FUTURE PROFITABILITY AND GROWTH, AND THE ROLES OF FIRM LIFE CYCLE AND BARRIERS-TO-ENTRY

by

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ABSTRACT

This thesis examines how firm profitability and growth, both cross-sectionally and temporally, are impacted by firm life cycle (a fundamental economic construct) and the barriers-to-entry erected by the firm. Evidence reveals that operating income displays a nonlinear pattern across life cycle stages. This suggests that partitioning firms by performance does not adequately capture differences in firm life cycle. Evidence also reveals that the rates of convergence for the drivers of profitability and growth are impacted by firm life cycle. This implies that the validity of constant growth rates is at least partially determined by firm life cycle. It also implies that modeling the behavior of operating income conditional on life cycle stages enhances the predictive value of its drivers—profit margin and asset turnover.

The rate of progression through the life cycle stages is affected by the existence and persistence of a firm's competitive advantage. Consequently, barrier-to-entry variables are examined to determine their impact on firm and industry profitability, both cross-sectionally and temporally. Results show that there are several barrier-to-entry variables (economies of scale, product differentiation, power over suppliers, and power over customers) that explain profitability. Elevated levels of these barriers result in persistent profits above the norm even after five years. Additionally, contemporaneous levels of these variables have a positive effect on one-year-ahead RNOA, even after controlling for current profitability and growth in net operating assets. Market share serves a within-industry function as a barrier-to-mobility against existing competitors, but is ineffective as a barrier-to-entry against potential competitors.

CHAPTER 1

INTRODUCTION

Industrial organization is defined as that part of economics that examines the strategic behavior of firms and their interactions (Tirole 1988; Shy 1995). Further, Bain (1956) states "the purpose of economic theory is to analyze, explain, predict, and evaluate." To that end, this thesis examines the explanatory power and predictive value of economic variables related to industrial organization as determinants of firm profitability and growth. In other words, a comprehensive framework is developed which can be used to predict, evaluate, and analyze a firm's performance conditional on its strategic positioning and interaction with other firms.

Two specific dimensions of industrial organization are examined in this thesis: firm life cycle and barriers-to-entry (BTE). The life cycle is comprised of distinct phases and entities progress through those phases as a result of strategic decision-making and the competitive environment (Gort and Klepper 1982). Economic theory pertaining to life cycle has been studied empirically at the product and/or industry level. [1] However, a firm's performance is a function of its aggregation of products and industry mix. Therefore life cycle theory at the product level must be extended to the firm level since the firm is a composite of all product offerings in its portfolio. In response, this study develops a generalized framework to study the interaction of firm life cycle and profitability using empirical methods that are applicable to large sample archival data analyses.

The other dimension of industrial organization under examination is that of BTEs. Strategic decisions that drive life cycle behavior include investment decisions made for the

[1] The following studies examine the validity of product life cycle for the following industries: German automobile manufacturers (Brockhoff 1967); pharmaceuticals (Cox 1967); tobacco, food, and personal care products (Polli and Cook 1969); household cleansers (Parsons 1975).

purpose of erecting barriers to entry. The recent economics literature has focused on defining what constitutes a "barrier" to entry (McAfee et at. 2004; Carlton 2004). Both the McAfee et al. study and the Carlton study compile numerous definitions of an entry barrier that have been proposed in the economics literature and conclude that no single definition or theory is dominant.

For example, Bain (1956) defines a barrier as an incumbent's advantage over potential entrants such that persistent profits can be earned without attracting new entrants into the market. McAfee et al. point out that Bain uses a consequence of the definition to define the term which results in a circular argument. Stigler (1968), on the other hand, defines a barrier as a cost advantage that has accrued to the incumbent. However, McAfee et al. raise the objection that the incumbent only gained the cost advantage over time and that this definition ignores that time dimension. Similar criticisms are raised for the other candidate theories.

In response, this thesis uses ex-post realizations of performance to establish which expenditures are effective in establishing barriers among the general population of firms and across industry groups. This approach tests Bain's and Stigler's original hypotheses, among others', from a different perspective to determine whether abnormal levels of profitability are associated with identifiable investments in BTE.

A common framework is employed to study the existence and evolution of profits by both firm life cycle and entry barrier dimensions. First, profitability is examined over a five-year window to determine whether profitability portfolios, formed on either life cycle stage or barrier expenditures, converge to an economy-wide mean. Convergence is an important property due to the fact that valuation models assume the firm is in a steady state. Thus, if a firm converges to the mean, the firm can be assumed to be in a steady state in the long run. If the firm's profitability has not converged, then either the forecast horizon must be expanded (i.e., the forecast truncation period is delayed) and/or growth rates leading up to and those used in the terminal value calculation will be differentially affected.

Further, forecasting future profitability is simplified when the firm's profitability is constant. In this case, only forecasts of sales and assets are needed to forecast future profits. However, the firm life cycle stage can be used to identify firms that do not have constant profitability or full convergence to the mean. Likewise, BTEs, when effective, will prevent convergence of profitability to the mean. The implications are as follows: a firm with non-constant profitability is not in a steady state and as such either the forecast horizon needs to be expanded until profitability is constant or differential growth rates should be used in the forecast horizon and terminal value calculation, or both. Conversely, a firm may display constant profitability, but yet the level of profitability may be substantially higher or lower than the economy-wide mean. This situation may result when effective barriers to entry are erected. In this case, the steady state assumptions in valuation models are valid, and forecasting is reduced to a forecast of sales and asset growth.

Stigler (1963) reported that profitability displayed a strong central tendency over time, but that the convergence was incomplete. Impediments to complete convergence stem from disturbances related to shifts in demand, advances in technology, and macroeconomic factors. These disturbances also affect a firm's tenure in each life cycle stage and the effectiveness of BTEs that have been erected. Interestingly, Stigler noted considerable variation in profitability within industries, which is likely to result from differences in life cycle stage and differences in barrier expenditures across firms in each industry.

A second mode of analysis models future changes in profitability as a function of life cycle and barrier variables. The numerator in any valuation model is a function of expected future profitability such that, any increase in explanatory power of such a model of future profitability is considered a forecasting and valuation innovation. The model used in this thesis controls for variables that are known to affect future profitability such as the level and change in current profitability and asset growth. The model also decomposes current change in profitability into changes in profit margin and asset turnover, which control for strategy choices made within the firm that may be confounded with both life cycle and barriers to entry.

Incremental increases in explanatory power attributable to firm life cycle or BTE levels provide evidence that forecasts are improved with the consideration of a firm's life cycle stage or current level of barrier investment. Moreover, life cycle and barrier information can be used to analyze a firm's current behavior relative to its life cycle stage or barrier expenditure. By comparing a firm's performance to the mean level of performance that would be expected conditional on life cycle stage or barrier expenditure, better evaluation of the firm's current financial performance is possible.

Unlike extant economic theory, this paper provides a comprehensive framework to link life cycle to performance. Research has addressed individual components of performance such as production behavior, learning/experience, investment, entry/exit patterns, and market share. Yet it is difficult to use multiple, disparate metrics to assess and capture firm life cycle. As such, a second major contribution of this study is the development of a parsimonious proxy to capture firm life cycle. Because firm life cycle is the aggregation of a firm's individual and overlapping product life cycles, a firm's life cycle stage is difficult to assess in large scale samples. In this paper, I develop and validate a classification method using cash flow patterns from the Statement of Cash Flows, which is mapped to industrial organization theory. Cash flow patterns provide a coherent and economically intuitive model of firm behavior conditional on a firm's life cycle stage.

More importantly, the methodology is "organic" in that life cycle stage identification results from the comprehensive information set regarding the firm's resources and performance. Extant literature uses a univariate variable such as age, sales growth, capital expenditures, dividend payout, or some combination of these variables to assess life cycle stage. However, this methodology requires the researcher to make an assumption regarding the underlying distribution of life cycle stages across firms. Quite often, a uniform distribution is assumed via the choice of a portfolio sort on one or more variables of interest. However, economic theory does not suggest that firms are uniformly distributed across life cycle stages (i.e., there are an equal number of observations across life cycle stages for each dimension). Cash flow patterns, on the other hand, represent the firm's use of resources, access to capital, and operational capabilities interacted with strategy and as a consequence, the resultant life cycle stage distribution is more congruent with existing theory.

The results show that partitioning by life cycle stage leads to varying profitability convergence patterns over time. Specifically, return on net operating assets (RNOA), the profitability metric used throughout the analysis, partially converges to a permanent range of approximately 4 to 11 percent. This evidence suggests that the validity of a constant growth rate for early and late life cycle stages is dubious. Additionally, incorporating information about firm life cycle enhances the explanatory power of the drivers of RNOA for future RNOA. Results also indicate that even after controlling for current profitability and growth, incorporating information about life cycle stage substantially improves model performance by over 50 percent. Current and past profitability, the level and change of operating liability leverage (OLLEV), the growth in net operating assets (NOA), and the changes in asset turnover take on varying degrees of importance in explaining future profitability by life cycle stage.

The economics literature has identified several variables that proxy for BTEs, defined as factors that allow a firm or industry to deter the entry of new competitors. Similarly, Porter (1980) defines barriers-to-mobility (BTM) as those factors that allow a firm to shield its current level of profitability from existing competitors. Profits and losses signal the existence of excess supply or demand (Mueller, 1986; Stigler, 1963). When firms are free to respond to these signals, they enter and exit markets until returns are equalized across markets. However, because of entry and mobility barriers, along with competitive uncertainty, this normalization never obtains in the short run. The barrier variables chosen for this study are based on comprehensive economic theory pertaining to competition and business strategy (Porter 1980, Oster 1990). Additionally, the use of industry-specific data provides contextual information about the drivers of profitability (current and future) across industry groups.

The industry analysis is important because the prior literature is divided on whether industry membership has predictive value for forecasting future profitability. In general, Schmalensee (1985) and McGahan and Porter (1997) reported that industry effects accounted for approximately 20 percent of firm profitability. Nissim and Penman (2001) suggest that permanent differences in profit margin and asset turnover are due to variation in production and cost technologies across firms that are captured by industry. This indicates that industry should affect the level of profitability and enhance performance of explanatory and forecasting models. Soliman (2004) finds that adjusting profit margin and asset turnover by industry-medians does enhance the predictive value of those components for forecasting future changes in RNOA.

However, other studies find that industry factors do not improve prediction models for the majority of industries (Joos, 2000; Fairfield, Ramnath and Yohn, 2004). Yet these studies do not report the economic significance for specific industries in which the industry factors do represent an improvement in forecasts. It is possible that even though the number of industries does not represent a simple majority, the economic significance of those industries makes the industry analysis worthwhile.

Results show that there are several successful barrier variables that generalize across the entire sample including economies of scale (Δ in gross profit margin), product differentiation (advertising intensity), leverage over suppliers (operating liability leverage), and bargaining power over customers (receivables turnover) are successful entry and mobility barriers, which provide persistent operating returns even after five years. Additionally, contemporaneous levels of these variables had a positive effect on one-year-ahead RNOA, even after controlling for current profitability and growth in NOA. Finally, market share serves as an effective barrier-to-mobility against existing competitors, but does not appear to deter entry with respect to potential competitors.

The findings in this thesis are important in that they determine when mean reversion and constant growth assumptions are valid within a valuation context. Further, the results shed light on the temporal earnings process (and hence, future cash flows) by life cycle stage, which is useful to creditors in assessing solvency. Therefore, the study provides empirical evidence with respect to profitability and growth patterns across life cycle stages, which is a step toward building a unified framework of business performance measures and firm life cycle that is currently lacking in the literature.

The findings also provide evidence as to whether resources expended to erect barriers to entry and mobility result in persistent abnormal profits. For example, the evidence shows that efforts to expand economies of scale and to erect barriers by increasing capital intensity do not protect profitability from converging to an economy-wide and industry-wide mean. Investing in research and development and other intangible assets do not provide increases in profitability at least over the five-year window examined in the paper. Firm size is not a barrier against competitors, and in fact, dampens profitability. The study also provides an industry-level analysis of which barrier variables are successful among the Fama-French 48 industry classifications.[2]

The remainder of this thesis proceeds as follows: Chapter 2 provides a review of the prior literature and extant theory used to develop the hypotheses under study. The intersection of firm life cycle and profitability is examined in Chapter 3, while the effect of barriers-to-entry on profitability is addressed in Chapter 4. The final chapter provides a summary of the conclusions set forth within the thesis.

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[2] The 48 industry groups are defined in Fama and French (1997).

CHAPTER 2

RELATION TO PRIOR LITERATURE

Relation to Profitability Literature

Past research pertaining to profitability theory has examined both the time series properties of profitability and the cross-sectional measures and determinants of profitability.

Time Series Properties of Profitability

Stigler (1963) examined whether rates of return tend toward equality in competitive markets. He reported inter-industry rates of return displayed strong central tendencies. However, he also provided evidence that there was wide dispersion among the rates of return within industries. Even though the rates of return across all firms should tend toward equality in the long run, the length of time necessary for this convergence to take place is incongruent with the truncated forecast horizons used in valuation. Stigler suggests that various economic disturbances can occur in the intervening period to prevent convergence.[3]

Brooks and Buckmaster (1976) demonstrated that mean-reversion of profitability occurred for firms with extreme performance. Nissim and Penman (2001) suggest that when profitability is mean-reverting, then forecasting future profitability is reduced to forecasting growth in net operating assets (NOA) and revenue. They reported that return on net operating assets (RNOA) converges when firms are sorted into portfolios based on their RNOA performance. However, sorting on performance masks the effects of firm life cycle since both early and late stage firms tend to under-perform. Likewise, the erection of successful barriers-to-

[3] The disturbances can result from unanticipated shifts in consumers demand, advances in technology, or macroeconomic shocks.

entry can prevent mean-reversion. Therefore, it is not clear that profitability is mean-reverting for all life cycle stages or at all levels of barrier expenditures. If profitability does not converge on some dimension, then constant growth rate assumptions and truncated forecast horizons can be questioned for those life cycle stages or levels of entry barriers.

Determinants of Profitability

Research in this area examines the predictive ability of current profitability for future profitability. Fairfield, Sweeney and Yohn (1996) show that forecasts of future return on equity (ROE) are improved when based upon operating earnings rather than GAAP net income. Likewise, Nissim and Penman (2001) specify that RNOA is more relevant for forecasting future profitability than traditional return on assets (ROA) or ROE.[4]

RNOA is decomposed into two factors: net operating profit margin (NOPM) and net operating asset turnover (NOAT). Profit margin is indicative of the firm's ability to convert sales into profit whereas asset turnover indicates the amount of assets needed to generate those sales. Nissim and Penman suggest that there are permanent differences in profit margin and asset turnover due to variation in production and cost technologies across firms. Strategic actions involve trade-offs between product differentiation versus cost leadership. A product differentiation strategy is oriented toward improving profit margin whereas a cost leadership strategy is aimed at improving the asset turnover ratio through increased market share.

[4] Net operating assets (NOA) exclude financial assets from the denominator since they are already valued at their fair value on the balance sheet. NOA also subtracts out any operating liabilities from operating assets. This is because operating liabilities reflect a source of leverage that can increase profitability.

Firm Life Cycle Theory

Figure 1 displays the joint interaction of profitability analysis and life cycle theory. Agarwal, Sarkar and Echambadi (2002) define life cycle phases as discontinuous transformations of competitive conditions at particular points in time during an industry's evolution. While there has been a vast literature on entry and exit behavior of firms within an industry, little is known about the continuous expansion and contraction paths of individual firms.[5]

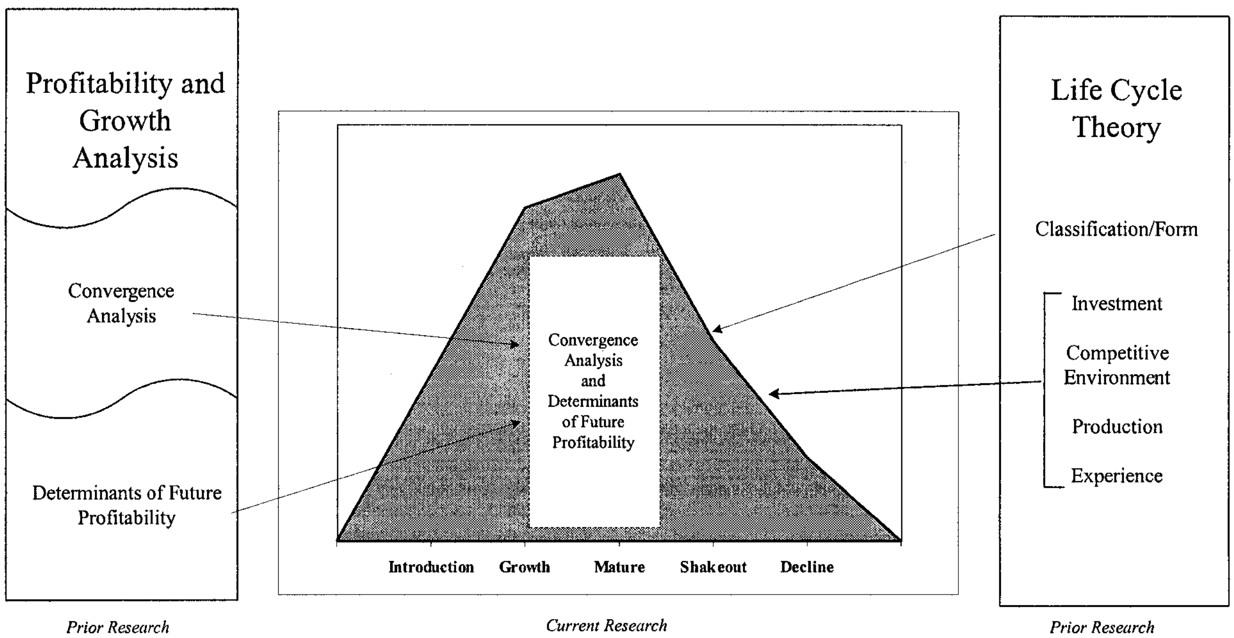

Fig. 1. Joint interaction of profitability/growth analysis and life cycle.

Industry life cycle patterns occur because the rate of innovation and intensity of competition change over the industry life cycle. However, individual firms' life cycle stages can differ within an industry because innovation is a continuing process with firms entering and

[5] Study of an incumbent firm's temporal relation between changes in profitability and scale of operations has been largely ignored (Caves 1998).

exiting the market throughout the entire industry life cycle.[6] Further, the life cycle stages of individual firms within an industry vary significantly due to differences in a firm's level of knowledge acquisition (about core competencies, cost structure and operating efficiencies), level of initial investment and re-investment of capital, and adaptability to the competitive environment.

Gort and Klepper (1982) defined five life cycle stages in a given market.[7] The five stages include: (1) an *introductory stage,* where an innovation is first produced; (2) a *growth stage,* where the number of producers increases dramatically; (3) a *maturity stage,* where the number of producers reaches a maximum; (4) a *shakeout stage,* where the number of producers begins to decline; and (5) a *decline stage,* where there is almost zero net entry.

Introduction Stage

In the introduction stage, a firm attempts to build awareness and develop market share. First movers enjoy temporary ownership of the market. Jovanovic (1982) suggests that firms pay a non-recoverable fee to enter the market and upon commencing operations, they receive noisy information about their true costs and performance levels. As such, firms enter the market with incomplete knowledge about both the relative quantity and quality of their endowments. Through accounting and operational feedback, they learn about their absolute and relative endowments. The more ambiguous the feedback, the riskier additional investment becomes for the firm. Therefore, firms with high levels of information uncertainty will invest less to manage

[6] For example, high growth rates in demand early in the industry's life cycle prompt additional firms to enter the market, which results in a lagged life cycle stage relative to early entrants.

[7] It follows that those same life cycle stages arguably apply at the firm level since industry or market life cycle is the aggregate of firm-specific life cycle.

risk. This leads to performance differences across firms within the same industry and ultimately results in different rates of progression through life cycle stages among individual firms.

Growth Stage

Conversely, firms with the most optimistic expectations regarding their abilities (such as cost structure and competitive advantage) make larger initial investments in the growth stage (Jovanovic 1982). By making additional investments early in the life cycle, firms can erect barriers to entry (Spence 1977, 1979, and 1981). These investments (initial and additional) include not only financial and tangible assets, but also organizational capital such as investments in distribution systems, manufacturing infrastructure, and technological capabilities (Levinthal 1991). As a result, firms can temporarily capture monopoly rents in the growth stage.

Mature Stage

Both initial endowments and additional investments obsolesce and the rate of obsolescence is related to the technological intensity of the industry. As firms mature, obsolescence increases relative to new investments to the point where net investments are eventually negative. Hence, the level of initial endowments, rate of re-investment, and rate of obsolescence all contribute to differences of firm-specific life cycle within industries (Jovanovic 1982). A firm's inability to adapt to changing competitive conditions also affects the life cycle progression. For example, the established routines of mature firms become a hindrance in the face of changing competitive conditions (Hannan and Freeman 1984). Mature firms become more homogenous through imitation and diffusion of industry technologies (Jovanovic and MacDonald 1994). The availability and mobility of skilled labor within an industry mitigates any prior knowledge-related competitive advantage for all firms in the industry in these later stages (Jovanovic and Nyarko 1995). At the end of the mature stage, profitability is eroded, as firms must channel additional resources into product differentiation and/or new resources into efficiency enhancements.

Shake-Out Stage

The erosion of competitive advantage that characterizes the mature stage leads to an inevitable shakeout where firms can either rejuvenate operations through structural change (such as acquisition, merger, and joint venture) or expansion into other markets. Firms attempt to liquidate unproductive assets in order to channel those resources into new projects that will generate positive returns.

