm size (Greene, 1993). In our framework, we divide each variable in the partial adjustment equations by the square root of firm assets. Third, the models include a time-varying parameter, λ, to control for the impact of sample selection bias (Heckman, 1979). We use Lee's (1979) generalization of Heckman's (1979) two stage sample selection model. The selection model includes an organization's size and net income, as well the density and mass of incumbents and entrants.

The degree of convergence depends on α, the coefficient on the lag dependent variable, and on the R^2 of equation 6. Dividing R^2 by α^2 provides a test statistic for convergence that approximates to an F distribution (Lichtenberg, 1994). [6] A significant F value indicates support for the convergence hypothesis (H1). As noted above, our estimator is based on GLS but this method does not generate an R^2 value. As a result, to generate an R^2 value, we use OLS with robust (e.g., Huber/White) variance estimates.

RESULTS

Table 1 provides means and standard deviations of ROS and abnormal ROS for each sample (cohort 1, entrants, and incumbents). Figure 2 shows the annual average ROS for each cohort and suggests a lack of convergence among firms. Table 2 presents the results of GMM specification for the superior and poor performing firms in each cohort, separately. The findings for Cohort One (Model 1) provide support for hypothesis 2, the advantages held by superior performing firms in

6. Research suggests that Lichtenberg's test is biased toward showing no convergence and notes that Lichtenberg incorrectly identifies the degrees of freedom for the denominator and numerator as N-2 instead of N-1. We adjust the df when defining significance levels for the test. Moreover, if the test is biased toward no convergence, and convergence is found, the result would seem to suggest a conservative test of hypothesis 1. It is important to note that this test augments the traditional autoregressive approach.

Cohort One persist at a rate of 26%. The findings also show that, the profits of superior performing firms in the full entrant cohort persist at a rate of 26% (Model 2) whereas those of incumbent firms' persist at a rate of 42% (Model 3); the difference in persistence rates is statistically significant (Table 3, $X^2 = 116.59$, $p<.01$). A persistence rate of 42% indicates that it will take approximately 2 years and 8 months to dissipate 90% of an incumbent's profit advantage. On the other hand, it will take approximately 1 year and 8 months to dissipate 90% of an entrant's profit advantage. In sum, the advantage held by superior performing firms in Cohort One and the full entrant cohort are more temporary or dissipate more rapidly than those held by superior performing incumbent firms. While the findings are consistent with the traditional indicators of profit persistence, holding an advantage for less than 2 years suggests marginal persistence and a lack of sustained advantage.

Given the intensely competitive environment that emerged after deregulation, some part of the incumbent cohort may have difficulty in adjusting to the new regime and generate profits below the industry norm. We argued that, given their legacy in the industry, these firms may encounter challenges in overcoming their weak positions. As a result, hypothesis 4 predicted that the profit disadvantages of these firms will persist. The findings indicate that the persistence (convergence) rate for poor performing incumbents is 0.06 (Table 2, model 6). Even though the persistence parameter is positive and greater than zero, suggesting support for H4, a rate of 6% implies that poor performing incumbent firms' disadvantages dissipate rather quickly, within 9 to 10 months. Despite the transformative shock to the industry, the results demonstrate that both weak and strong incumbents are able to renew their positions over time.

Recall that we use a partial adjustment model and an additional test for profit convergence as a robustness check. Table 4 reports parameters from the differential equation form of the partial adjustment model that inform the Lichtenberg convergence test. Models 1, 2 and 3 in Table 4 report

the test results for the superior performing firms in cohort 1, the entrant cohort and the incumbent cohort, respectively. As mentioned above, the F tests indicate convergence for all three cohorts; Cohort One: $F = 39.81$, $p<.05$, the entrant cohort: $F= 57.84$, $p<.05$, and the incumbent cohort: $F=2.78$, $p<.05$. Recall that the Lichtenberg test is conservative. Given this and that the F value for the incumbent cohort is near the lower bound for statistical significance, the findings imply that the profit advantages of superior performing firms in the incumbent cohort may persist rather than converge. This interpretation is consistent with the findings regarding persistence reported above.

DISCUSSION

Returning to one of the motivations for this paper, we show that the stages of firm and industry evolution matter quite strongly in examining the persistence (convergence) of profit advantages. Institutional change resets an industry's clock, segmenting an industry's population of firms into two cohorts – incumbents with a legacy of competing under in the prior institutional regime and entrants with no history in the industry. The findings show that, after deregulation, the persistence rates for these two cohorts differ dramatically. Thus, after a fundamental shift in an industry's development, differences in firm's histories are critical to understanding the temporal dimension of advantage. While the resource-based view and work on the organizational learning emphasize that firm-specific cumulative experiences contribute to differences in competitive behavior (e.g., Argote, 1999; Barney, 1991; Dierickx and Cool, 1989), the extant empirical work on the persistence of a profit advantage ignores this important source of heterogeneity. It would be reasonable to presume that following a shock to an industry, firms that are not constrained by obsolete practices would be better positioned to gain and sustain an advantage. Yet, our findings show the opposite: in the trucking industry after deregulation, superior performing incumbents sustain an advantage longer than entrants. This result is counterintuitive since entrants are not

constrained by a legacy of competing under regulation. Consistent with the traditional theory of industry evolution, the profit advantages of superior performing firms in Cohort One are also short-lived (~ 90% of the advantage erodes within about 20 months). Given the differences in persistence rates, it would seem prudent to consider the stages of firm evolution and industry evolution in future empirical work examining the persistence of profit differences within and across industries.

What else might contribute to the differences in persistence rates among the entrant and incumbent cohorts? One explanation is that incumbent firms' experiences from regulation initially attenuate their adaptation to deregulation. During this period, entrants might compete more intensely with other entrants. As time since deregulation increases, however, incumbents may eventually catch up to entrants and become more formidable competitors. Thus, entrants' initial advantages appear to be temporary. Cockburn et al., (2000: 1141) find a similar result when considering a population of firms. In their study, firms that were initially behind "were able to catch up to their more advanced competitors." Future work might explore these dynamics by segmenting the time period of observation into sub-periods and examining how persistence rates evolve across the sub-periods for entrants and incumbents following a fundamental industry shock. Under these conditions and consistent with the traditional theory of industry evolution, early entrants practices may converge relatively quickly as they gain experience in the industry.

Second, entrants may converge on process innovations that increase productivity and enhance performance faster than incumbent firms. Even though low barriers to imitation may exist, as the low persistence rates for entrants suggest, incumbents may delay investing in new practices due to uncertainty in the new regime. After deregulation, incumbents face at least two forms of uncertainty, demand uncertainty, and uncertainty with regards to which entrants' productivity enhancements will become dominant. Incumbents may focus on maintaining their existing rent

streams until some of this uncertainty is resolved. Firm-specific size effects appear to reduce this delay in adaptation, moving incumbents toward a pattern of convergence, suggesting that advantages are temporary (Madsen and Walker, 2012). Clearly the dynamics are more complex. Nevertheless, the findings suggest that the evolution of performance heterogeneity among different cohorts of firms and firms with different mixes of experience varies substantially after fundamental institutional change.

The findings also raise interesting questions about the definition of temporary advantage. As mentioned above, we find that, following industry transformation, incumbent firms sustain 90% of their advantage for about 2 years and 8 months, a year longer than entrants. Are these temporary advantages? On the surface, one might answer yes. But, what defines temporary? Can we assign a number to the duration of a temporary advantage? The answers to these questions are not clear. As background, the extant work shows that persistence rates vary by industry classifications. Our findings demonstrate that that persistence rates also vary by the stage of firm evolution and the stage of industry evolution. Thus, three conditions that inform the duration of profit advantages are the stage of an industry's evolution, the timing of a firm's entry to an industry, and the stage of a firm's evolution. But under what conditions is a temporary advantage sufficient, if at all? The extant work controls for industry effects but future work might explore the time or history based origins of heterogeneity in each industry in more depth to inform our understanding of profit dynamics (Pacheco de Almeida, 2007). For instance, in industries where technology is continuously changing, such as the semiconductor industry, firms might succeed with a series of temporary advantages (e.g. Madsen & Leiblein, 2007). The duration of these advantages may be tied to the industry's rate of technological change. In less dynamic spaces, a temporary advantage might be longer in duration. Third, one might use persistence (convergence) rates to define the breakpoints for classifying

advantages as temporary or durable (sustained). For instance, a persistence rate significantly greater than zero suggests the persistence of abnormal profits. Yet, a 10% rate is quite different than an 80% rate.