Decline Stage

A firm can enter the decline stage from any of the previous stages. For example, Jovanovic (1982) presents an analytical model where firms' hazard rates (probability of failure) initially increase in the early life cycle stages. Hazard rates are higher for new firms due to the extended period of learning required for a firm to identify its core competencies. Likewise, if a late-stage firm's attempts at competitive adaptation or innovation are unsuccessful, the firm enters the decline phase where eventual options include disposal of business units or discontinuance of the entire firm.

Entry/Mobility Barrier Theory

Figure 2 displays the joint interaction of profitability analysis and competition theory. Lev (1983) examined the variability of the earnings process when considering the effect of product type, barriers to entry (BTE), capital intensity, and firm size. He reported that durable good industries and firms with higher capital intensity displayed higher earnings variability whereas firms with high barriers to entry displayed lower earnings variability.

In this paper, I considerably expand the explanatory variables used to determine barriers to entry, whereas Lev used a dichotomous BTE variable based upon Palmer (1973). More importantly, this paper looks beyond the effect on accounting earnings to that of RNOA, which focuses on core operations and any change in profitability that is due to growth in NOA.

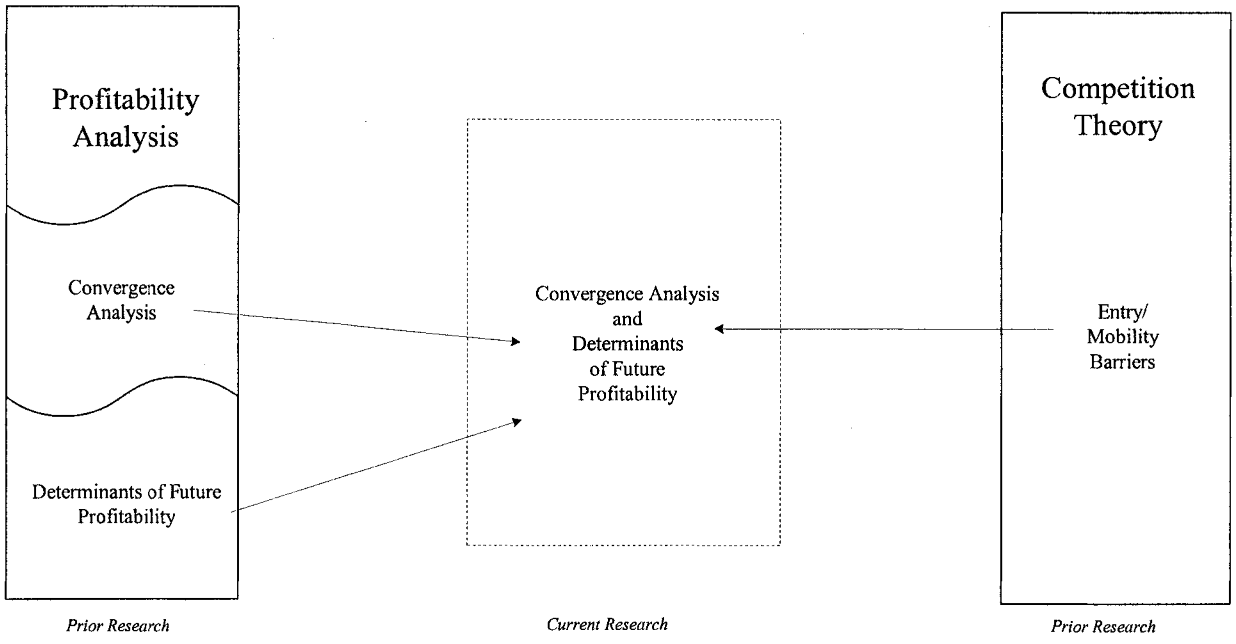

Fig. 2. Joint interaction of profitability/growth analysis and entry/mobility barriers.

In an attempt to model the general behavior of financial ratios, Lev (1969) showed that firms adjust (smooth) their accounting numbers toward the mean performance of their industry. He suggests that a model based on industry membership would improve the prediction of performance ratios. This suggests that an industry analysis can improve the explanatory power of profitability drivers.

Waring (1996) examined industry-adjusted persistence of profitability by several industrial organization variables from the economics literature including economies of scale (labor/capital ratio in an exponential form), sunk costs (R&D and advertising intensity), impediments to imitation (employee skill levels), rivalry (concentration ratio, number of firms in industry, sales growth), switching costs (percentage of output bought by consumers), expropriation (degree of labor unionization), excess capacity (capital intensity), and diversification (specialization ratio). This study complements Waring by using variables derived from accounting information to measure variables related to entry/mobility barriers. More importantly, it focuses on the incidence and persistence of barriers that affect operating profitability, which is the only sustainable source of profits.

Cheng (2005) examined how BTE variables impacted the persistence of abnormal ROE. Specifically, he hypothesized that abnormal ROE increases with industry-level BTE. He also hypothesized that abnormal ROE increases with market share, firm size, and firm-level BTEs. He used three proxies for BTE including R&D intensity, advertising intensity, and capital intensity. This paper expands Cheng's variable set to include proxies for changes in economies of scale (change in gross profit margin), expected retaliation of incumbents (excess cash), borrowing capacity, power over suppliers (operating leverage liability), and power over customers (receivables turnover). Again, this paper focuses on operating profitability and its components: NOPM and NOAT, as opposed to aggregate ROE.

This research also extends previous literature by examining both inter- and intra-industry variation in profitability. Joos (2000) suggests that intra-industry differences in profitability are of a short-term nature, while inter-industry differences account for permanent differences in profitability. Mueller (1986) reported that profit rates did not converge to an economy-wide mean for approximately two-thirds of his sample. More important, Mueller (1986) reported that the convergence process is incomplete when analyzing industry deviations from economy-wide profitability. For this reason, industry controls can help determine whether entry variables and related profitability are an industry phenomenon.

An analysis of the DuPont decomposition by industry is important.[8] Soliman (2004) finds that industry membership explains a significant amount of the variation in profit margin (PM) and asset turnover (ATO), but not in RNOA. He finds that while industry-median RNOAs do mean revert to an economy-wide level, the industry medians for PM and ATO do not. He suggests that mean-reversion for PM and ATO take place within industries, but not across industries. He tests this conjecture by analyzing the industry-portion and industry-adjusted values for PM and ATO and finds that the coefficients are significant and negative for the industry-adjusted values, that confirms the mean reversion within industries.

The hypotheses development, research design, and test results for the life cycle and barrier-to-entry studies are contained in Chapters 3 and 4, respectively.

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[8] Selling and Stickney (1989) provided descriptive data regarding return on assets (ROA) and its components PM and ATO by industry. They graphically demonstrated the negative relation between PM and ATO.

CHAPTER 3

FIRM LIFE CYCLE

Hypothesis Development

Research by Nissim and Penman (2001) provides the framework for the hypotheses development. They show residual operating income is determined (forecasted) by future return on net operating assets (RNOA) and the level of net operating assets (NOA) necessary to earn that rate of return. As such, forecasting innovations stem from understanding how the drivers of RNOA and growth in NOA behave across life cycle stages.[9] RNOA is decomposed into two factors: net operating profit margin (NOPM) and net operating asset turnover (NOAT). Profit margin is indicative of the firm's ability to convert sales into profit whereas asset turnover indicates the amount of assets needed to generate those sales. Economic theory suggests that growth firms focus on market expansion whereas mature firms focus on production efficiency. Therefore, NOPM and NOAT arguably have differential information content for future profitability across life cycle stages.

Thus, life cycle theory suggests the existence of structural differences in the economics of the firm. Such differences across life cycle stages are not exploited when looking at a pooled sample of firms or by partitioning on industry alone. Nissim and Penman state that pooled, linear models of current versus future profitability are not well-specified due to the non-linear nature of the data in the cross-section. They suggest that a careful partitioning of the data will

[9] In untabulated multivariate analysis, they found key regression coefficients lacked stability across firms and time. Nissim and Penman point to the contextual nature of financial statement information as an explanation for the instability and suggest that the relation between current and future ratios is nonlinear. Further, they hypothesize that a careful partitioning of the data can improve the performance of the profitability models. Life cycle analysis is a natural partition of the data. Moreover, such a partition potentially captures the nonlinearities evident in the evolution of these metrics (due to the nonlinear profitability pattern implicit in the life cycle curve).

improve the forecasting performance of the drivers of profitability and growth. Wernerfelt (1985) demonstrates that market share will (analytically) initially increase and then decrease over time. This pattern results in a non-linear profit function across the life cycle stages that is expected to also capture the non-linearities documented by Nissim and Penman in the pooled data. Accordingly, partitioning firms on life cycle stage predictably provides differential information about the variables that determine future profitability and growth.

Structural Differences across Life Cycle Stages

Return on common equity (ROCE or ROE) reflects the profitability and growth from both operating and financing activities while RNOA focuses solely on the asset base used to generate core earnings, and therefore is better suited to analysis of future operating profitability. Firm life cycle will affect both the numerator and denominator of RNOA. Spence (1977, 1979) states preemptive investments are made by new firms to deter entry. However, as preemptive investments taper off with maturity (Wernerfelt 1985), the denominator effect on RNOA will lessen and profitability is predicted to increase as the firm matures. Therefore, RNOA (and ROCE since RNOA is a primary driver of ROCE) will increase with the transition to the mature stage.

Although the primary focus of this study is on operating profitability, financial variables are included in the first hypothesis to provide evidence with respect to financing activities by life cycle stage. Financial leverage (FLEV) reflects the extent of debt financing used in obtaining assets. Myers (1984) proposes a pecking order theory of financing which suggests that firms will finance operations in the following order: 1) through internal funds generated from operations; 2) through external funds from issuing debt; and 3) through external funds from issuing equity.

Further, Diamond (1991) suggests that in early stages of firm's life when a firm's solvency is questionable, banks play an important monitoring role. As a firm builds credibility through increased profitability, the firm can access less expensive financing through issuances of public equity.[10] For this reason, FLEV is expected to increase during the introduction and growth stages and then steadily decline during the mature stage as the firm is able to raise capital through the equity markets.

A firm's ability to exert power over its creditors (particularly vendors) is demonstrated by its operating liability leverage (OLLEV) which is measured as the ratio of operating liabilities to NOA. This metric measures the degree of power a firm has over its operating creditors. Two theories suggest that mature firms by virtue of their market share should possess the highest degree of OLLEV. Transaction cost theory (Petersen and Rajan 1997) suggests that a supplier will offer a major customer credit terms so as to minimize the amount of transactions processed during the period. The "quality guarantee" theory (Smith, 1987) suggests that more powerful customers will demand trade credit to allow a period of inspection of the goods before final payment is made. Both theories suggest that OLLEV will increase monotonically from the introduction to the mature stage.

The effect of OLLEV on decline firms is less clear. Operating creditors tend to suspend or curtail credit terms to customers that are distressed. However, decline firms may experience a high level of OLLEV by virtue of their inability to service trade payables. Wilner (2000) finds that distressed customers exploit their bargaining power against suppliers due to the suppliers'

[10] The sample used in this study is limited to firms listed on Compustat which suggests these firms have self-selected to use equity financing in addition to (or in place of) debt financing. Any bias induced by this self-selection should mitigate the presence of a life cycle effect for firms in the early and late life cycle stages (i.e., work against the results reported later in the paper).

desire to continue the relationship. Thus, an ex ante prediction regarding the effect of distress on OLLEV is unclear.

Finally, RNOA is decomposed into two ratios: NOPM which reflects operating performance and NOAT which measures asset utilization. Both NOPM and NOAT are a function of operating strategy, which is conditional on firm life cycle. Spence (1977, 1979, 1981) suggests that profit margins are maximized during the period of greatest investment, which implies NOPM will be maximized during the growth stage. However, Wernerfelt (1985) states that declining growth rates lead to declining prices for competitive firms which suggests that NOPM will decline as firms enter the mature stage. Additionally, the bureaucracy of mature firms hinders the ability to adapt to changing competitive conditions (Hannan and Freeman 1984). Finally, Jovanovic and MacDonald (1994) state that mature firms become more homogenous through imitation and diffusion of technology, which implies that gains from product differentiation (increases in NOPM) will occur earlier in the firm life cycle. For this reason, NOPM is expected to increase monotonically from introduction to growth, and to decline thereafter.

With respect to efficiency (NOAT), Spence (1981) suggests that firms increase operational knowledge as they become more experienced. The experience curve leads to a reduction in production costs (Wernerfelt 1985). This suggests that NOAT is predicted to be maximized for mature firms.

Although profitability is partially driven by the level of investment, the relation across life cycle stage is not expected to be linear because the growth rates in earnings and investments likely differ. However, growth rates are expected to be linearly and negatively related to life cycle stage. The entrance of only one additional competitor in a market erodes the growth rates of incumbents. As firms compete for market share and profits diminish, growth necessarily fades. Therefore, growth in NOA and sales revenue are predicted to decline across life cycle stages. In sum, this discussion yields two hypotheses (stated in alternative form):

H1a: Return on common equity, return on net operating assets, operating liability leverage, and net operating asset turnover will monotonically increase from the introduction to mature stage; financial leverage and net operating profit margin will monotonically increase from introduction to growth and then monotonically decline over the remaining stages.

H1b: Growth in net operating assets and sales growth decrease monotonically across life cycle stages as competition intensifies.

Mean Reversion by Life Cycle Stage

Previous research documents that profitability measures mean-revert in the cross-section of firms (Freeman, Ohlson and Penman 1982; Fairfield, Sweeney and Yohn 1996; Fama and French 2000; Nissim and Penman 2001). Patterns of decay provide information about the time-series behavior of the various profitability and growth ratios. More importantly, understanding the evolution of profitability and growth improves predictability.

This paper examines whether the profitability and growth metrics mean-revert uniformly across all life cycle stages, or mean-revert at all. It is possible that certain stages of firm life cycle represent opportunities for sustained economic rents. This point has ramifications for assumptions used in equity valuation and for assessing the timing of future cash flows for debt service. The long-term inflation rate is often used as a perpetual growth rate in computing continuing value in equity valuation models.

Likewise, Nissim and Penman suggest that truncated forecast horizons can be used if valuation attributes "settle down" to permanent levels within the forecast horizon. More importantly, they state that if RNOA settles to a constant rate, then forecasting growth reduces to a forecast of NOA and sales revenue. Therefore, by studying the convergence of the various profitability and growth metrics across life cycle stage, the validity of a constant long-term growth rate regardless of life cycle stage can be assessed along with a determination of the appropriate forecast horizon. This discussion yields the following hypotheses (stated in alternative form):

H2a: Mean-reversion (convergence) in return on net operating assets and its components (net operating profit margin and net operating asset turnover) does not occur uniformly when firms are sorted according to firm life cycle stage.

H2b: Growth in net operating assets and sales growth do not mean-revert over time toward zero when firms are sorted according to firm life cycle stage.

Profitability Drivers and the Effect of Life Cycle Stage

Fairfield and Yohn (2001) examined the effect of both levels and changes in profit margin (PM) and asset turnover (ATO) on changes in future RNOA. They reported that current levels of PM and ATO are not informative in forecasting one-year-ahead change in RNOA but that the change in ATO is positively related to one-year-ahead change in RNOA. Life cycle theory suggests that profit maximization usually precedes operational efficiency for most firms. Therefore, life cycle stage should differentially affect the information content of change in PM and change in ATO for one-year-ahead change in RNOA.

Profit margins are hypothesized to be maximized in the growth stage (H1a); however, ***changes*** in profit margin should be negatively related to future profitability. Penman and Zhang (2004) found a negative relation between change in PM and future profitability for a pooled sample. They suggest that an increase in PM is derived from a current reduction in operating expenses, which is not sustainable and thus has negative consequences for future profitability.

Further, if the growth stage displays the maximum profit margin, then it is unlikely that any future increases in profit margin will lead to sustainable positive changes in future profitability. Thus, the coefficient on NOPM will be negative for all life cycle stages.

Changes in asset turnover are indicative of increased efficiency in production and should represent permanent sources of profitability. Penman and Zhang report a positive coefficient on change in ATO for a pooled sample. Life cycle theory suggests the mature stage is characterized by a focus on cost containment and increases in productive efficiency (Spence 1981; Wernerfelt 1985; Jovanovic and MacDonald 1994). Therefore, changes in asset turnover are predicted to be positively associated with future profitability for all life cycle stages, but the effect should be most prevalent in the mature stage. This discussion yields the following hypotheses (in alternative form):

H3a: Changes in net operating profit margin are negatively associated with all life cycle stages.

H3b: Changes in net operating asset turnover are positively associated with all life cycle stages, but are most pronounced in the mature stage.

Life Cycle Proxy

Drawing on prior research, this paper develops a parsimonious method for identifying firm life cycle using a combination of cash flow patterns.[11] Use of the entire financial information set contained in operating, investing, and financing cash flows avoids the necessity

[11] Livnat and Zarowin (1990) document that the decomposition of cash flows into operating, investing and financing activities differentially affects stock returns. Therefore, these cash flows capture differences in a firm's profitability, growth, and risk; and those differences can be paired with life cycle theory to derive a method of life cycle classification.

of using firm age or a limited number of financial ratios to determine firm life cycle.[12] This is important because different financial ratios take on differential importance conditional on life cycle stage (Anthony and Ramesh 1992).[13] Examining the combination of a firm's patterns of cash inflows and outflows can provide a life cycle mapping at a given point in time.[14] Table 1 delineates the mapping of the eight possible cash flow pattern combinations into the five theoretical life cycle stages discussed in previous paragraphs.[15,16]

Operating cash flows are usually negative in the introduction stage as a firm is learning about its cost structure and operating environment. Growth and mature firms will experience positive cash flows from operations and will seek to maximize their profit margins, which attracts aggressive competition. As more firms compete for position in a saturated market,

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[12] The use of limited financial statement ratios makes it difficult to incorporate the nonlinearites that characterize various life cycle stages into the classification scheme. Using a univariate indicator to determine life cycle stage necessitates the use of equal-sized portfolios or the selection of arbitrary break points to define the life cycle stages which is inconsistent with economic theory. The goal is to use the full articulation of the financial statements to determine firm life cycle. Additionally, cash flows are also the most "primitive" of accounting numbers and are not distorted by accounting accruals.

[13] Black (1998) uses Anthony and Ramesh's method to determine life cycle stage and examines the value relevance of earnings and cash flows in each stage. He documents that at least one cash flow component is value relevant for explaining the market value of equity in each life cycle stage. This lends support to the notion that the *combination* of cash flow activities will capture a comprehensive assessment of life cycle stage at a given point in time.

[14] At first glance, the life cycle proxy using cash flows may appear to have a tautological relation with operating rates of return. However, life cycle stage is based on the full articulation of the financial information set which is accomplished by using *combinations* of cash flow patterns to assign firm life cycle. While operating cash flows may indeed have a tautological relation with operating rates of return for many firms, it must be stressed that the life cycle assignment is *not* based on a simple correlation with operating cash flows. Rather, the simultaneous pattern of the three cash flows provides the life cycle mapping such that no one cash flow type by itself is sufficient to identify life cycle.

[15] Eight possible combinations of cash flow patterns based on the sign of each cash flow activity is possible, however these eight combinations can be collapsed into the five categories supported by life cycle theory (Gort and Klepper 1982).

[16] The growth, introduction, mature and decline cash flow characteristics are determinable from economic theory (Stigler 1963; Spence 1977, 1979, and 1981; Gort and Klepper 1982; Wernerfelt 1985; Jovanovic and MacDonald 1994; Agarwal, Sarkar, and Echambadi 2002)· It is more difficult to predict the cash flow effects of shakeout firms, and as a result, their classification tends to be by exception (those firms that are clearly not in the other four categories).

operating profits decline and firms must innovate, reduce costs, or affect a structural change to sustain operations. This phase is characterized in the economics literature as the shakeout phase.[17] Firms that cannot emerge from the shakeout stage into one of the previous life cycle stages (introductory, growth, or maturity) find themselves in a state of decline where operating cash flows are predictably negative.

TABLE 1

Cash Flow Patterns by Life Cycle Stage

	1 Introduction	2 Growth	3 Mature	4 Shake-Out	5 Shake-Out	6 Shake-Out	7 Decline	8 Decline
Predicted sign								
Cash flows from operating activities	–	+	+	–	+	+	–	–
Cash flows from investing activities	–	–	–	–	+	+	+	+
Cash flows from financing activities	+	+	–	–	+	–	+	–
Number of firm-year observations	4,643	14,008	16,540	487	229	2,472	1,010	852

For firm years 1989 - 2002.

Investing activities are comprised of transactions in financial and tangible assets, both of which normally increase during the early stages of the life cycle (firms experience investing outflows of cash). As the firm moves into maturity, it invests to maintain capital rather than to grow, however, the cash flow is still negative. The shakeout phase can result in either acquiring additional assets for innovation and/or liquidating idle or obsolete assets. Declining firms usually continue to liquidate their asset base to internally fund operations and/or service debt which result in investing cash inflows.

[17] Operating cash flows may be either positive or negative during this stage depending on the effect of increased competition that characterizes this phase.