It is worth noting some of this study's limitations. First, since successful early entrants to an industry may grow over time, and since other firms may enter the industry as it develops, it seems likely that the market share, and performance prospects, of Cohort One's typical members may necessarily decline as the time since deregulation increases. Our analysis, however, also shows short-lived advantages for the entire entrant cohort. Nonetheless, additional research is required to evaluate the generalizability of our findings and to reconcile the different empirical tests for persistence and convergence. Second, it is important to ask how including very small trucking firms for which data were not available, might alter our results. We believe that their inclusion would have little substantive influence. One possibility is that very small incumbents endure because of size-based competition, which occurs when smaller firms occupy protected niche markets. Size-based competition is apparent when there is a persistent, abnormally high frequency of smaller firms in the size distribution of the population, which would otherwise be log-normal. This is not the case in the trucking industry after deregulation; the size distribution is consistent with log-normality and has no irregularity in the left tail. Therefore, we feel confident that our findings have broad generalizability. In addition, the omission of very small firms is consistent with prior studies exploring persistence (convergence) (for example, McGahan & Porter, 1999, 2003).

How well our results extrapolate to other industries spanning longer time periods depends on the number and severity of institutional changes over an industry's history, coupled with the amount of entry after each change. We analyze a period of thirteen years after deregulation; this is similar to the time periods observed by existing research on profit persistence (McGahan & Porter, 1999,

2003; Villalonga, 2004). Nevertheless, larger studies of industry and population evolution, rather than profit persistence, typically extend over a much longer time period, say 75 to 100 years. During this extended period, it is likely that at least several changes in the institutional environment have occurred. One could assume then that the results of analyses performed over such a long time frame are smoothed across these changes, merging incumbents and entrants as the importance of each institutional event fades. Understanding how our results might inform research on industry evolution therefore entails asking the following questions. First, how many significant institutional or technological changes occurred during the time period examined? If there was only one change, then the results presented here might be found again. If there were many changes, then incumbents and entrants lose their distinctiveness over time. Second, how many firms entered the industry after each change? If few firms entered, then it would be clear that the industry was consolidating; and one might contend that the dramatic industry changes were virtually insignificant in their implications for incumbents' abilities to adapt, since there was no important challenge from new firms with innovative practices.

In conclusion, this study provides an important contribution to the literature on the persistence of superior profits. Our results show conclusively that studies examining the persistence or convergence of abnormal profits should consider the stage of an industry's evolution and differences in the histories of firms. Partial convergence in superior profits of entrants after a major industry disruption illustrates the prominent role that exogenous forces play in the durability of profit differences and that early entrants play in an industry's redevelopment. In sum, the stage of industry evolution matters.

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FIGURE 1.
# of Exit Events/Population Density, Incumbents & Entrants, 1981-1991

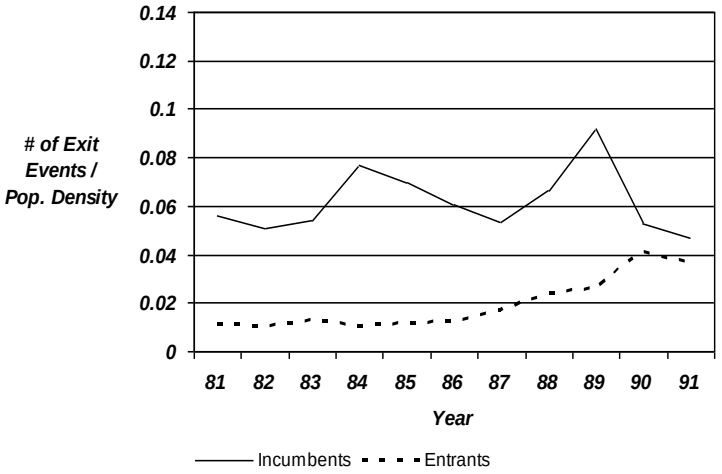

Figure 2. Average ROS by Year for Cohort 1, Entrants and Incumbents.