TABLE 2

Validation of Life Cycle Stage Assignment

	Pooled	Introduction	Growth	Mature	Shake-Out	Decline
Number of firm-year observations	40,241	4,643	14,008	16,540	3,188	1,862
Percentage of total observations	100.00%	11.54%	34.81%	41.10%	7.92%	4.63%
Median number of distinct firms	2,684	311	935	1,103	213	126
Earnings per share	0.65	-0.21	0.77	1.00	0.33	-0.51
Return on net operating assets (RNOA)	9.02%	-7.90%	9.84%	10.75%	7.66%	-34.50%
Return on total assets (ROA)	5.76%	-4.03%	6.23%	6.77%	4.58%	-13.17%
Net operating profit margin (NOPM)	5.02%	-4.32%	6.36%	5.81%	4.66%	-21.52%
Change in NOPM	0.06%	-0.44%	0.03%	0.11%	0.37%	0.01%
Net operating asset turnover (NOAT)	1.93	1.99	1.82	2.03	1.77	1.67
Change in NOAT	-0.003	-0.084	-0.047	0.030	0.037	-0.007
Sales growth	9.88%	19.98%	17.64%	6.07%	0.28%	3.25%
Dividend payout ratio	0.20	0.02	0.19	0.26	0.25	0.04
Market share	7.69%	3.15%	7.47%	9.94%	6.76%	2.32%
Firm age (years)	9.67	5.58	8.33	14.33	10.67	6.50

For firm years 1989 - 2003.
All data presented are median figures except for number of observations and dividend payout ratio and market share. The use of medians instead of means mitigates the effect of extreme observations which arise from small values used in the denominators of the various ratios. Earnings per share (EPS) is before extraordinary items (Compustat #58). Net Operating Profit margin = Operating Income (OI) / Net sales (Compustat #12). Net Operating Asset Turnover = Net sales (Compustat #12)/Average Net Operating Assets (NOA). Return on net operating assets = Operating Income (OI_t)/Average Net Operating Assets (NOA). Return on total assets = (Net income (loss) (Compustat #172) plus (Interest expense (Compustat #15) * (1 minus the marginal tax rate)))/Average total assets (Compustat #6). Sales growth is defined as (Net $Sales_t$/lagged Net $Sales_{t-1}$) – 1. Dividend Payout Ratio = Dividends per Share (DPS)/ Basic earnings per share EPS (Compustat #58) and mean dividend payout ratio is presented since the median is zero for all stages except mature since many firms do not pay dividends during expansions and contractions. Market share is computed as the firm's mean percentage of 2-digit annual revenue. Firm age is defined as number of years since first appearance in the CRSP database. Firms with sales revenue, common equity or net operating assets less than $1 million are excluded.

Financing cash flows are positive for introduction and growth firms as they rely on external financing to fund operations. However, mature firms change the focus from acquiring new financing to servicing its debt. Shake-out firms can fund innovations either with internal or external funds. Finally, decline firms can renegotiate its debt and/or secure additional funds if lenders perceive the firm's downturn to be temporary. Once a decline firm exhausts it credit lines, it enters bankruptcy if it is unable to finance operations internally. The validity of the life cycle classification is demonstrated in Table 2. Expectedly, the number of observations across life cycle stages increases as entry continues until the market is saturated (mature stage) followed by a sharp decrease of firms in the shakeout and decline phase (see rows 1 through 3). More important, the ratio analysis suggests that the classification is valid. Specifically, profitability measured by earnings per share, RNOA and ROA are maximized for mature firms (see rows 4 through 6).[18] Profit margin is maximized in the growth phase indicating the presence of temporary monopoly rents. Asset turnover is maximized in the mature stage, which reflects a change in focus to efficient production as profit margins are eroded by competitive pressure.

Sales growth declines monotonically across the introduction, growth, mature and decline phases and dividend payout ratio is highest for mature firms.[19] Market share is computed as the firm's percentage of 2-digit SIC code total revenues in a given year and increases monotonically to the mature stage and declines thereafter (an inverted U-shape) consistent with economic theory. Firm age does not decline monotonically across life cycle stages but also exhibits an inverted-U shape.[20] This distribution occurs due to the increase in hazard rates for younger firms as predicted by Jovanovich (1982).[21,22,23]

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[18] ROA includes financial assets and excludes operating liabilities in its denominator which results in a lower value than that for RNOA.

[19] Dividend payout ratio is becoming less useful as Fama and French (2001) document a decrease in the number of firms that are paying dividends in recent years.

[20] Firm age is defined as years since a firm's first appearance on the Center for Research on Security Prices (CRSP) database which is a common proxy for firm age in the research literature.

[21] The use of firm age as a proxy assumes that a firm moves monotonically through its life cycle. Yet, by making substantial product innovations, expanding into new markets, or affecting a structural change, firms can recycle through the classifications in a non-sequential manner. Additionally, firm life cycle differs from firm age because firms of the same age can learn at different rates due to imperfections in their feedback mechanisms (such as accounting quality). In addition, differences in managerial ability affect the interpretation of performance while differences in incentive structure affect a firm's risk tolerance. Both factors can result in a misalignment between firm performance and firm age.

[22] The management literature documents a "liability of newness" phenomenon (Stinchcombe 1965; Freeman, Carrol and Hannan 1983; Amit and Schoemaker 1993), which means that variation in the level of initial endowments interacts with the time effect of mortality rates. This interaction between endowments and time determines how quickly a firm is able to identify and develop its core competencies and adapt to the competitive environment (Fichman and Levinthal 1991). Therefore, firms in the decline stage are likely to include very young firms that succumbed to this high initial mortality rate and, thus, the life cycle progression is likely to be nonlinear in age.

The results in Table 2 are consistent with the prior research of Anthony and Ramesh (hereafter referred to as AR) (1992), who examined the relation of life cycle to unexpected stock returns. This paper differs from AR in that it examines patterns of *actual* persistence over a five-year horizon, rather than examining the market's average expected persistence by life cycle stage. Additionally, the profitability decomposition provides evidence with regard to prevalent strategies employed (product differentiation versus cost efficiency) over each life cycle stage. Thus, the current analysis demonstrates the actual determinants of profitability in each stage rather than a documentation of investor's expected mean profitability. [24]

Furthermore, Anthony and Ramesh classified firms by life cycle stage (growth, growth/mature, mature, mature/stagnant, and stagnant) using three financial statement metrics (sales growth, capital expenditures, and dividend payout ratio) along with firm age. They reported that sales growth and dividend payout were differentially informative for explaining stock returns across life cycle stage. The current study uses cash flow patterns (which were unavailable during Anthony and Ramesh's sample period), however, this paper's life cycle classification is compared with the three variables used in Anthony and Ramesh (1992): sales growth, dividend payout ratio and firm age. Table 2 demonstrates the consistency between the

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[23] Another difficulty in using firm age as a proxy for life cycle is that age is usually defined as years since an initial public offering (IPO) or years since first appearance in a commercial database. However, the life cycle of the firm begins with its inception. Using the first appearance or years since an IPO can result in a skewed distribution of firm life cycle.

[24] A concurrent working paper by Aharony, Falk and Yehuda (2003) examines the value-relevance of accrual versus cash flows for three life cycle classifications which are computed using a simplified version of Anthony and Ramesh (1992). They divide observations into three equal groups: growth, maturity and decline. They find that accrual accounting information is more value relevant than cash for all classifications. This paper differs from Aharony et al. by: 1) development of a life cycle proxy that is based on the full articulation of the accounting information system rather than relying on univariate financial ratios that take on differential importance contingent on a firm's life cycle stage; 2) use of Nissim and Penman (2001)'s drivers of profitability and growth as a level of analysis as opposed to summary accounting data; 3) examination of the time-series behavior of profitability and growth by life cycle stage; and 4) investigation of what drives differences in *future* profitability by life cycle stage.

two classification methods. However, AR's method requires an assumption regarding the underlying distribution of the classification variables and necessitates the use of arbitrary breakpoints to assign life cycle stage. For example, using portfolio sorts is based on a uniform distribution, which is not consistent with economic theory regarding life cycle. Cash flow patterns are the natural result of the underlying economics of the firm and its markets, thus a distributional assumption is not necessary for classification.

One concern is that the life cycle effect proxies for an industry effect. For example, if industries were concentrated in specific life cycles, then a simple industry control would subsume the firm life cycle effect. However, the entry and exit patterns and the differing rates of knowledge acquisition, level of endowments, and rates of re-investment and obsolescence across firms within an industry, likely result in a broad life cycle stage representation within each industry. Table 3 presents the distribution of life cycle stage frequency across industry partitions using one-digit SIC codes. The distribution is similar to the pooled sample across life cycle stages, which suggests that industry factors and life cycle stages are distinct. Table 4 reports median RNOA by industry. The inverted U-shape pattern is present in each industry partition. Thus, a simple industry control variable fails to capture the distinct, economic differences underlying firm life cycle stage.[25]

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[25] This analysis was repeated for 2-digit SIC codes and for the Fama and French (1997) 48 industry classifications with inferences substantially unchanged. Only construction firms and credit unions did not display an inverted-U pattern of RNOA. In both of these industries, RNOA for introduction firms was equal to or higher than that of growth firms within the industry. Additionally, the mature life cycle stage contained the highest percentage of observations for all industry groups except the following which had a higher proportion of observations in the growth life cycle stage: Entertainment, Healthcare, Precious Metals, Petroleum, Communication, Business Services, Computers, Electronics, Restaurants/Hospitality, Banking, Insurance, Real Estate, and Trading. Likewise, Medical Equipment and Pharmaceuticals had the highest proportion of observations in the introduction life cycle stage.

TABLE 3

Distribution of Life Cycle Stage Frequency across Industries

	Pooled	Introduction	Growth	Mature	Shake-Out	Decline
Median Annual Frequency by Industry						
Agriculture, Forestry, and Fishing	10	2	2	5	1	1
Mining and Construction	164	13	76	56	15	5
Manufacturing:						
(SIC Code 2000 - 2999)	447	55	111	222	33	27
(SIC Code 3000 - 3999)	835	109	262	354	67	44
Transport., Communications & Utilities	300	17	128	134	16	5
Retail	290	35	101	132	15	7
Finance, Insurance and Real Estate	203	14	88	59	31	11
Services						
(SIC Code 7000 - 7999)	321	49	127	100	26	20
(SIC Code 8000 - 8999)	114	17	40	41	9	6
Sum of Median Annual Frequency	2,684	311	935	1,103	213	126

For firm years 1989 - 2003. Distribution is the mean of the annual median number of observations by 1-digit SIC code.

TABLE 4

RNOA by Life Cycle Stage across Industries

	Pooled	Introduction	Growth	Mature	Shake-Out	Decline
Median Annual RNOA by Industry						
Agriculture, Forestry, and Fishing	10.85%	-69.52%	8.92%	16.18%	5.28%	-168.64%
Mining and Construction	6.93%	0.10%	6.13%	8.93%	5.94%	-3.08%
Manufacturing:						
(SIC Code 2000 - 2999)	9.30%	-41.99%	9.49%	12.16%	9.00%	-121.84%
(SIC Code 3000 - 3999)	9.28%	-8.52%	11.33%	11.23%	7.49%	-30.30%
Transport., Communications & Utilities	7.88%	-11.61%	7.54%	8.58%	6.74%	-15.15%
Retail	9.58%	5.75%	9.99%	10.65%	6.94%	-12.60%
Finance, Insurance and Real Estate	19.99%	5.48%	28.06%	28.17%	14.48%	-2.71%
Services						
(SIC Code 7000 - 7999)	8.00%	-33.17%	11.37%	12.15%	2.95%	-57.41%
(SIC Code 8000 - 8999)	8.88%	-23.55%	11.08%	11.40%	4.65%	-55.76%
Mean of Median Annual RNOA by Ind.	10.08%	-19.67%	11.54%	13.27%	7.05%	-51.94%

For firm years 1989 - 2003. RNOA is the mean of the annual median RNOA by 1-digit SIC code.

Sample and Research Design

Sample Details

The sample includes NYSE, AMEX and NASDAQ firms (excluding ADRs) with necessary data on Compustat.[26] The sample period extends from 1989 (the first year data from the Statement of Cash Flows was available) through 2003 (change variables use data extending to 2004). Firms with absolute values of net operating, investing, or financing cash flows of less than 0.005 of total assets are excluded to enhance the power of the life cycle classifications.[27] Additionally, firms with sales revenue or NOA less than $1 million are excluded because small or negative denominators skew the profitability metrics. This constraint omits primarily firms in the financial industries. Firms with SIC codes greater than 9100 are omitted to ensure only for-profit firms are in the sample. Incorporating these constraints results in a sample with 40,241 firm-year observations and the distribution of these observations across life cycle stages is reported in Table 2. The sample selection analysis is reported in Table 5. All variables used throughout the paper are defined in the Appendix.

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[26] It is unclear whether a Compustat reporting bias exists regarding information from the statement of cash flows. The mean total asset value of all sample firms listed in Compustat (before the statement of cash flow data requirement) is $2,811 million whereas the mean total asset value for firms meeting the statement of cash flow data requirement is $2,170 million. To ensure that the results were not driven by a sample bias correlated with the likelihood to report cash flow data on the statement of cash flows, an alternative classification method was employed using only balance sheet and income statement data to emulate cash flow activities. The results were robust using the alternative classification method.

[27] The distribution of excluded observations was similar in life cycle stage proportions to the original sample and as such, the exclusion did not introduce a bias into the reduced sample. Additionally, 56% of the excluded observations were the result of a small magnitude of financing cash flows (proportion of excluded observations due to operating and investing cash flows were 19 and 25 percent, respectively). The results presented throughout the paper are robust excluding this constraint.

TABLE 5

Sample Selection Analysis

	Number of Firm-Year Observations
NYSE, AMEX or NASDAQ observations excluding ADRs with necessary Compustat data	60,740
Less firm-years with cash flows < 0.005 × total assets	(5,358)
Less governmental entities	(95)
Less firm-years with net operating assets or sales < $1 million	(15,046)
Total sample size	40,241

For firm years 1989 - 2003.
Results are substantially similar when this control for cash flow magnitude is excluded.

Research Design

To determine if profitability and growth metrics vary by firm life cycle (H1), median profitability and growth ratios are examined to determine if there are structural differences across life cycle stage.[28] If life cycle does not differentially affect profitability and growth, then there should be little, if any, observable difference among the ratios across life cycle stage. To examine the mean-reversion characteristics of the profitability and growth drivers by life cycle (H2), this paper follows Nissim and Penman's analysis in which the median metrics are examined over time.

[28] Median ratios are reported throughout the paper to mitigate extreme values due to small denominators.

The convergence to a permanent level of each metric is studied by computing life cycle portfolio medians in a classification year and repeating the analysis for the following five years. To avoid dependence among observations, two time series are formed using 1989 and 1995 as base years (Year 0). Each base year observation is compared with observations for Years 1-5 (1990 through 1994 and 1996 through 2000). The convergence patterns for each driver can be depicted graphically by plotting the mean of the time series for each life cycle stage. If there is no structural difference between life cycle stages or in the mean reversion patterns across stages, then the five life cycle portfolios will plot identically as a single line. Therefore, an analysis of the convergence of RNOA will determine whether the well-documented mean reversion in RNOA occurs uniformly across all life cycle stages (H2a). Further, firms can generate constant RNOA with different combinations of profit margins and asset turnovers. By analyzing the evolution of NOPM and NOAT, which are the components of RNOA, it can be determined if life cycle stages reflect permanent trends in these components consistent with life cycle theory.

Nissim and Penman suggest that if profit margin and asset turnover can be assumed constants, then the growth rate in operating income can be forecasted using the growth in sales. They also state that differences in long-run levels of profit margins and asset turnovers are due to permanent differences in technology and cost structures across firms. Economic theory suggests that life cycle stage is one driver of differences in product differentiation and efficiency, which are manifest in the lack of convergence across profit margin and asset turnover ratios. Therefore, changes in NOPM and NOAT are also evaluated to determine if strategies based on increasing one or the other are sustainable. Finally, if RNOA settles to a constant rate, then forecasting growth reduces to a forecast of NOA and sales revenue. Therefore, growth rates in NOA and sales revenue are investigated by life cycle stage to determine if these growth rates collapse, thus facilitating the use of long-term inflation as the appropriate growth rate in determining continuing values (H2b).

To examine whether changes in the components of RNOA (change in profit margin and change in asset turnover) are informative in explaining future changes in RNOA (H3a and H3b), a benchmark model (Equation 1) of one-year ahead change in RNOA is regressed on changes in NOPM and in NOAT (Fairfield and Yohn 2001; Penman and Zhang 2004). To gain insight into the effect of changes in NOPM or NOAT strategies, current profitability (both level and change in current RNOA) must be controlled for since it is known to be serially correlated with future profitability (Fairfield and Yohn 2001; Penman and Zhang 2004). OLLEV is also included as a control variable since it directly affects profitability (Nissim and Penman 2001). Operating liabilities reduce the amount of NOA needed to generate a given level of profitability in the form of interest-free credit with suppliers (Penman 2004). Finally, future changes in profitability can also occur due to a denominator effect, or growth in NOA, G^{NOA} (Fairfield and Yohn 2001; Penman and Zhang 2004). Thus, an NOA growth variable is included to ensure that the effects of changes in NOPM and NOAT are not driven solely by changes in investment:

$$\begin{aligned}\Delta RNOA_{t+1} = \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t +\\ \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + e_{t+1}\end{aligned} \quad (1)$$

The coefficient on current RNOA is expected to be negative since profitability is mean-reverting (Freeman, Ohlson and Penman 1982; Fairfield and Yohn 2001). The change in profitability, ΔRNOA, is comprised of current profitability and lagged profitability. Therefore, $\beta_1 + \beta_2$ reflects the true weight on current RNOA, while $-\beta_2$ reflects the weight on $RNOA_{t-1}$ which is expected to be positive (which means that the expected sign of the ΔRNOA is negative).[29] The sign of the coefficient on ΔNOPM is predicted to be negative for all stages but introduction, and its magnitude should be greatest for growth firms. The coefficient on ΔNOAT is hypothesized to be positive for all firms, but should have the strongest future profitability effect for mature firms. The OLLEV variable is expected to be positive since higher levels OLLEV reduce the carrying costs of debt. Additionally, ΔOLLEV may be informative if the effect of operating liability leverage on future profitability is conditional on both the level and directional change of that leverage. Finally, prior research has shown the coefficient on the growth in NOA variable to be negative since investment in NOA is subject to diminishing returns.

Next, the firm life cycle effect is introduced in Equation 2 to determine whether life cycle stage provides incremental benefit to the traditional variables included in Equation 1. The informativeness of life cycle is modeled using interaction effects of life cycle indicator variables on all independent variables.[30]

$$\begin{aligned}\Delta RNOA_{t+1} = {} & \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \beta_5 OLLEV_t \\ & \beta_6 \Delta OLLEV_t + \beta_7 G_t^{NOA} + \sum_{k=1}^{4} D_k LC + \sum_{k=1}^{4} \delta_{1k}(RNOA_t \times LC_k) \\ & + \sum_{k=1}^{4} \delta_{2k}(\Delta RNOA_t \times LC_k) + \sum_{k=1}^{4} \delta_{3k}(\Delta NOPM_t \times LC_k) + \sum_{k=1}^{4} \delta_{4k}(\Delta NOAT_t \times LC_k) \\ & + \sum_{k=1}^{4} \delta_{5k}(OLLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{6k}(\Delta OLLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{7k}(G_t^{NOA} \times LC_k) + e_{t+1}\end{aligned} \tag{2}$$

[29] The regression coefficients on current RNOA and change in RNOA can be restated as: β_1*$RNOA_t$ + β_2*$\Delta RNOA_t$ = β_1*$RNOA_t$ + β_2*($RNOA_t$ – $RNOA_{t-1}$) = (β_1 + β_2)* $RNOA_t$ – β_2* $RNOA_{t-1}$.

[30] By summing the main effects with the incremental effects of the interaction variables, both the intercept and change in slope can be incorporated in the analysis.

Empirical Results

Structural Difference Results

Table 6 reports the results for H1. The evidence is consistent with both H1a and H1b, which suggests that firm life cycle is informative for drivers of both profitability and growth. [31] The profitability drivers exhibit the predicted behavior across life cycle stages. Namely, all median values are significantly different across the majority of life cycles for all variables.[32]

Both ROCE and RNOA increase monotonically to a maximum for mature firms and then drop off as predicted. FLEV is maximized for growth firms (0.31) and then monotonically declines which is consistent with pecking order theory. It should be noted that FLEV is negative for shake out firms due to the existence of net financial assets rather than obligations. However, the negative FLEV for decline firms results from negative values of common equity in the denominator. With the exception of a decline for growth firms, OLLEV increases across life cycle stages rather than peaking at maturity as predicted. It appears that transaction costs and/or quality guarantees result in a firm exerting more power against suppliers as they progress through the life cycle. OLLEV is maximized for decline firms (0.48), which is consistent with the involuntary nature of suppliers extending credit concessions.

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[31] The median ratios for the pooled sample are comparable with Nissim and Penman, however their sample excluded NASDAQ firms which results in slightly lower profitability and financial leverage levels in the current sample. The NASDAQ firms were important to retain in the current sample to obtain an improved distribution of firms in the earlier and later life cycle stages.

[32] The equality of medians across life cycle stages was tested using a pairwise Wilcoxon rank sums test. All medians were significantly different at a .05 level or better with the following exceptions: NOAT not significantly different between introduction and mature stages and the growth and shake-out stages; OLLEV is not significantly different between the mature and shake out stages.

TABLE 6

Profitability and Growth Metrics for Pooled Sample
and by Life Cycle Classification

Profitability Ratios	**Pooled**	**Introduction**	**Growth**	**Mature**	**Shake-Out**	**Decline**
Number of Obs.	**40,241**	**4,643**	**14,008**	**16,540**	**3,188**	**1,862**
ROCE	9.74%	-8.28%	10.85%	11.82%	6.18%	-16.53%
RNOA	8.97%	-12.19%	9.80%	10.87%	7.91%	-31.96%
FLEV	0.19	0.13	0.31	0.21	-0.04	-0.30
OLLEV	0.39	0.38	0.35	0.42	0.43	0.48
NOPM	5.02%	-7.56%	6.30%	5.83%	4.64%	-20.15%
NOAT	1.92	2.00	1.80	2.02	1.79	1.73
Growth Ratios	**Pooled**	**Introduction**	**Growth**	**Mature**	**Shake-Out**	**Decline**
Growth in NOA	7.43%	25.85%	20.39%	0.96%	-9.73%	-3.16%
Growth in Revenue	9.87%	19.26%	17.05%	6.03%	0.58%	3.89%

For firm years 1989 - 2003.
All data presented are the means of yearly medians for each metric . The use of medians instead of means mitigates the effect of extreme observations which arise from small values used in the denominators of the various ratios. Return on equity (ROCE) = Comprehensive Income (CNI_t) /Average Common Equity (CSE); Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/Average Net Operating Assets (NOA); Financial Leverage (FLEV) = Net Financial Obligation (NFO)/Common Equity (CSE); Operating Liability Leverage (OLLEV) = Operating Liabilities (OL)/ Net Operating Assets (NOA); Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12); Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/Average Net Operating Assets (NOA); Growth in Net Operating Assets (NOA) = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; Growth in Net Sales = (Net $Sales_t$/lagged Net $Sales_{t-1}$) – 1.
All medians are significantly different at a .05 significance level or better using a Wilcoxon Rank Sums test for the equality of the medians with the following exceptions: NOAT not significantly different between introduction and mature stages and the growth and shake-out stages; OLLEV is not significantly different between the mature and shake out stages.

Consistent with expectations, NOPM increased through the growth phase and then declined over the remaining stages. This is consistent with economic theory that firms in early life cycles will focus on market penetration and entrenchment but that competitive forces erode their temporary rents in later life cycle stages. NOAT was expected to increase monotonically through the mature stage. However, the evidence suggests that growth firms temporarily experience declines in efficiency. This may be due to inefficiencies that arise from rapid growth. NOAT does peak as expected in the mature stage, which is consistent with firms resorting to operating efficiencies to contend with declining profit margins.

The median growth drivers are statistically different across life cycle stages and decline monotonically throughout the shakeout stage. The decline stage experiences an upswing in growth of NOA (from – 9.73 percent in the shakeout stage to -3.16 percent in the decline stage), which can arise from an overliquidation of productive assets in the shakeout stage. Decline firms are also characterized by increased sales growth. It is possible that these firms are decreasing prices, which leads to increased volume, which in turn drives revenue growth above that experienced in the shakeout phase.

Overall, the evidence demonstrates that differences across firm life cycle affect profitability and growth in the cross-section. Profitability metrics such as ROCE, RNOA, and NOPM display a strong inverted U-shaped pattern, which demonstrates that partitioning firms by performance does not adequately control for differences in firm life cycle.

Mean Reversion Results

Figure 3 replicates the pooled convergence patterns of RNOA (based on RNOA deciles) from Nissim and Penman.[33]

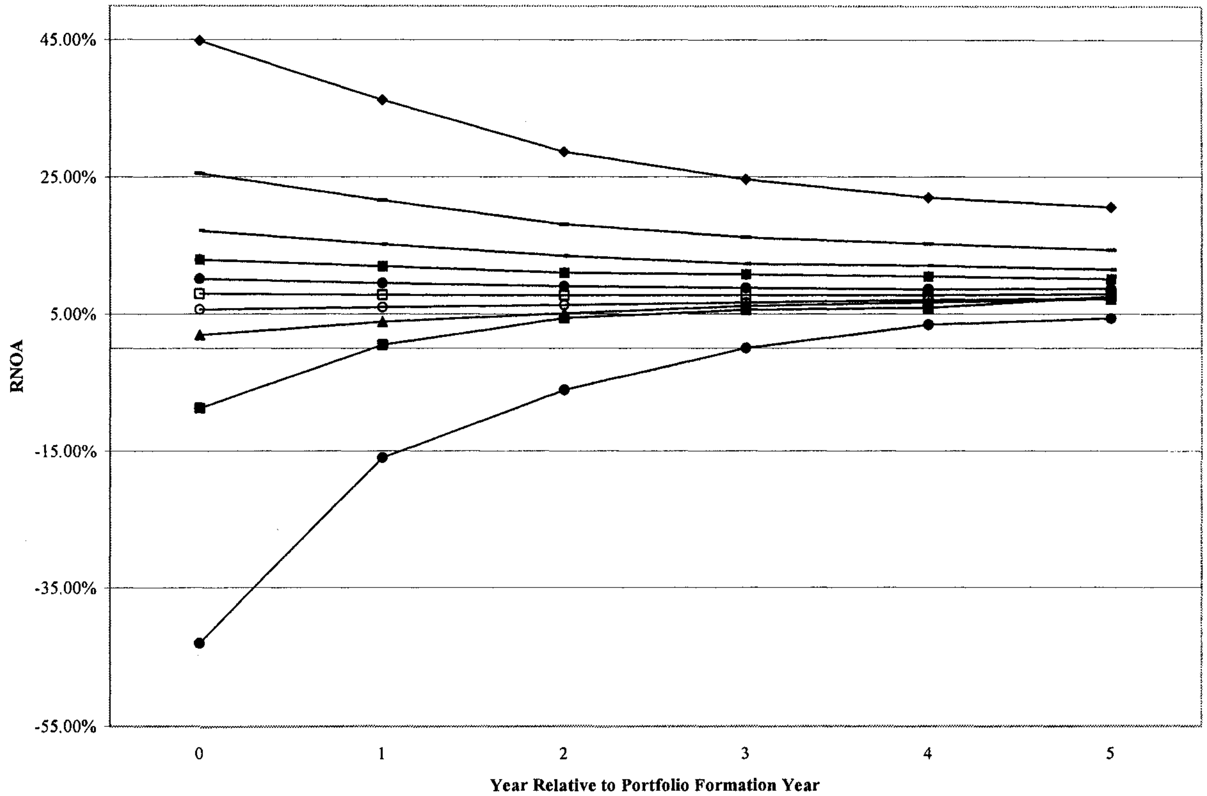

Fig. 3. Evolution of RNOA-sorted portfolios over time – pooled sample.

[33] The nonlinearity of the life cycle effect is evident when the portfolios sorted on RNOA are analyzed by life cycle stage (results are untabulated). In the lowest RNOA portfolio, 44.4% of the observations are introduction firms, and 25.4% are decline firms (for a combined total of 69.8%). Conversely, 45.0% of the observations in the top RNOA portfolio belong to the growth stage and 39.7% are from the mature stage (for a combined total of 84.7%).

Figures 4a through 4g report the convergence patterns for various profitability and growth metrics by life cycle stage.[34] These ratios include RNOA, growth in NOA, sales growth, NOPM, NOAT, ΔNOPM and ΔNOAT. RNOA in Figure 4a slightly converges at year 3, and then begins an upward trend, reaching levels at year 5 of approximately 4 to 11 percent for profitable firms. The variation in these returns is economically significant and the returns potentially reflect each life cycle stage's cost of capital. Mature firms enjoy a sustainable advantage over the other life cycle categories while introduction firms earn substantially less,

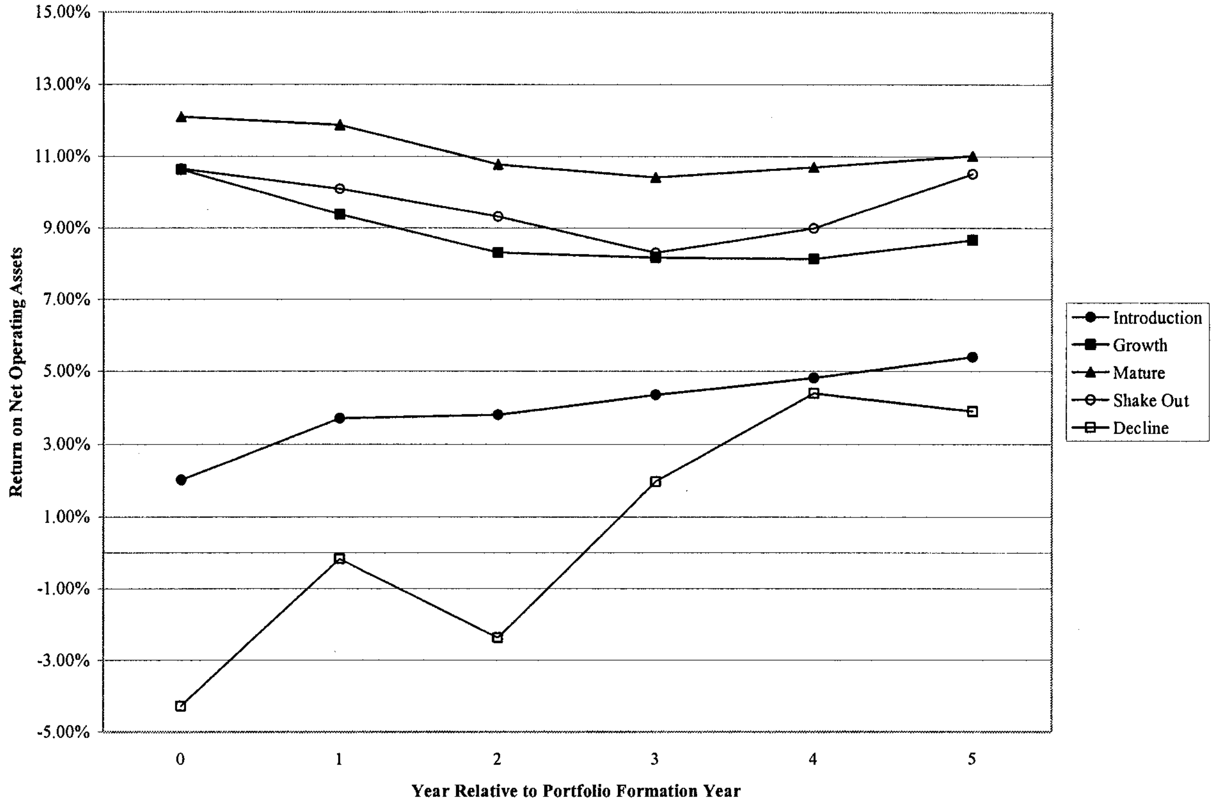

Fig. 4a. Evolution of RNOA over time by life cycle stage.

[34] Firms are classified by life cycle during the base year and their convergence patterns are analyzed over time. As in Nissim and Penman, firms that do not survive the entire time series are dropped when their associated data no longer appear in Compustat. This imparts a survival bias for decline firms so results should be interpreted as decline firms that survive after initial classification in the base year. However, the effect of dropped firms should bias against finding results as it would impart a tendency toward the mean, which in this case is the null hypothesis. As an additional test of survivorship bias, the tests were run on a constant sample with similar (untabulated) results. Therefore, survivorship bias does not appear to drive the findings.

even five years out. Thus, the evidence supports H2a which states that mean reversion does not occur uniformly across all life cycle stages. This suggests that since RNOA does not converge to a constant rate, forecasting growth is more complicated than a simple forecast of growth in NOA and in sales revenue. Information regarding life cycle stage will substantially impact forecasts of future RNOA.

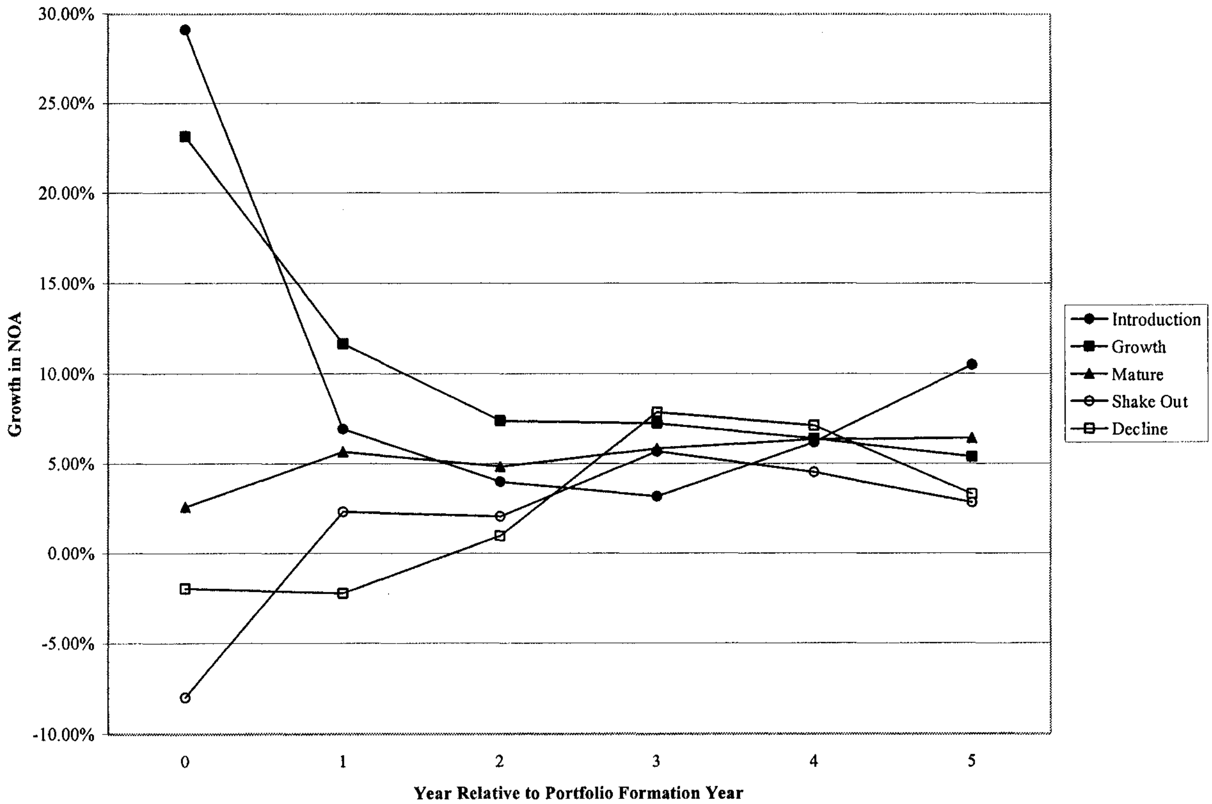

Fig. 4b. Evolution of growth in NOA over time by life cycle stage.

Growth in NOA (Figure 4b) collapses within a tight range by year 4 but diverges in year 5. Introduction firms tend to go through waves of growth, while growth firms converge to the same rate of growth as mature firms (which are relatively constant over time). Shakeout firms reacquire additional capital assets in Year 1, which is indicative of a shift from less productive assets to those that will generate higher future returns. In Figure 4c, revenue growth collapses slightly across life cycles by year 2, but then appears to increase uniformly by two to four percent for all stages, which is near the long-run inflation rate, a rate often used as a terminal growth rate in valuation models.

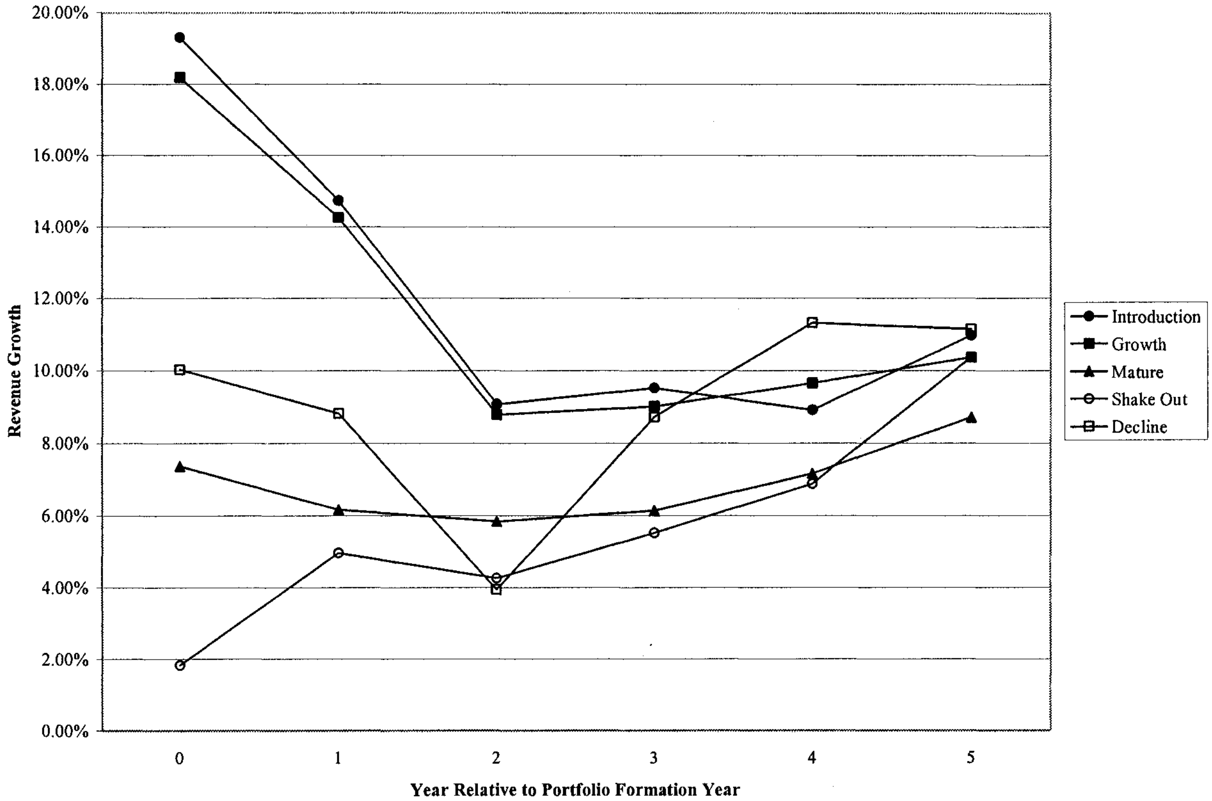

Fig. 4c. Evolution of growth in revenue over time by life cycle stage.

Thus, the mean reversion in growth in NOA and revenue appears to be stronger than the mean-reversion in profitability (RNOA in Figure 4a) and consequently H2b is not supported. However, it must be noted that a reduction of forecasting to NOA and sales growth was contingent on RNOA converging over time. Overall, the results indicate that while long-term inflation rates are a reasonable surrogate for growth for firms in the pooled sample, an analysis of firms in specific life cycle stages can further refine these long-term growth assumptions. This is an important finding.

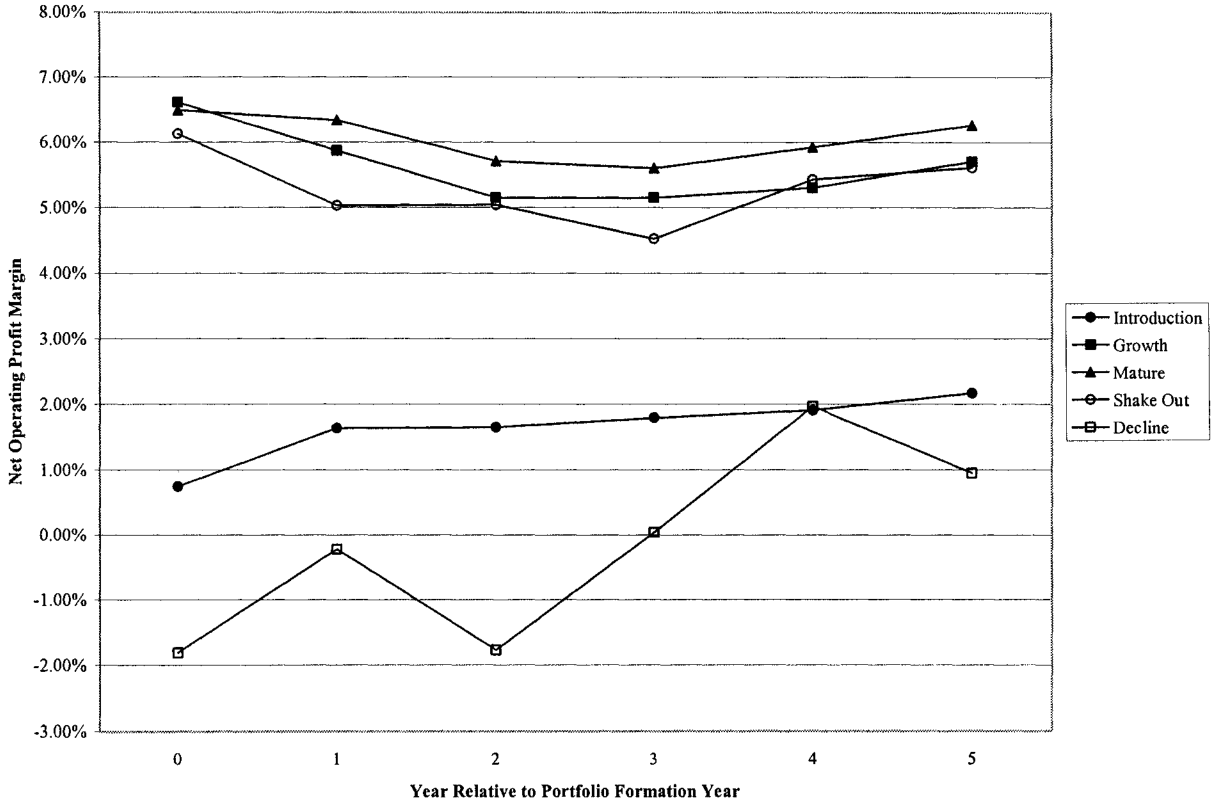

Fig. 4d. Evolution of NOPM over time by life cycle stage.