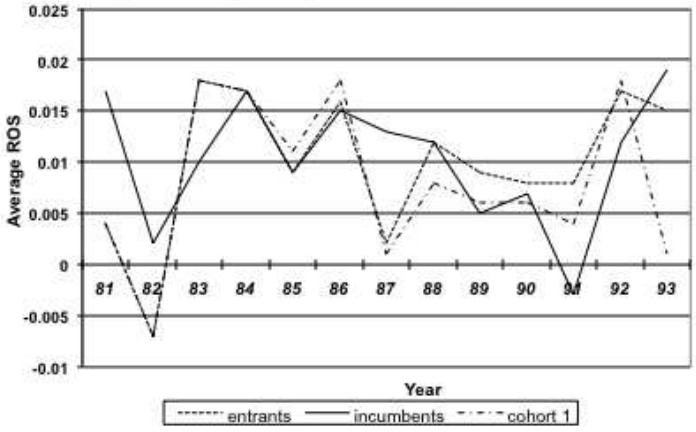

TABLE 1. Means and Standard Deviations by Cohort

	Entrants: Cohort 1		All Entrants		Incumbents	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
ROS	.008	.098	.009	.084	.01	.105
Abnormal ROS	.001	.098	.011	.084	.002	.105

TABLE 2. The Persistence (Convergence) of Abnormal Profits, Trucking Industry (1980-1993)[1,2,3]

	Superior Performing Firms			Poor Performing Firms		
	Cohort One	Entrant Cohort	Incumbent Cohort	Cohort One	Entrant Cohort	Incumbent Cohort
	1	2	3	4	5	6
r_{t-1} (ρ)	0.26••	0.26••	0.42••••	0.18••••	0.09••••	0.06••••
	(0.08)	(0.002)	(0.06)	(0.02)	(0.02)	(0.01)
α_0	0.03••••	0.03••••	0.03••••	-0.03••••	-0.03••••	-0.04••••
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Firm & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Wald X^2	9.60••	9.69••	53.59••••	131.65••••	14.78••	17.37••••
N	673	1092	5982	532	786	4551

•p<.05, •• p<.01, •••p<.001, ••••p< .0001

1. Robust Standard Errors are in parentheses.
2. Generalized Method of Moments (GMM) Estimation with dependent variable = abnormal ROS.
3. Specification tests indicate no 2nd order (or higher) serial autocorrelation in the first differenced idiosyncratic errors.

TABLE 3. Comparison of Persistence Rates, Superior Performing Firms

Comparison of Persistence Rates	*Wald X^2*	*Hypothesis Supported*
$\rho_{Entrants}$ = .26 < $\rho_{Incumbents}$ = .42	116.59••	H3

•• p<.01

TABLE 4. Results from Partial Adjustment (PA) Models for Cohort One, Entrants, and Incumbents, Trucking Industry (1981-1993)[1]

	Superior Performing Firms		
	Cohort One	Entrant Cohort	Incumbent Cohort
	1	2	3
α = coefficient on ros_{it-1}	.076	.0588	.2684
R^2	.23	.20	.20
Convergence Test			
$F = R^2/\pi^2$	39.81•	57.84•	2.78•
AdjR^2	.21	.18	.19
Log Likelihood	2196.32	3528.59	17948.82
N	673	1092	5982

•p<.05, •• p<.01, •••p<.001, ••••p< .0001

1. The PA models (dep. Variable = ROS) include fixed effects using a mean-centering approach and include year effects using year dummy variables (refer to the data section for a description of the additional independent variables). Weighted least squares estimation was used to correct for heteroskedastic errors.