Further, Nissim and Penman suggests that if profit margin and asset turnover can be assumed constants, then the growth rate in operating income can be forecasted using the growth in sales. Figures 4d and 4e reflect the evolution of NOPM and NOAT. Profit margins are uniformly higher for growth, mature, and shakeout stages than for the introduction stage, and this difference is permanent even after five years. The differences for asset turnover across life cycle stage are pronounced. Introduction and mature firms exhibit an elevated NOAT (however, these gains in productivity wane for mature firms) while the NOAT of growth firms is depressed for the entire five years. The NOAT of both shakeout and decline firms peak three years from formation and then subsequently decline.

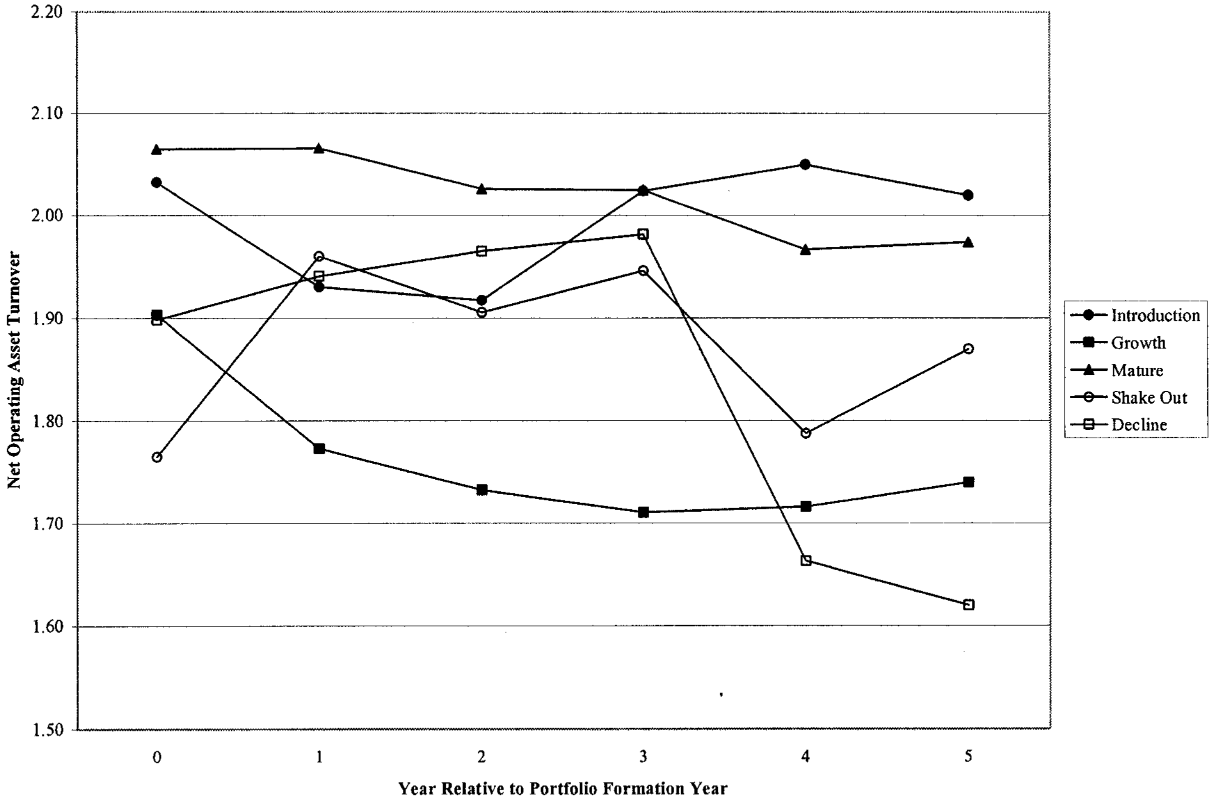

Fig. 4e. Evolution of NOAT over time by life cycle stage.

H2a predicted non-convergence for both NOPM and NOAT. This is supported, as there are permanent differences in these metrics by life cycle stage. Further, NOPM does seem to be constant for each life cycle stage, while NOAT is relatively stable for only mature firms. This suggests that the growth rate in sales will be informative for forecasting growth in profitability for mature firms; but forecasting profitability growth for the other stages is confounded by the temporal pattern of NOAT. In other words, the evidence suggests that asset turnover is important for explaining changes in profitability conditional on life cycle stage.

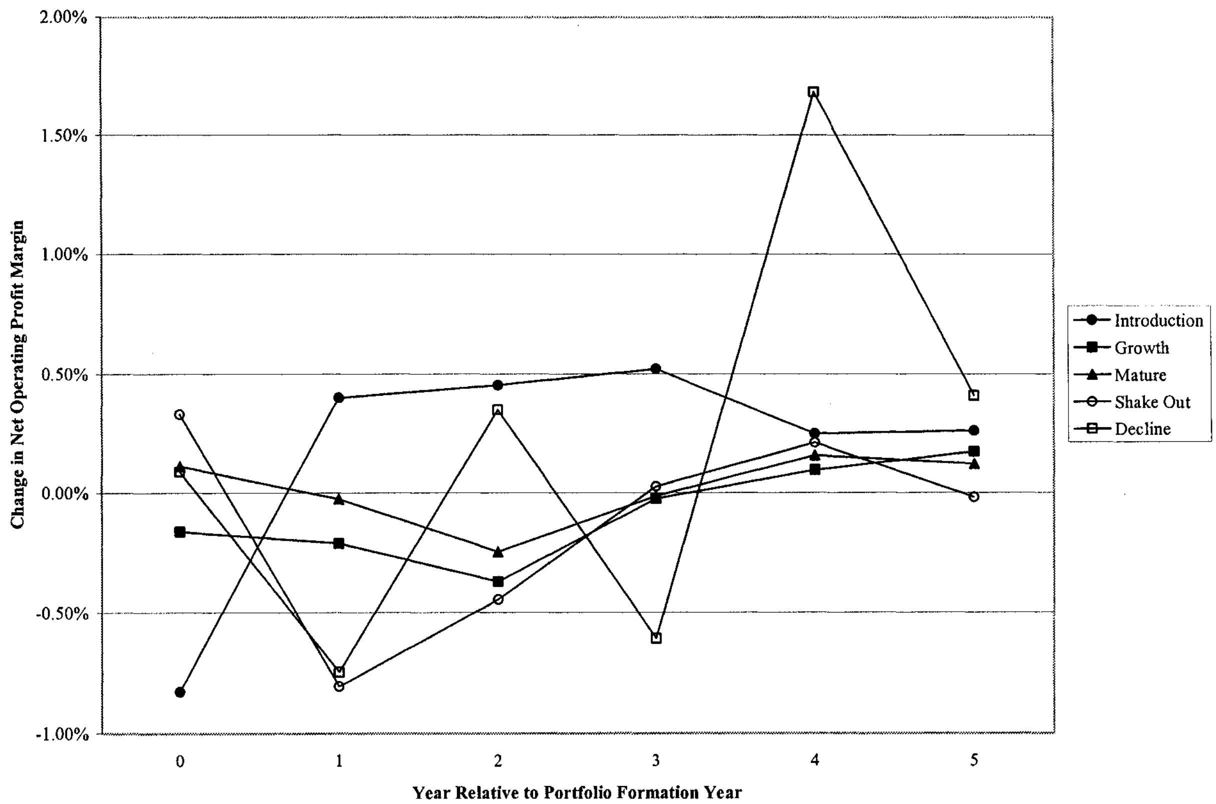

Fig. 4f. Evolution of change in NOPM over time by life cycle stage.

Finally, an analysis of the changes in NOPM and NOAT are displayed in Figures 4f and 4g. While the changes collapsed rapidly for the pooled cross-section in Nissim and Penman, there is a variety of patterns occurring across the various life cycle stages. The graphs suggest that these variables contain information for future profitability. For changes in NOPM, decline stage firms display negative serial correlation throughout the five years. Growth and mature firms display decreasing rates of change for the first two years with continual increases thereafter. Shakeout firms display a sharp decrease over the first year, which can be the result of the competitive pressures that characterize this stage, followed by eventual recovery. Only introduction firms sustain increases in profit margin during the analysis period.

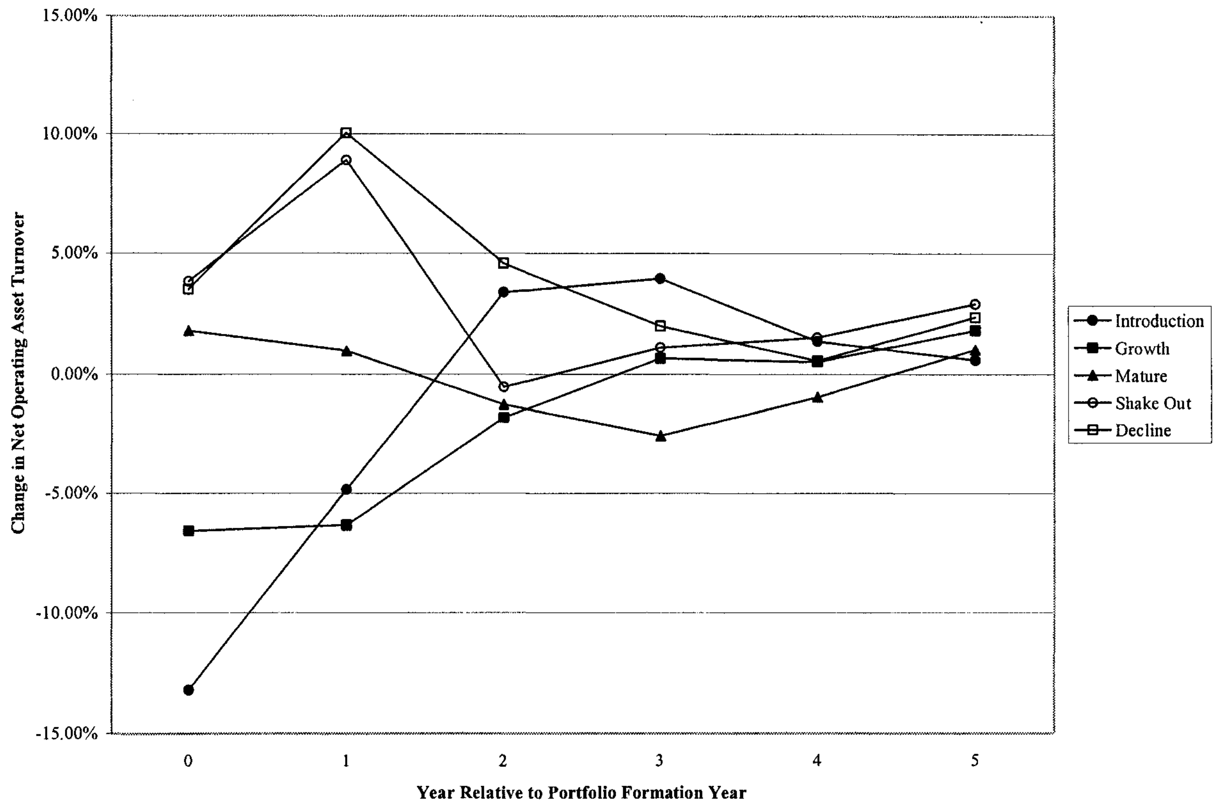

Fig. 4g. Evolution of change in NOAT over time by life cycle stage.

Changes in NOAT are equally volatile. Introduction firms display strong positive increases in NOAT; growth firms are characterized by similar increases, but to a lesser extent. Mature firms show a slight decrease as they attempt to maintain their increased efficiency for sustained periods. Shake out and decline firms experience an initial increase in productivity which is likely the result of liquidation, but these increases are not sustainable.

If life cycle did not differentially affect the convergence patterns of the profitability and growth metrics, all life cycle stages would plot on a single line. However, the evidence strongly supports H2a for both profitability (RNOA) and its components (NOPM and NOAT), such that the patterns of mean-reversion differ by life cycle stage. To summarize, RNOA partially converges to a permanent range of approximately 4 to 11 percent for profitable firms, but this variation is economically significant. Growth in NOA temporarily collapses, but diverges again by the fifth year. Differences in profit margins among life cycle stages are largely permanent, while asset turnover displays divergence over time. Consequently, incorporating information about firm life cycle enhances the explanatory power of the drivers of RNOA for future RNOA.

However, it is possible that firm observations change life cycle stage classifications over the analysis period. Instability among life cycle categories may limit the explanatory power of future profitability with respect to life cycle stage. Table 7 – Panel A examines the stability of life cycle stages by reporting the percentage of observations that remain in the initial category over five subsequent years. The growth and mature stages are relatively stable, while the remaining categories are largely transient over the analysis period.

Panel B uses transition empirical probabilities (Frees, 2006) to study the relation between the "origin" stage and the "destination" stage in the following period. The stability percentages from year 1 in Panel A plot on the diagonal in Panel B. Growth, mature, and shake out firms tend to remain in their origin stage or move to adjacent stages in the following year. However, the path for introduction and decline firms are less predictable which may inhibit the ability to forecast future profitability from these origin states.

TABLE 7

Stability and Evolution of Life Cycle Stages

Panel A - Stability Analysis Over Time

	Number of Years Relative to Base Year				
	1	2	3	4	5
Base Year Life Cycle Stage:					
Introduction	38.70%	30.80%	28.86%	27.31%	23.88%
Growth	52.57%	46.17%	43.29%	41.86%	40.04%
Mature	60.84%	57.60%	56.91%	56.45%	56.24%
Shake Out	23.12%	19.48%	17.19%	17.32%	15.61%
Decline	32.46%	26.94%	22.21%	22.15%	20.38%

Panel B - Subsequent Life Cycle Stage

	Life Cycle Stage in One Year					
	Introduction	Growth	Mature	Shake Out	Decline	Total
Current Life Cycle Stage:						
Introduction	38.70%	20.14%	18.58%	8.58%	14.01%	100.00%
Growth	6.53%	52.57%	32.80%	6.19%	1.90%	100.00%
Mature	4.06%	26.25%	60.84%	7.39%	1.46%	100.00%
Shake Out	8.49%	20.91%	39.91%	23.12%	7.57%	100.00%
Decline	28.50%	12.81%	12.70%	13.52%	32.46%	100.00%

Profitability Decomposition Results

To further test this assertion, a regression of one year-ahead change in RNOA on variables related to the profit margin and asset turnover mix is performed while controlling for current profitability, OLLEV (both the level and change), and change in investment. Table 8 reports the correlation coefficients among the regression variables. All variables with the exception of ΔNOAT are significantly correlated with future profitability at a level of 0.05 or better.

TABLE 8

Correlation Coefficients Across Variables (RNOA) - Life Cycle Model

	ΔRNOA$_{t+1}$	**RNOA**	**ΔRNOA**	**ΔNOPM**	**ΔNOAT**	**OLLEV**	**ΔOLLEV**	**G^{NOA}**
ΔRNOA$_{t+1}$	**1.000**	**-0.368**	**-0.161**	**-0.042**	0.006	**0.036**	**0.045**	**-0.060**
RNOA		**1.000**	**0.202**	**-0.031**	**0.011**	**-0.011**	**-0.019**	0.008
ΔRNOA			**1.000**	**0.379**	**0.257**	**0.067**	**-0.023**	**0.102**
ΔNOPM				**1.000**	**0.112**	**0.020**	-0.010	**0.063**
ΔNOAT					**1.000**	**0.251**	**0.204**	**-0.272**
OLLEV						**1.000**	**0.367**	**-0.068**
ΔOLLEV							**1.000**	**-0.431**
G^{NOA}								**1.000**

For firm years 1989 - 2003. Correlations in bold are significant at the 0.05 level or better.
Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/Average Net Operating Assets (NOA); Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12); Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/Average Net Operating Assets (NOA); Operating Liability Leverage (OLLEV) = Operating Liabilities (OL)/ Net Operating Assets (NOA); Growth in Net Operating Assets (G^{NOA}) = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1.
Firms with sales revenue and net operating assets of less than $1 million are excluded. Lastly, the top and bottom 1 percent of observations are winsorized to prevent extreme values due to small denominators.

Table 9 reports the regression coefficients from two models that are estimated on an annual basis. Model 1 estimates the decomposition of changes in RNOA while controlling for the current level of and growth in RNOA, OLLEV (both level and change), and for the growth in NOA. The regression achieves an adjusted R^2 of 15.91% and all variables are of the predicted sign and statistically significant.[35] Consistent with prior research, the sign of the coefficient on ΔNOPM is negative, which implies that increases in profit margin are unsustainable. Further, the positive coefficient on ΔNOAT suggests that increases in future profitability are driven by increasing efficiency in the cross-section. The OLLEV variables are insignificant in the pooled model. The negative coefficient on growth in NOA demonstrates mean reversion in asset growth and, thus, that the current level of growth is not sustainable.

[35] Penman and Zhang (2004) report an R^2 of 8.5%. The difference in comparison with this paper is due to sample composition. They exclude firms with extreme revenue changes of 50% or more. When these firms are excluded from this paper's sample, the regression R^2 declines to 8.74%, which is consistent with their results.

TABLE 9

Regression Results of Profitability, Growth, and Disaggregation of RNOA on Future Changes in RNOA

Model 1:

$$\Delta RNOA_{t+1} = \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + e_{t+1}$$

Model 2:

$$\Delta RNOA_{t+1} = \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \beta_5 OLLEV_t$$
$$\beta_6 \Delta OLLEV_t + \beta_7 G_t^{NOA} + \sum_{k=1}^{4} D_k LC + \sum_{k=1}^{4} \delta_{1k}(RNOA_t \times LC_k)$$
$$+ \sum_{k=1}^{4} \delta_{2k}(\Delta RNOA_t \times LC_k) + \sum_{k=1}^{4} \delta_{3k}(\Delta NOPM_t \times LC_k) + \sum_{k=1}^{4} \delta_{4k}(\Delta NOAT_t \times LC_k)$$
$$+ \sum_{k=1}^{4} \delta_{5k}(OLLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{6k}(\Delta OLLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{7k}(G_t^{NOA} \times LC_k) + e_{t+1}$$

n = 40,241	α	RNOAt	ΔRNOAt	ΔNOPMt	ΔNOATt	OLLEVt	ΔOLLEVt	GNOAt	Adj. R2
Predicted Sign		—	—	—	+	+	+/—	—	
Model 1									
	0.003	**-0.303**	**-0.090**	**-0.047**	**0.010**	0.016	0.010	**-0.024**	**15.91**
	(0.35)	**(-13.08)*****	**(-4.98)*****	**(-1.98)****	**(2.23)****	(1.59)	(0.93)	**(-2.15)****	
Model 2									
Intro	**-0.108**	**-0.283**	**-0.079**	-0.018	**0.021**	0.035	-0.009	0.019	
	(-3.66)***	**(-6.37)*****	**(-1.92)***	(-0.41)	**(1.65)***	(1.01)	(-0.41)	(0.93)	
Growth	**0.026**	**-0.379**	**-0.135**	-0.061	0.009	**0.024**	-0.007	**-0.035**	
	(3.47)***	**(-8.45)*****	**(-3.98)*****	(-1.32)	(1.02)	**(1.67)***	(-0.32)	**(-2.50)****	
Mature	**0.023**	**-0.320**	**-0.114**	**-0.116**	**0.026**	**0.029**	**0.038**	**-0.070**	**24.15**
	(2.74)***	**(-7.36)*****	**(-2.46)****	**(-3.15)*****	**(2.16)****	**(1.81)***	**(1.80)***	**(-1.88)***	
Shake-Out	0.031	**-0.372**	**-0.153**	-0.071	**0.031**	-0.016	0.008	**-0.055**	
	(1.60)	**(-5.19)*****	**(-1.94)***	(-0.97)	**(1.77)***	(-0.54)	(0.27)	**(-1.74)***	
Decline	**-0.175**	**-0.298**	-0.060	-0.030	0.027	0.123	-0.025	0.003	
	(-3.58)***	**(-5.52)*****	(-0.95)	(-0.51)	(1.17)	(1.63)	(-0.70)	(0.11)	

For firm years 1989 - 2003.
***(**,*) Indicates significance at the .01 (.05, .10) level. Coefficients are means of the annual regression coefficients and t-statistics (reported in parentheses) are based on the White's heteroskedasticity-corrected standard errors of the time series. Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/average Net Operating Assets (NOA); Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12); Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/Average Net Operating Assets (NOA); OLLEV = Operating Liabilities (OL)/ Net Operating Assets (NOA); G^{NOA} = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1.
Firms with NOA < \$1 million and Sales Revenue < \$1 million are excluded to minimize the effect of outliers. Lastly, the top and bottom 1 percent of observations are winsorized to prevent extreme values due to small denominators.

Model 2 of Table 9 incorporates the interaction between life cycle indicator variables and the explanatory variables. It also allows for slope changes across life cycle stage, which in turn, captures the sensitivity of each determinant of future RNOA by life cycle stage.[36] Coefficients for each variable are determined by summing the appropriate β_j's and δ_{jk}'s to get the life-cycle specific coefficient.[37] The explanatory power of Model 2 substantially increases to 24.15% compared with an adjusted R^2 of 15.91% for Model 1, which represents a 52% increase in explanatory power.

The current level RNOA ($\beta_1 + \beta_2$) consistently displays significant negative correlation with future changes in RNOA across all life cycle stages. In addition, the change in NOPM variable is negative, but insignificant for all life cycle stages except for mature firms (which are significantly negative at t = -3.15). The negative coefficients suggest that incremental increases in profit margin cannot be sustained since firms are already operating at or near the maximum level of profit margin. This would explain the extreme negative effect of increases in NOPM for mature firms, since profit margins are maximized in the growth stage. These increases are likely caused by temporary increases in revenue which competition will eventually erode or temporary decreases in operating expenses which are unsustainable to maintain the current level of revenue.

Changes in NOAT remain positive and significant for all firms with the exception of growth and decline firms (which are positive, but insignificant). The significance is most pronounced for mature firms (t = 2.16), which supports H3b. OLLEV is a positive driver of

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[36] Another option is to partition the sample into life cycle stage sub-samples; albeit this test is less powerful due to smaller sample sizes. Still, when this specification is used, the inferences are unchanged when estimating Model 2.

[37] The t-statistics presented in Table 8 relate to whether the coefficients are different from zero. However, tests in untabulated results were performed to directly compare coefficients across the five life cycle stages. Many of the tests were insignificant between all coefficients other than those for mature firms. This suggests that the model specification used in this analysis (and in prior research) is not descriptive for capturing differences in future profitability among the remaining life cycle stages. Future research is needed to develop life cycle stage-specific models to better exploit the economic differences among those stages.

future profitability for growth and mature firms. These firms may be nearing the maximum potential gains from increases in NOPM and NOAT, and therefore must tap into supply-chain intangibles to further increase their profits. The positive and significant coefficient on ΔOLLEV for mature firms is interesting in that it suggests that gains related to bargaining power over suppliers do not mean-revert (i.e., are limitless) for the most powerful firms.

The negative coefficients on growth in NOA demonstrate that higher earnings are necessary to keep the return on the increased asset-base constant. The absence of a negative relation between growth in NOA and future RNOA for introduction and decline firms is intuitive, specifically that growth in NOA is not detrimental to these firms since expansion remains a profitable strategy.

Future change in RNOA is improved through increased NOAT for introduction firms. The NOAT effect is a manifestation of the rapid growth in earnings with a lagging growth in operating assets. Future profitability for growth firms is reliant on expanding the bargaining power over suppliers (positive and significant coefficient on OLLEV). Mature firms are similar to growth firms except that increases in productivity (ΔNOAT) become a more important source of profitability improvement. The future profitability of shakeout firms is similar to introduction firms, with the exception of diminishing returns on growth in NOA. Lastly, decline firms' future profitability is not evident in strategy-based variables such as ΔNOPM, ΔNOAT or OLLEV, but is likely dependent on the availability of financing and market conditions.

To summarize, the increase in explanatory power from introducing firm life cycle variables along with the differential weights placed on explanatory variables by each life cycle stage suggests that an analysis of future profitability benefits from the inclusion of firm life cycle information. A final step in the process is to evaluate the predictive ability of the life cycle information in forecasting future change in RNOA. However, the lack of significant differences among the coefficients between life cycle stages other than mature may impede the effectiveness of the benchmark and life cycle models (Model 1 and 2, respectively) used in the preceding analysis. An estimation model was computed based on the years 1989 to 2002 and those coefficients were applied to a holdout sample from 2003 to forecast changes in RNOA for 2004. The difference in absolute forecasting errors between the benchmark and life cycle models (standardized by mean $\Delta RNOA_{t+1}$) is presented in Table 10. T-statistics are based on a comparison of the raw absolute forecast difference to zero.

TABLE 10

Predictive Ability of Benchmark versus Life Cycle Model

	Standardized Error	**t-stat**
Pooled Sample	0.09	**2.16** **
Introduction	-0.05	-1.12
Growth	0.20	0.92
Mature	2.18	**4.51** ***
Shake Out	-0.15	-1.29
Decline	0.01	0.25

The life cycle model (Model 2) results in a significant improvement over the benchmark model (t = 2.16). However, this a further analysis by life cycle stage demonstrates that this improvement is limited to firms in the mature life cycle stage (t = 4.51). This underscores the importance of developing life cycle stage-specific forecasting models that better capture the underlying economic differences among life cycle stages. At the same time, information about firm life cycle stage enhances existing models used in forecasting future profitability for valuation and analysis purposes among mature firms. Life cycle stage identification through cash flow patterns is an important screening mechanism to improve forecasts of future profitability.

Sensitivity Analyses

Explanatory Power for Future Changes in Return on Common Equity

Nissim and Penman (2001) specify that RNOA is more relevant for forecasting future profitability than traditional return on common equity (ROCE). This is because increases in profitability must be derived from operations to be sustainable (i.e., financing ability is limited for most firms). Additionally, financial assets and liabilities are reflected at amounts closer to fair value on the balance sheet than are operating assets due to conservative accounting. For example, accounting depreciation and amortization may not reflect economic depreciation of operating assets. Furthermore, unrecognized intangible assets related to research and development are not carried on the balance sheet and thus, are not recognized in net operating assets. Assuming the capital markets is better able to assess the fair value of net operating assets, an unbiased value for net operating assets should be reflected in a firm's common equity.

If these effects of conservative accounting are correlated with life cycle stage, then it is difficult to assess whether the increased explanatory power of the life cycle model is due to life cycle effects or accounting conservatism. For that reason, the regressions in the previous section are repeated for explaining future ROCE rather than RNOA. Because ROCE is driven by RNOA and the effects of financial leverage, the benchmark equation is modified as:

$$\begin{aligned}\Delta ROCE_{t+1} &= \alpha + \beta_1 ROCE_t + \beta_2 \Delta ROCE_t + \beta_3 \Delta RNOA_t + \beta_4 \Delta NOPM + \beta_5 \Delta NOAT \\ &\quad + \beta_6 \Delta FLEV_t + \beta_7 \Delta FLEV_t + \beta_8 G_t^{NOA} + e_{t+1}\end{aligned} \quad (3)$$

This model reflects that ROCE can be bolstered by increases in financial leverage, while the components that drive RNOA remain in the model. Since ROCE is mean-reverting, the current level and change in ROCE are included as control variables [similar to RNOA in model (1)].

Model 4 expands the Model 3 to include the interaction terms for life cycle stages:

$$\begin{aligned}\Delta ROCE_{t+1} &= \alpha + \beta_1 ROCE_t + \beta_2 \Delta ROCE_t + \beta_3 \Delta RNOA_t + \beta_4 \Delta NOPM_t + \beta_5 \Delta NOAT_t \\ &\quad + \beta_6 FLEV_t + \beta_7 \Delta FLEV_t + \beta_8 G_t^{NOA} + \sum_{k=1}^{4} D_k LC + \sum_{k=1}^{4} \delta_{1k} (ROCE_t \times LC_k) \\ &\quad + \sum_{k=1}^{4} \delta_{2k} (\Delta ROCE_t \times LC_k) + \sum_{k=1}^{4} \delta_{3k} (\Delta RNOA_t \times LC_k) + \sum_{k=1}^{4} \delta_{4k} (\Delta NOPM_t \times LC_k) \\ &\quad + \sum_{k=1}^{4} \delta_{5k} (\Delta NOAT_t \times LC_k) + \sum_{k=1}^{4} \delta_{6k} (FLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{7k} (\Delta FLEV_t \times LC_k) \\ &\quad + \sum_{k=1}^{4} \delta_{8k} (G_t^{NOA} \times LC_k) + e_{t+1}\end{aligned} \quad (4)$$

Table 11 presents the correlation matrix for the regression variables. All variables are significantly correlated with future change in ROCE at the 0.05 significance level or better.

TABLE 11

Correlation Coefficients Across Variables (ROCE) - Life Cycle Model

	ΔROCE$_{t+1}$	ROCE	ΔROCE	ΔRNOA	ΔNOPM	ΔNOAT	FLEV	ΔFLEV	G^{NOA}
ΔROCE$_{t+1}$	**1.000**	**-0.512**	**-0.402**	**-0.074**	**-0.068**	**0.027**	**0.084**	**0.082**	**-0.050**
ROCE		**1.000**	**0.460**	**0.089**	**0.045**	**-0.010**	**-0.048**	**-0.116**	**0.013**
ΔROCE			**1.000**	**0.199**	**0.238**	**0.054**	**-0.017**	**-0.118**	0.002
ΔRNOA				**1.000**	**0.379**	**0.257**	**-0.027**	-0.006	**0.102**
ΔNOPM					**1.000**	**0.112**	**-0.034**	**-0.020**	**0.063**
ΔNOAT						**1.000**	**-0.054**	**-0.035**	**-0.272**
FLEV							**1.000**	**0.295**	-0.009
ΔFLEV								**1.000**	**0.118**
G^{NOA}									**1.000**

For firm years 1989 - 2003. Correlations in bold are significant at the 0.05 level or better.
Return on equity (ROCE) = Comprehensive Income (CNI_t) /Average Common Equity (CSE); Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/Average Net Operating Assets (NOA); Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12); Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/Average Net Operating Assets (NOA); Financial Leverage (FLEV) = Net Financial Obligation (NFO)/Common Equity (CSE); Growth in Net Operating Assets (G^{NOA}) = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1.
Firms with sales revenue of less than $1 million are excluded. Lastly, the top and bottom 1 percent of observations are winsorized to prevent extreme values due to small denominators.

Table 12 reports the regression coefficients from Models 3 and 4 that are estimated on an annual basis. The increase in R^2 between Model 3 and Model 4 represents an increase in explanatory power of approximately 20 percent (from 31.80 to 38.03 percent). While a significant improvement, this increase is substantially lower than the 52 percent improvement demonstrated in Table 9. This suggests that life cycle effects are correlated with conservative accounting, which is intuitive since asset growth (tangible and intangible) and research and development expenditures are bound to be a function of firm life cycle. However, there is still an incremental improvement in explanatory power of 20 percent over and above forecast attributes related to accounting conservatism.

TABLE 12

Regression Results of Profitability, Growth, and Disaggregation of ROCE on Future Changes in ROCE

Model 1:

$$\Delta ROCE_{t+1} = \alpha + \beta_1 ROCE_t + \beta_2 \Delta ROCE_t + \beta_3 \Delta RNOA_t + \beta_4 \Delta NOPM + \beta_5 \Delta NOAT + \beta_6 \Delta FLEV_t + \beta_7 \Delta FLEV_t + \beta_8 G_t^{NOA} + e_{t+1}$$

Model 2:

$$\begin{aligned}\Delta ROCE_{t+1} = {} & \alpha + \beta_1 ROCE_t + \beta_2 \Delta ROCE_t + \beta_3 \Delta RNOA_t + \beta_4 \Delta NOPM_t + \beta_5 \Delta NOAT_t \\ & + \beta_6 FLEV_t + \beta_7 \Delta FLEV_t + \beta_8 G_t^{NOA} + \sum_{k=1}^{4} D_k LC + \sum_{k=1}^{4} \delta_{1k}(ROCE_t \times LC_k) \\ & + \sum_{k=1}^{4} \delta_{2k}(\Delta ROCE_t \times LC_k) + \sum_{k=1}^{4} \delta_{3k}(\Delta RNOA_t \times LC_k) + \sum_{k=1}^{4} \delta_{4k}(\Delta NOPM_t \times LC_k) \\ & + \sum_{k=1}^{4} \delta_{5k}(\Delta NOAT_t \times LC_k) + \sum_{k=1}^{4} \delta_{6k}(FLEV_t \times LC_k) + \sum_{k=1}^{4} \delta_{7k}(\Delta FLEV_t \times LC_k) \\ & + \sum_{k=1}^{4} \delta_{8k}(G_t^{NOA} \times LC_k) + e_{t+1}\end{aligned}$$

n = 40,241	α	$ROCE_t$	$\Delta ROCE_t$	$\Delta RNOA_t$	$\Delta NOPM_t$	$\Delta NOAT_t$	$FLEV_t$	$\Delta FLEV_t$	G^{NOA}_t	Adj. R2
Model 3										
	0.003	**-0.544**	**-0.181**	0.000	0.017	**0.007**	**0.018**	-0.003	-0.013	**31.80**
	(0.47)	**(-26.21)*****	**(-14.5)*****	(0.05)	(1.36)	**(3.29)*****	**(5.27)*****	(-0.89)	(-1.52)	
Model 4										
Intro	-0.145	-0.564	-0.176	-0.036	0.047	0.009	**0.035**	**-0.018**	0.016	
	(-10.55)***	(-16.85)***	(-6.33)***	(-1.65)*	(1.58)	(1.21)	**(2.93)*****	**(-2.05)****	(0.85)	
Growth	**0.031**	**-0.694**	**-0.131**	-0.003	**0.091**	0.003	0.004	-0.011	-0.009	
	(4.64)***	**(-20.40)*****	**(-9.92)*****	(-0.19)	**(2.42)****	(0.84)	(1.32)	(-1.58)	(-1.22)	
Mature	**0.054**	**-0.619**	**-0.169**	-0.010	0.049	**0.012**	**0.019**	0.005	**0.014**	**38.03**
	(6.99)***	**(-20.75)*****	**(-6.85)*****	(-0.78)	(0.85)	**(3.34)*****	**(3.29)*****	(0.50)	**(1.65)***	
Shake-Out	0.002	**-0.626**	**-0.131**	0.015	0.001	**0.015**	**0.028**	**0.025**	-0.003	
	(0.15)	**(-12.78)*****	**(-3.75)*****	(0.38)	(0.02)	**(1.79)***	**(3.24)*****	**(1.72)***	(-0.16)	
Decline	**-0.166**	**-0.493**	**-0.174**	0.033	0.020	-0.004	0.008	-0.003	-0.005	
	(-5.93)***	**(-6.03)*****	**(-4.27)*****	(1.10)	(0.58)	(-0.43)	(0.36)	(-0.28)	(-0.27)	

For firm years 1989 - 2003.
***(**,*) Indicates significance at the .01 (.05, .10) level. Coefficients are means of the annual regression coefficients and t-statistics (reported in parentheses) are based on the White's heteroskedasticity-corrected standard errors of the time series.
Return on equity (ROCE) = Comprehensive Income (CNI_t) /Average Common Equity (CSE); Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/Average Net Operating Assets (NOA); Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12); Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/Average Net Operating Assets (NOA); Financial Leverage (FLEV) = Net Financial Obligation (NFO)/Common Equity (CSE); Growth in Net Operating Assets (G^{NOA}) = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1.
Firms with sales revenue of less than $1 million are excluded. Lastly, the top and bottom 1 percent of observations are winsorized to prevent extreme values due to small denominators.

Additionally, removing the conservative accounting bias from the denominator of the performance metric results in ΔNOPM and ΔNOAT effects consistent with life cycle theory. Specifically, increases in NOPM have a positive and significant future profitability effect on growth firms (t = 2.42), while increases in NOAT have a positive and significant effect on mature firms (t = 3.34). The effects of financial leverage are also enlightening: introduction firms benefit from their current level of financing (t = 2.93), but changes in FLEV have a negative effect on future profitability (t = -2.05). This likely reflects the risk associated with an increasing debt burden for firms that are not yet profitable. Both mature and shake out firms also benefit from the use of financial leverage, presumably in order to pursue additional positive net present value projects.

Industry and Age Effects

RNOA convergence tests are repeated for industry and age portfolios to ensure that the life cycle proxy is not simply capturing differences in industry or firm age. Figure 5a reports the convergence patterns for portfolios formed on one-digit SIC code.[38] While the financial services and mining industries create a nearly parallel upper and lower bound, the majority of the remaining industries cluster around a constant return of approximately 10 percent. The financial services and mining industries appear to be more sensitive to macroeconomic factors than the other industries, which may explain their extreme temporal behavior. In general, RNOA by industry displays a stable RNOA and the firm life cycle effect depicted in Figure 4a is capturing a distinct effect.

[38] The convergence graph for two-digit SIC codes was substantially similar. However, only the one-digit results are included in the paper for ease of presentation.

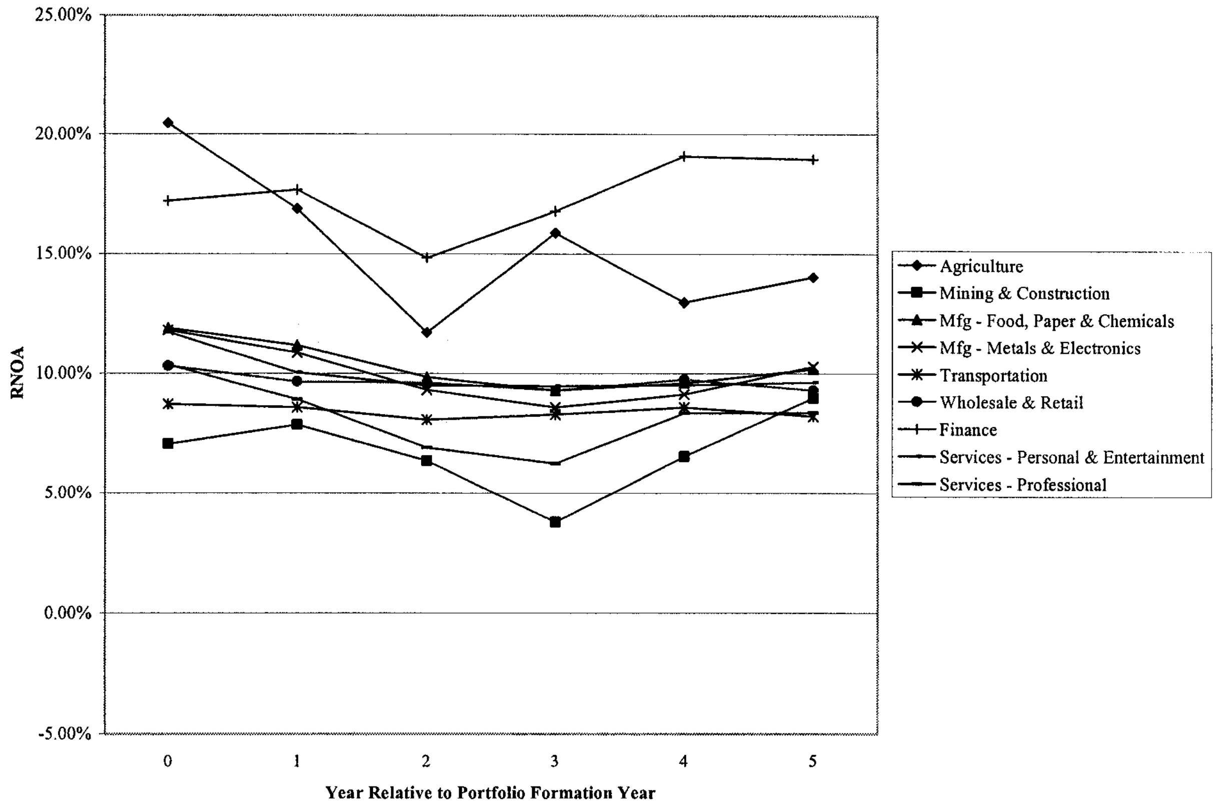

Fig. 5a. Evolution of RNOA over time by industry.

To test whether the firm life cycle effect proxies for firm age, annual age quintiles are formed. The RNOA convergence test is repeated in Figure 5b for the age quintiles. There is minimal temporal variation in RNOA based on firm age, which calls into question its use as a proxy for firm life cycle. Using cash flow patterns to proxy for life cycle stage detects an effect that is not captured by using firm age.

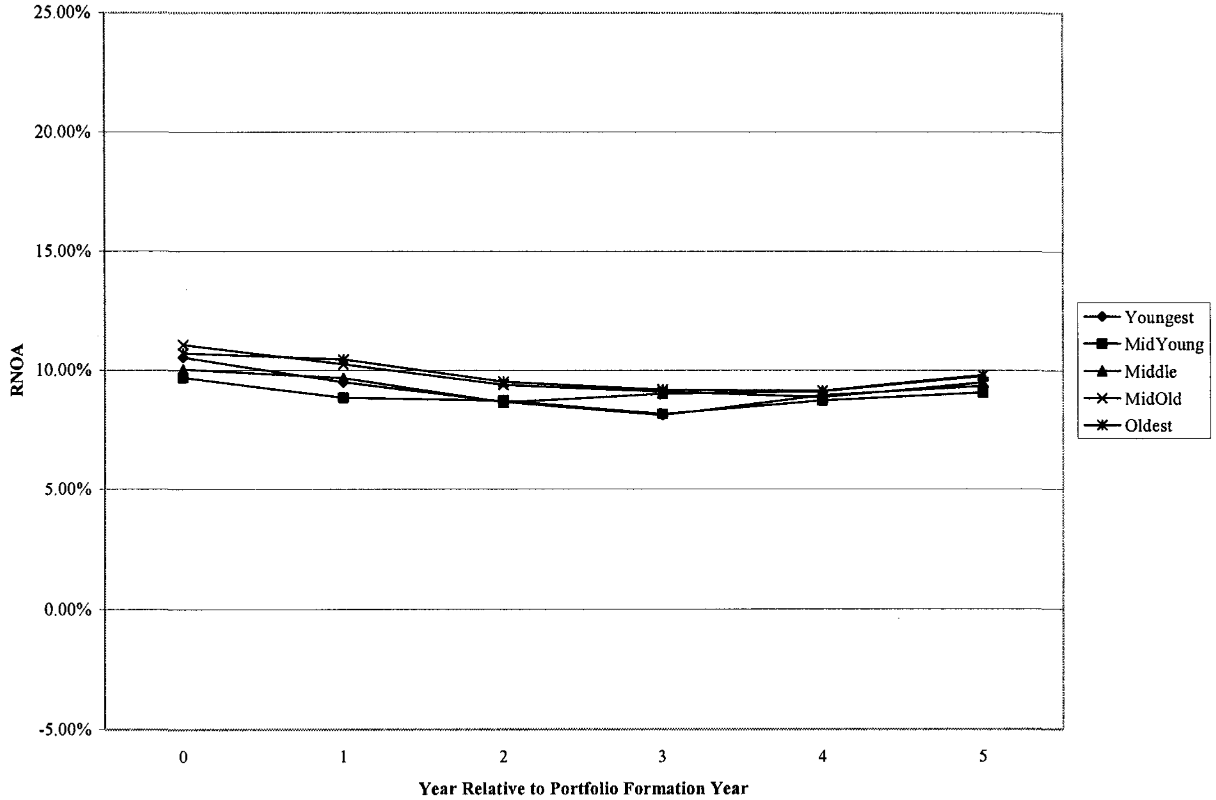

Fig. 5b. Evolution of RNOA over time by firm age.

CHAPTER 4

BARRIERS-TO-ENTRY

Entry/Mobility Barrier Identification and Hypotheses Development

This chapter investigates the interaction of barriers-to-entry (BTEs) and operating profitability. While the economics literature has identified and provided analytical theory regarding numerous entry barriers, empirical evidence with respect to the effectiveness of these barriers is sparse. In response, this study evaluates the effectiveness of BTEs bi-directionally. Specifically, firm-observations are sorted by current profitability to determine which barrier variables display a positive association with profitability. Next, firm-observations are sorted univariately by the levels of BTEs and long-run, ex-post profitability is examined to determine which barrier investments result in positive returns on net operating assets (RNOA), and its components, net operating profit margin (NOPM) and net operating asset turnover (NOAT). Finally, future profitability is modeled as a function of the current levels of entry barriers.

This research is aimed at determining which investments in BTEs are most effective for firms in general and by industry. For example, an examination of the long-run profitability and explanatory power of a particular barrier variable sheds light on whether further investments in maintaining that barrier is warranted. Further, this paper provides a set of benchmark values of the BTE variables in the cross-section and by industry for purposes of evaluating a particular firm's performance.

The industrial organization variables draw heavily from Porter's (1980) model of competitive strategy. He suggests that competition is driven by BTEs, availability of substitute products, bargaining power of suppliers and customers, and the degree of rivalry among existing competitors. Under normal conditions of competition, free entry and exit ensures that firms producing homogeneous products all charge a similar price and only efficient firms survive. However, Mueller (1986) points out that if all firms within an industry earn above normal profits, there must exist a BTE. Oster (1990) describes barriers to entry as "industry characteristics that reduce the rate of entry below that needed to level profits." Consequently, higher barriers to entry will lead to higher levels of profitability, at least for some firms in the industry.

Although most economic analysis considers BTE an industry variable, Oster (1990) points out that some firms within an industry can free-ride on barrier-erecting actions of other firms within the industry. Moreover, if only some firms within the industry earn above normal profits, they must have access to a resource, technology, or special managerial talent that protects other firms from eroding those profits (Mueller, 1986). For that reason, it is important to consider BTE at the firm level as well as at the industry level. The BTE variables identified and considered in this analysis include: 1) Economies of scale, 2) Product differentiation, 3) Capital requirements, 4) Proprietary technology, 5) Experience/learning curve, 6) Industry regulation, 7) Expected retaliation, 8) Bargaining power over customer, and 9) Bargaining power over suppliers. Each variable is discussed in detail below. The directional effect of the hypotheses for each barrier variable is summarized in Table 13.

TABLE 13

Summary of Predictions by Barrier Variable

Independent Variables	Dependent Variables ΔRNOA	ΔNOPM	ΔNOAT
Barriers to Entry:			
Economies of Scale (Change in GPM)	+	+	+
Product Differentiation (Advertising Intensity)	+	+	N/A
Capital Requirements (Capital Intensity)	+/–	N/A	+/–
Proprietary Technology (Intangible Intensity)	+	+	N/A
Experience/Learning Curve (Firm Age)	+	N/A	+
Regulation	+	+	+
Expected Retaliation: *Market share*	+	+	N/A
Leverage	–	–	N/A
Operating Liability Leverage	+	+	+
Industry Growth	+/–	+/–	N/A
Power over Customers (Receivables Turnover)	+	N/A	+
Power over Suppliers (InventoryTurnover)	+	N/A	+
Size	–	N/A	–

RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Receivables turnover = Net sales / Average receivables; Inventory turnover = Cost of goods sold / Average inventory; Size = log of total assets.

Economies of Scale

This variable represents efficiencies in production that cannot be achievable by new entrants (unless knowledge spillovers are prevalent). Economies of scale are present if a decline in cost of goods sold is accompanied by an increase in sales revenue. A positive change in gross profit margin (GPM) would capture either an increase in sales holding costs constant, or a decrease in costs holding sales constant, either of which would be symptomatic of increased economies of scale. Oster (1990) points out that economies of scale can arise from efficient use of capital assets or from specialization of labor. As such, this variable will capture economies of scale that cannot be ascertained from level of capital intensity alone. Change in GPM is predicted to be positively associated with $\Delta RNOA_{t+1}$, along with $\Delta NOPM_{t+1}$ and $\Delta NOAT_{t+1}$.

Product Differentiation

Product differentiation is the ability of a firm to establish brand identification that represents a barrier to new entrants. Mueller (1986) states that if a firm with a differentiated profit can continually earn above-normal profits, other firms must be prevented from developing a close substitute to eliminate the profit advantage of the differentiating firm. Caves and Porter (1977) posit that product differentiation reduces the cross-elasticity of demand, which reduces the likelihood that customers will switch to competitors' products. The brand identification and customer loyalties are the result of past advertising, customer service, product differences, or first-mover advantages.

Profitability ($\Delta RNOA_{t+1}$) should be positively related to product differentiation, specifically through increased profit margin ($\Delta NOPM_{t+1}$) although Waring (1996) reported that advertising intensity is insignificant for explaining industry-adjusted persistence of profitability.[39] The advertising intensity ratio used to capture differentiation is as follows:

Advertising Intensity = Advertising Expense/Sales Revenue

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[39] Oster (1990) states that brand identification is a more successful BTE when the industry is characterized by experience goods versus search goods. Experience goods can only be evaluated after the customer purchases them, while search goods can be judged through simple inspection before purchase. This suggests that the level of product differentiation will differ by industry.

Capital Requirements

When a high level of capital is required in order to compete in the industry, there exists a BTE. This is proxied for by the capital intensity ratio (Lev, 1983)[40]:

Capital Intensity = Depreciation Expense /Sales Revenue

Firms with higher levels of capital intensity should have higher profitability if the preemptive investment effectively deters entry.[41] However, if the industry is mature and most firms have entered, overinvestment could result in lower profits if there is excess capacity (Porter, 1980; Lieberman, 1987).

Joos (2000) also examines capital intensity as a proxy for barriers to entry but uses the ratio of total PPE to total assets that he states represents the firm's commitment to capital investment. The proxy chosen in this study represents an "average" commitment to capital and accounts for the obsolescence of the capital investment. For example, if the bulk of the PPE was purchased early in the firm's life cycle, it may be outdated, and new entrants could enter the market with newer and more efficient technology. Thus, the capital intensity ratio used in this paper represents capital maintenance as opposed to strictly capital investment.

Barring that the industry is mature, capital intensity is expected to be positively associated with profitability ($\Delta RNOA_{t+1}$) and more specifically, with asset turnover ($\Delta NOAT_{t+1}$). When the industry is mature, the opposite is predicted, consistent with Selling and Stickney's findings.

[40] Traditionally, the capital intensity ratio uses the sum of depreciation expense and net interest expense in the numerator. However, many firms in the financial sector have net interest income, which inflated the capital intensity ratio. For that reason, only depreciation expense is used in the numerator.

[41] Lev (1983) reported that firms with higher capital intensity had a more variable earnings series and Selling and Stickney (1989) showed that firms with high capital intensity have low ATO and high PM and vice versa.

Proprietary Technology

When the industry is characterized by a high level of proprietary knowledge, there exists a BTE. Waring (1996) reported that R&D intensity is positively associated with industry-adjusted persistence of profitability. Proprietary technology is proxied for by the intangible intensity ratio:

$$Intangible\ Intensity = (R\&D + Patent\ Amortization\ Expense)/Sales\ Revenue$$

Consistent with Waring, profitability ($\Delta RNOA_{t+1}$) is expected to be positively associated with intangible intensity, and the main effect is predicted to be evident in the profit margins ($\Delta NOPM_{t+1}$). Additionally, if the research and development includes process improvements, the effect is also expected to be found in the asset turnover ratios ($\Delta NOAT_{t+1}$).

Experience/Learning Curve

Theory suggests that firms with more experience produce more efficiently and thus construct a BTE. However, experience can be portable through the mobility of labor or knowledge spillover for some firms and/or industries. This variable is measured using firm age. Oster (1990) suggests that barriers to entry are more important once the industry's evolution ends meaning that BTE should be more important for mature firms that should magnify the positive association. Therefore, firm age is expected to be positively associated with profitability ($\Delta RNOA_{t+1}$), primarily through the asset turnover, $\Delta NOAT_{t+1}$.

Industry Regulation

Since this variable is the same for all firms within an industry, it is omitted from the industry-specific regressions. Firms operating in regulated industries will perhaps benefit from a regulation-imposed BTE. This regulatory barrier can take the form of licensing or oversight requirements and/or limited access to raw materials. Following Warfield, Wild and Wild (1995) these industries are SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX and observations within those SIC codes are designated with an indicator variable. Regulatory barriers that are permission-oriented are predicted to be evident through increased profit margins, while resource access-oriented barriers will be evident in asset turnovers.

Expected Retaliation

If rival firms are expected to retaliate against a new entrant, this propensity for retaliation creates a BTE. The threat of retaliation results in higher profits only if incumbents can credibly execute the retaliation. Firms can signal their credibility through significant market share, borrowing capacity, leverage with suppliers, and low industry growth.

Market Share

Firms with higher market share will have a higher propensity to retaliate. The reasoning is that they have previously invested capital and/or resources to attain their market share and will fight harder to protect their investment. For example, Joos (2000) hypothesizes and finds that future ROE is higher for firms with more market share. Consequently, profitability ($\Delta RNOA_{t+1}$) and specifically, profit margins ($\Delta NOPM_{t+1}$) are hypothesized to be positively associated with market share. Market share is the proportion of firm sales to total industry sales for the year (where industries are defined using the Fama-French industry classifications).

Leverage

Firms with lower outstanding debt have the financial flexibility through untapped credit resources. Conversely, firms with high outstanding debt are less credible when making a protracted price-cutting threat. This is measured as total debt/total assets. Therefore, profitability ($\Delta RNOA_{t+1}$) and profit margins ($\Delta NOPM_{t+1}$) are expected to be negatively associated with leverage, that implies a positive association with borrowing capacity.

Leverage with Suppliers

Firms with more power over their suppliers are able to arrange favorable credit terms or concessions in order to stage a retaliation against new entrants. This is measured as operating liability leverage (OLLEV) (Nissim and Penman, 2001). Higher OLLEV will indicate a higher propensity to retaliate.

Operating Liability Leverage (OLLEV) = Operating Liabilities (OL)/ Net Operating Assets (NOA)

Because OLLEV enables firms to contain product-related costs, they are able to divert resources toward production-efficiency measures. Therefore, OLLEV is hypothesized to be positively associated with profitability and both its components, profit margin and asset turnover. An additional variable is the inventory turnover ratio which will affect profitability through $\Delta NOAT_{t+1}$:

Inventory Turnover (InvT/O) = Cost of Goods Sold/ Average Inventory

Industry Growth

Since this variable is the same for all firms within an industry, it is omitted from the industry-adjusted analyses. Slower industry growth induces incumbents to fight harder to protect their ground. Porter (1980) suggests that slow industry growth curtails the ability of the industry to absorb new entrants without eroding the profitability of the incumbents. Thus, firms in slow-growth industries will have a higher propensity to retaliate. As such, industry growth (as measured by change in industry sales) is predicted to have a negative relation with firm profitability, and specifically profit margins. Conversely, high industry growth allows the industry to absorb new entrants without curtailing the profit margins of individual firms. Thus, the effect of industry growth on profitability is indeterminable ex ante.

Bargaining Power over Customers

Porter (1980) defines the bargaining power ***of*** customers as the ability of buyers to erode profitability through a variety of actions including bargaining for higher quality, lower prices, and/or both. However, a firm should have bargaining power ***over*** its customers when repeated or frequent transactions exist. For that reason, bargaining power over customers is proxied for by the receivables turnover ratio:

Receivables Turnover (RecT/O) = Net Sales/ Average Receivables

The receivables turnover should affect profitability via $\Delta NOAT_{t+1}$ because it is also a turnover ratio.

Size

Size is included as a control variable in the analyses to capture any scale effects that are not correlated with firm age and market share. Monsen and Downs (1965) suggest that the bureaucratic structure of large firms results in suboptimal performance. If so, a negative relation between size and profitability will be present in the data.

Sample and Research Design

Sample Details

The sample includes NYSE, AMEX and NASDAQ firms, excluding ADRs, with necessary data on Compustat and covers the period 1970 to 2003.[42] Firms with sales revenue or NOA less than $1 million are excluded to prevent skewness due to negative or small denominator effects. This constraint primarily omits firms in the financial industries. Firms with SIC codes greater than 9100 are omitted to ensure only for-profit firms are in the sample. Incorporating these constraints results in a sample with 70,017 firm-year observations.[43] All results are the means of the annual medians or annual regression coefficients to mitigate potential time-specific biases or serial correlation.

Primary variable definitions are as follows (and further defined in the appendix) and descriptive statistics are presented in Table 14:

RNOA = Operating income (OI_t)/ Average NOA
NOPM = Operating income (OI) / Net sales
NOAT = Net sales / Average NOA
$Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1.
GPM = Gross profit / Net sales
Advertising intensity = Advertising expense / Net sales
Capital intensity = Depreciation expense / Net sales
Intangible intensity = (R&D + patent amortization expense) / Net sales
Firm age = number of years since first appearance on CRSP

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[42] The sample period begins in 1970 since variables needed for the intangible intensity calculation were not available until then.

[43] The advertising intensity and intangible intensity variables contained missing data for many observations. Only 23,667 firm-year observations contained advertising intensity data and 24,844 observations contained intantible intensity data. More importantly, few firms had data in both variables (n = 10,360 with overlapping data in both fields) due to the fact that product differenting firms are not necessarily R&D intensive firms. Thus, these variables were assumed to be zero if the actual data was missing. This would bias against finding significance for these variables and indeed the major inferences throughout the paper were unchanged when the analysis was repeated on the reduced sample of 10,360 firms.

Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise.
Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications)
Leverage = Debt / Total assets
Operating liability leverage = Operating liabilities (OL)/ NOA
Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications)
Receivables T/O = Net sales / Average receivables
Inventory T/O = Cost of goods sold / Average inventory
Size = log of total assets

TABLE 14

Barrier-to-Entry (BTE) Descriptive Statistics

n = 73,017	Mean	Median	Min	25%	75%	Max
RNOA	0.10	0.10	-1.33	0.05	0.17	1.40
NOPM	0.04	0.05	-1.09	0.02	0.09	0.52
NOAT	2.54	2.01	0.21	1.27	3.00	13.97
ΔRNOA	0.00	0.00	-1.25	-0.05	0.04	1.66
ΔNOPM	0.00	0.00	-0.64	-0.02	0.02	0.76
ΔNOAT	-0.04	0.00	-4.90	-0.22	0.18	4.52
$\Delta RNOA_{t+1}$	-0.01	0.00	-1.10	-0.05	0.04	1.08
$\Delta NOPM_{t+1}$	0.00	0.00	-0.64	-0.02	0.02	0.66
$\Delta NOAT_{t+1}$	-0.03	0.01	-3.90	-0.20	0.19	2.91
Growth in NOA	0.20	0.08	-0.69	-0.03	0.25	3.64
Δ Gross profit margin	0.00	0.00	-0.23	-0.02	0.02	0.27
Advertising intensity	0.03	0.02	0.00	0.01	0.04	0.22
Capital intensity	0.05	0.03	0.00	0.02	0.06	0.39
Intangible intensity	0.09	0.02	0.00	0.01	0.07	1.11
Firm age	15.87	10.75	0.33	5.08	21.33	69.08
Market share	0.02	0.00	0.00	0.00	0.01	0.26
Leverage	0.25	0.24	0.00	0.10	0.37	0.82
OLLEV	0.61	0.37	0.06	0.25	0.58	7.22
Receivables turnover	10.40	6.52	0.09	4.83	9.06	120.86
Inventory turnover	8.24	4.22	0.00	2.37	7.92	88.75
Industry revenue growth	0.09	0.09	-0.23	0.03	0.14	0.43
Size (ln assets)	5.42	5.23	1.95	4.03	6.66	10.28

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Size = log of total assets.

Research Design

Medians Test

To determine if the level of BTE varies by degree of profitability, median barrier values are examined across profitability regions.[44] Specifically, firms are alternatively sorted into quintiles based on RNOA, and its components: NOPM and NOAT. This provides evidence on the structural relation between profitability and the level of each barrier. The analysis is first performed in the cross-section to determine the association between profitability and entry barriers. Then the analysis is repeated on an industry-adjusted sample (based on the Fama-French industry classifications) to examine the relation between profitability and mobility barriers.

Convergence Tests

Previous research documents that profitability measures mean-revert in the cross-section of firms (Freeman, Ohlson and Penman, 1982; Fairfield, Sweeney and Yohn, 1996; Fama and French, 2000; Nissim and Penman, 2001). Patterns of decay provide information about the time-series behavior of the various profitability and growth ratios. More importantly, understanding the evolution of profitability and growth improves predictability. Past research has examined the persistence of profitability, but this paper also examines whether the levels of the variable barriers lead to persistent profitability or whether that profitability mean-reverts to an economy- or industry-wide mean over time. In general, if a BTE is effective, convergence should by delayed. Further, it is possible that the association between profitability and a barrier expenditure is not contemporaneous – that there is a lag between the actual expenditure and the erection of the barrier.

[44] Median ratios are reported throughout the paper to mitigate extreme values due to small denominators.

Following the framework in Nissim and Penman (2001), convergence to a permanent level of each metric is studied by computing ranked portfolio medians for each independent variable in a classification year and repeating the analysis for the following five years. To avoid dependence among observations, multiple non-overlapping five-year time series are formed. Each base year observation is compared with observations for Years 1-5. The convergence patterns for each driver are depicted graphically by plotting the mean of the various time series for each economic variable. This is done for the pooled sample to test for convergence to an economy-wide mean; and for the industry-adjusted variables to test for convergence to an industry mean. The effects of the barrier variables on RNOA, and on its components, NOPM and NOAT, are examined, but only the results based on RNOA are presented for brevity. In some cases, the results based on NOPM and NOAT are included in the interpretation of the profitability effect of the barrier variables.

Regression Analysis

The regression analysis examines the explanatory power of the barrier variables on alternative measures of profitability. Specifically, the dependent variables are change in $RNOA_{t+1}$, change in $NOPM_{t+1}$, change in $NOAT_{t+1}$. To examine whether barrier variables are informative in explaining future changes in RNOA, a base model of one-year ahead change in RNOA (alternatively, NOPM or NOAT) is regressed on current level and change in RNOA (alternatively, NOPM or NOAT) and growth in NOA. Current profitability must be controlled for since it is known to be serially correlated with future profitability (Fairfield and Yohn, 2001; Penman and Zhang, 2004). Additionally, future changes in profitability can also occur due to a denominator effect, or growth in NOA, G^{NOA} (Fairfield and Yohn, 2001; Penman and Zhang, 2004). Thus, an NOA growth variable is included to ensure that the effects of changes in profitability are not driven solely by changes in investment. Further, the regression results in chapter three demonstrated that changes in current NOPM and NOAT may be informative for future profitability and as such, are included in the $RNOA_{t+1}$ model. Finally, OLLEV and change in OLLEV are included to enhance consistency between the previous and current chapter. Thus, the benchmark models are:

$$\begin{aligned} \Delta RNOA_{t+1} = {} & \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \\ & \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + e_{t+1} \end{aligned} \tag{1a}$$

$$\begin{aligned} \Delta NOPM_{t+1} = {} & \alpha + \beta_1 NOPM_t + \beta_2 \Delta NOPM_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV \\ & + \beta_5 G_t^{NOA} + e_{t+1} \end{aligned} \tag{1b}$$

$$\begin{aligned} \Delta NOAT_{t+1} = {} & \alpha + \beta_1 NOAT_t + \beta_2 \Delta NOAT_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV \\ & + \beta_5 G_t^{NOA} + e_{t+1} \end{aligned} \tag{1c}$$

The coefficient on current level and change in each profitability variable is expected to be negative since profitability is mean-reverting (Freeman, Ohlson and Penman 1982; Fairfield and Yohn 2001). From the results in the previous chapter, ΔNOPM is expected to be negative and ΔNOAT is predicted to be positive in Model 1a. In addition, even though OLLEV is a variable of interest in the BTE analysis, it is included in the benchmark model to provide consistency between the current and previous chapter. Finally, prior research has shown the coefficient on the growth in NOA to be negative since investment in NOA is subject to diminishing returns.

Next, the barrier variables are introduced in the full model to determine whether information about the current level of entry barrier provides incremental explanatory power to the traditional variables included in equation 1.

$$\begin{aligned} \Delta RNOA_{t+1} = {} & \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \\ & \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + \beta_8 \Delta GPM_t + \beta_9 AdvInt_t \\ & + \beta_{10} CapInt_t + \beta_{11} IntgInt_t + \beta_{12} Age_t + \beta_{13} D^{reg}{}_t + \beta_{14} Mktshare_t \\ & + \beta_{15} Lev_t + \beta_{16} IndGr_t + \beta_{17} \mathrm{Rec}T/O_t + \beta_{18} InvT/O_t + \beta_{19} Size_t + e_{t+1} \end{aligned} \tag{2a}$$

$$\Delta NOPM_{t+1} = \alpha + \beta_1 NOPM_t + \beta_2 \Delta NOPM_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + \beta_6 \Delta GPM_t + \beta_7 AdvInt_t + \beta_8 CapInt_t + \beta_9 IntgInt_t + \beta_{10} Age_t + \beta_{11} D^{reg}{}_t + \beta_{12} Mktshare_t + \beta_{13} Lev_t + \beta_{14} IndGr_t + \beta_{15} \mathrm{Rec}T/O_t + \beta_{16} InvT/O_t + \beta_{17} Size_t + e_{t+1} \quad \text{(2b)}$$

$$\Delta NOAT_{t+1} = \alpha + \beta_1 NOAT_t + \beta_2 \Delta NOAT_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + \beta_6 \Delta GPM_t + \beta_7 AdvInt_t + \beta_8 CapInt_t + \beta_9 IntgInt_t + \beta_{10} Age_t + \beta_{11} D^{reg}{}_t + \beta_{12} Mktshare_t + \beta_{13} Lev_t + \beta_{14} IndGr_t + \beta_{15} \mathrm{Rec}T/O_t + \beta_{16} InvT/O_t + \beta_{17} Size_t + e_{t+1} \quad \text{(2c)}$$

Porter (1980) suggests that BTE are erected to deter potential competitors, while barriers-to-mobility (BTM) are erected to protect profits from existing competitors. Both the benchmark and full model are re-estimated with industry control variables to determine whether the barrier variables have BTM effects in addition to the BTE effects.

Empirical Results

Medians Test

Table 15 reports the results from the BTE medians test while Table 16 contains the industry-adjusted results to examine mobility barriers. In the medians tests, the industry-adjusted results followed the same pattern as the raw sample, which implies that the barrier variables serve simultaneously as effective protection from both potential and existing competitors.[45] Both NOPM and NOAT increase with RNOA, although the visual inspection of the functional form of the increase differs by RNOA component. Specifically, NOPM increases as a slightly concave function with RNOA, while NOAT's relation to RNOA is convex. When combined, the increase

[45] One exception was the leverage variable: leverage was declining in all profitability metrics for the industry-adjusted sample; whereas the effect varied by metric for the raw sample. This suggests that the borrowing capacity (low levels of leverage) are more important as a barrier-to-mobility than a barrier-to-entry.

in RNOA across portfolios is roughly linear. Further, the previously documented negative correlation between NOPM and NOAT (Selling and Stickney, 1989) is present in the data as evidenced by examining NOAT across NOPM quintiles in Panel B or NOPM across NOAT quintiles in Panel C.

Change in GPM increases in a concave fashion with RNOA and the result is driven by primarily through the NOPM. This result is somewhat tautological since gross profit margin is a primary component of NOPM. More interesting, the change in GPM variable takes on an S-shaped curve as NOAT increases. This suggests that moderately efficient firms are most sensitive to changes in economies of scale.

The profitabililty portfolios are convexly related to advertising intensity which suggests that extreme profitability (either negative or positive) is associated with higher levels of product differentiation. The overall effect is an increase in advertising intensity across the mid-low to highest RNOA portfolios and profit margins drive the convexity. This effect is magnified in the industry-adjusted values in Table 16. Thus, advertising intensity is a strong barrier-to-mobility and to a lesser extent, a barrier to entry.

Capital intensity, on the other hand, is negatively related to profitability, which is consistent with the idea that capital intensity is representative of excess capacity (Lieberman, 1987; Waring 1996). This is driven by the inverse relation between capital intensity and efficiency (NOAT). However, higher levels of capital intensity are associated with extreme levels of NOPM.

TABLE 15
Barrier-to-Entry (BTE) Descriptive Statistics Conditional on Profitability

		RNOA Quintiles				
Panel A	**Pooled**	**Lowest**	**Mid-Low**	**Middle**	**Mid-High**	**Highest**
RNOA	0.100	-0.068	0.061	0.100	0.147	0.285
NOPM	0.052	-0.045	0.036	0.056	0.067	0.104
NOAT	2.019	1.698	1.602	1.802	2.229	3.039
Δ Gross profit margin	0.0003	-0.0108	-0.0020	0.0006	0.0026	0.0046
Advertising intensity	0.0188	0.0192	0.0168	0.0178	0.0193	0.0232
Capital intensity	0.0325	0.0439	0.0376	0.0346	0.0294	0.0242
Intangible intensity	0.0249	0.0679	0.0188	0.0167	0.0192	0.0276
Firm age	10.8309	9.0797	12.3958	13.1507	12.0784	8.7806
Market share	0.0034	0.0021	0.0038	0.0045	0.0046	0.0029
Leverage	0.2385	0.2709	0.3168	0.2873	0.2019	0.0878
OLLEV	0.3695	0.3509	0.3120	0.3460	0.3798	0.5214
Receivables turnover	6.5744	5.7496	6.5863	6.9258	6.8387	6.8071
Inventory turnover	4.2213	3.5080	4.5919	5.0246	4.4246	3.7896
Industry revenue growth	0.0862	0.0798	0.0838	0.0856	0.0888	0.0943
Size (ln assets)	5.1337	4.5587	5.4011	5.5545	5.2967	4.9067

		Net Operating Profit Margin Quintiles				
Panel B	**Pooled**	**Lowest**	**Mid-Low**	**Middle**	**Mid-High**	**Highest**
RNOA	0.100	-0.066	0.075	0.115	0.148	0.176
NOPM	0.052	-0.046	0.028	0.052	0.081	0.156
NOAT	2.019	2.157	2.625	2.223	1.842	1.074
Δ Gross profit margin	0.0003	-0.0086	-0.0006	0.0012	0.0032	0.0039
Advertising intensity	0.0188	0.0188	0.0170	0.0186	0.0196	0.0234
Capital intensity	0.0325	0.0391	0.0241	0.0295	0.0353	0.0494
Intangible intensity	0.0249	0.0648	0.0142	0.0179	0.0294	0.0297
Firm age	10.8309	8.9154	11.3027	12.3382	11.0968	11.2868
Market share	0.0034	0.0022	0.0036	0.0046	0.0044	0.0031
Leverage	0.2385	0.2480	0.2424	0.2269	0.2138	0.2698
OLLEV	0.3695	0.4007	0.4019	0.3740	0.3540	0.3297
Receivables turnover	6.5744	6.2487	7.1045	6.8026	6.5241	6.2301
Inventory turnover	4.2213	3.8894	4.6579	4.4187	4.2054	3.7646
Industry revenue growth	0.0862	0.0797	0.0858	0.0860	0.0896	0.0971
Size (ln assets)	5.1337	4.4750	4.9013	5.1867	5.3744	5.9141

		Net Operating Asset Turnover Quintiles				
Panel C	**Pooled**	**Lowest**	**Mid-Low**	**Middle**	**Mid-High**	**Highest**
RNOA	0.100	0.071	0.085	0.102	0.124	0.164
NOPM	0.052	0.110	0.058	0.050	0.045	0.033
NOAT	2.019	0.706	1.472	2.019	2.720	4.642
Δ Gross profit margin	0.0003	-0.0014	-0.0011	0.0002	0.0015	0.0011
Advertising intensity	0.0188	0.0194	0.0186	0.0188	0.0201	0.0187
Capital intensity	0.0325	0.0801	0.0431	0.0322	0.0255	0.0159
Intangible intensity	0.0249	0.0361	0.0361	0.0314	0.0240	0.0083
Firm age	10.8309	12.2328	11.2966	11.9400	10.9020	8.9081
Market share	0.0034	0.0029	0.0041	0.0042	0.0034	0.0028
Leverage	0.2385	0.3733	0.2728	0.2237	0.1900	0.1375
OLLEV	0.3695	0.2491	0.2900	0.3430	0.4291	0.6878
Receivables turnover	6.5744	6.0446	5.7887	6.2255	6.9434	8.8373
Inventory turnover	4.2213	4.9410	3.1953	3.6653	4.4296	5.7161
Industry revenue growth	0.0862	0.0864	0.0841	0.0828	0.0865	0.0941
Size (ln assets)	5.1337	6.1832	5.2521	4.9675	4.7698	4.7259

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Size = log of total assets.

Likewise, intangible intensity has a negative correlation with RNOA that is most pronounced in the lower profitability regions and a negative NOAT effect dominates overall RNOA. Industry-adjusted intangible intensity also has a strong inverse relation with profitability.

There exists a concave relation between profitability and firm age, market share, and size. Firms with the highest levels of these variables attain only average profitability, whereas extreme performance is characterized by lower levels of these variables. Firm age is negatively related to efficiency (NOAT) which is counterintuitive if firm age captures learning or the experience curve. There may be strategy reasons for the shape of the market share curve. For example, firms will have high market share if they pursue a cost leadership strategy, which depresses profit margins. Conversely, firms will exhibit lower market share when they pursue a product differentiation strategy (Porter, 1980), but at higher profit margins as they are able to increase price due to their successful differentiation. The concavity present in firm size is the result of the negative correlation between NOPM and NOAT. Specifically, NOPM is increasing in firm size, while efficiency (NOAT) is decreasing in firm size. This is consistent with the bureaucratic inefficiencies proposed in Monsen and Downs (1965).

TABLE 16
Barrier-to-Entry (BTE) Descriptive Statistics Conditional on Profitability
Industry-Adjusted Variables

Panel A	RNOA Quintiles				
	Lowest	Mid-Low	Middle	Mid-High	Highest
RNOA	-0.163	-0.033	-0.001	0.040	0.170
NOPM	-0.092	-0.011	0.003	0.016	0.044
NOAT	-0.252	-0.197	-0.065	0.102	0.824
Δ Gross profit margin	-0.0099	-0.0017	0.0003	0.0017	0.0036
Advertising intensity	0.0009	-0.0007	-0.0005	0.0001	0.0012
Capital intensity	0.0076	0.0018	0.0003	-0.0012	-0.0032
Intangible intensity	0.0177	-0.0001	0.0000	-0.0001	0.0002
Firm age	-0.6268	0.2935	0.4234	0.6158	-0.5594
Market share	-0.0006	0.0002	0.0006	0.0006	-0.0001
Leverage	0.0450	0.0451	0.0193	-0.0222	-0.0931
OLLEV	-0.0120	-0.0437	-0.0187	0.0097	0.1267
Receivables turnover	-0.5185	-0.1268	0.0635	0.1516	0.5643
Inventory turnover	-0.1901	-0.0188	0.0717	0.1210	0.0660
Size (ln assets)	-0.3685	0.0583	0.2037	0.1633	-0.0868

Panel B	Net Operating Profit Margin Quintiles				
	Lowest	Mid-Low	Middle	Mid-High	Highest
RNOA	-0.160	-0.022	0.011	0.041	0.062
NOPM	-0.093	-0.015	0.003	0.027	0.077
NOAT	-0.009	0.269	0.110	-0.017	-0.153
Δ Gross profit margin	-0.0081	-0.0007	0.0007	0.0023	0.0030
Advertising intensity	0.0005	-0.0009	0.0001	0.0003	0.0011
Capital intensity	0.0055	-0.0029	-0.0016	0.0003	0.0049
Intangible intensity	0.0181	-0.0002	-0.0002	-0.0001	0.0010
Firm age	-0.6710	0.2567	0.4393	-0.0031	0.0925
Market share	-0.0005	0.0001	0.0006	0.0004	-0.0001
Leverage	0.0313	0.0135	-0.0018	-0.0171	-0.0185
OLLEV	0.0189	0.0170	0.0051	-0.0083	-0.0236
Receivables turnover	-0.2425	0.1493	0.0792	0.0634	-0.0824
Inventory turnover	0.1046	0.2252	0.0737	0.0476	-0.2752
Size (ln assets)	-0.4139	-0.0823	0.0877	0.1700	0.2066

Panel C	Net Operating Asset Turnover Quintiles				
	Lowest	Mid-Low	Middle	Mid-High	Highest
RNOA	-0.017	-0.014	0.000	0.017	0.058
NOPM	0.017	0.001	0.000	-0.001	-0.006
NOAT	-0.427	-0.442	-0.037	0.476	2.078
Δ Gross profit margin	-0.0011	-0.0012	-0.0001	0.0007	0.0006
Advertising intensity	0.0001	0.0002	0.0002	0.0007	-0.0012
Capital intensity	0.0189	0.0061	0.0002	-0.0030	-0.0064
Intangible intensity	0.0070	0.0009	0.0002	-0.0001	-0.0001
Firm age	-0.0974	0.0888	0.3989	0.0729	-0.3609
Market share	-0.0002	0.0001	0.0002	-0.0001	0.0001
Leverage	0.0397	0.0291	0.0046	-0.0219	-0.0613
OLLEV	-0.0859	-0.0602	-0.0157	0.0479	0.2633
Receivables turnover	-0.4804	-0.3514	-0.0633	0.1831	1.5629
Inventory turnover	-0.4761	-0.3658	-0.0773	0.2360	1.3095
Size (ln assets)	0.1966	0.1258	0.0479	-0.1245	-0.2629

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Size = log of total assets.

Leverage has a negative relation with profitability, which means that borrowing capacity (the converse of leverage) does increase with profitability. The overall leverage effect is driven by NOAT which also is decreasing in leverage. This suggests that firms that are debt-constrained have less flexibility to adopt efficiency-increasing strategies. Industry-adjusted profitability (Table 16) is also decreasing in leverage but profit margins drive this result which means that firms that have lower than the industry average of debt are more profitable.

While operating liability leverage (OLLEV) is inversely related to profit margins, it has a convex, increasing association with operating efficiency. The overall effect on profitability, specifically RNOA, is a convex function with extreme RNOA portfolios displaying the highest levels of OLLEV.

The receivables turnover has a positive effect on RNOA due to the effect on NOAT. The inventory turnovers have little effect on RNOA due to a concave relation with NOPM, while the effect on productivity is convex. Industry growth is positively correlated with profitability through NOPM but negatively correlated with NOAT in the low-to-mid NOAT regions. This is intuitive since rapid growth generally impedes efficiency.

Convergence Tests

Figures 6a – 6m report the convergence patterns for RNOA by barrier variable.[46] These tests determine whether the relation between the barrier variables is contemporaneous, or whether the barrier variable has a lagged effect on profitability. The effect of the variables on RNOA, and its components, NOPM and NOAT are examined, but only the results based on RNOA are presented for brevity. In some cases, the results based on NOPM and NOAT are discussed in the interpretation of the profitability effect of the barrier variables. Additionally, the convergence tests were repeated using industry-adjusted profitability and barrier variables to ensure that result is not purely industry-driven. Any differences in industry-adjusted profitability address BTMs rather than (or in addition to) BTEs. Therefore, the following analysis indicates that the variables serve as both a BTE and BTM, unless stated otherwise.

[46] Firms are classified by barrier portfolio during the base year and their convergence patterns are analyzed over time. As in Nissim and Penman (2001), firms that do not survive the entire time series are dropped when their associated data no longer appear in Compustat. This imparts an inherent survival bias in the sample.

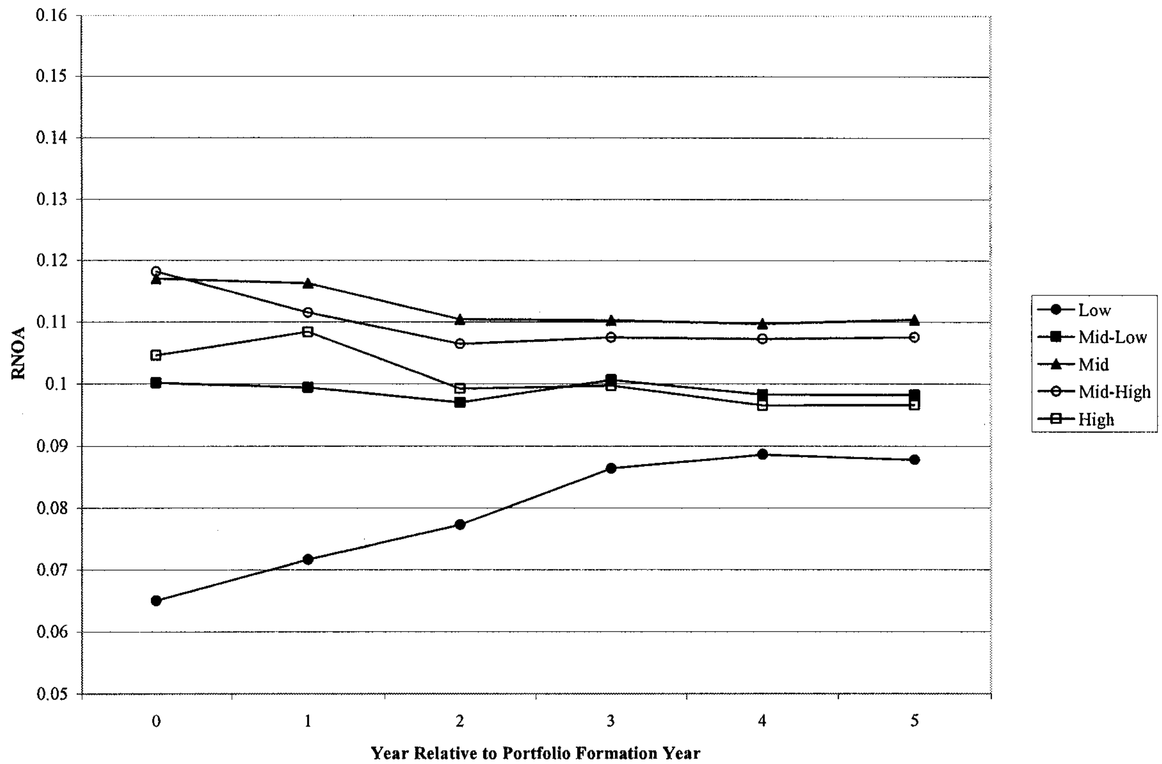

Fig. 6a. Evolution of RNOA over time by economies of scale (change in GPM).

Figure 6a displays the RNOA convergence for change in GPM that proxies for economies of scale. There is substantial difference among the lowest economies of scale firms and the remaining portfolios in overall RNOA (approximately 3 percent), however, the difference converges to approximately 1-2 percent over time. The highest change quintile has consistently higher NOPM which is sustainable over subsequent periods, however, it also displays low levels of NOAT (by as much as .40 between the high and middle quintiles). Hence, there is a barrier effect of economies of scale in protecting profit margins, but this effect is dampened by the reduced efficiency that accompanies an expansion in scale.

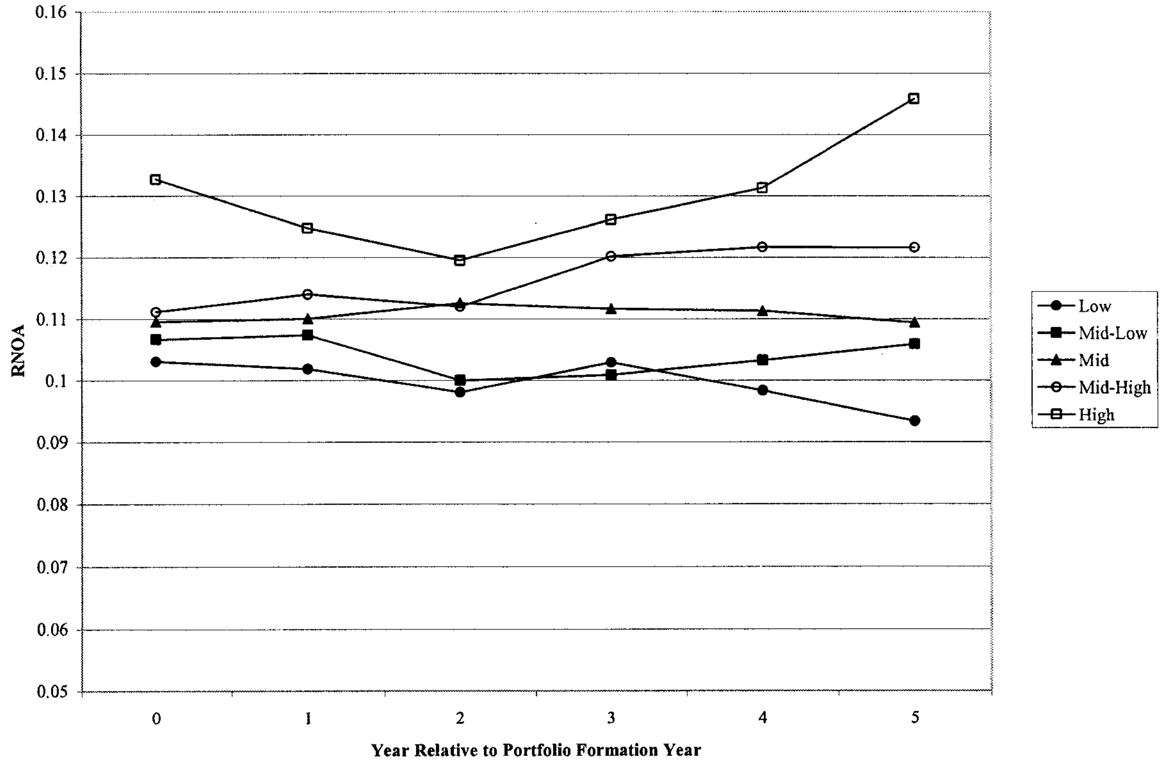

Fig. 6b. Evolution of RNOA over time by level of product differentiation (advertising intensity).

Advertising intensity, presented in Figure 6b, does result in immediate and persistent future profitability and this result is driven by increased profit margins. Further, the results of increased advertising expenditures have a long-run return payoff by as much as five percent between the highest and lowest advertising intensity portfolios. However, the positive effect is slightly dampened (difference between high and low portfolios of three percent) and delayed two periods when examining industry-adjusted advertising intensity (graph is omitted for brevity). Therefore, advertising intensity is both a barrier-to-entry and a barrier-to-mobility, but the entry effect is stronger.

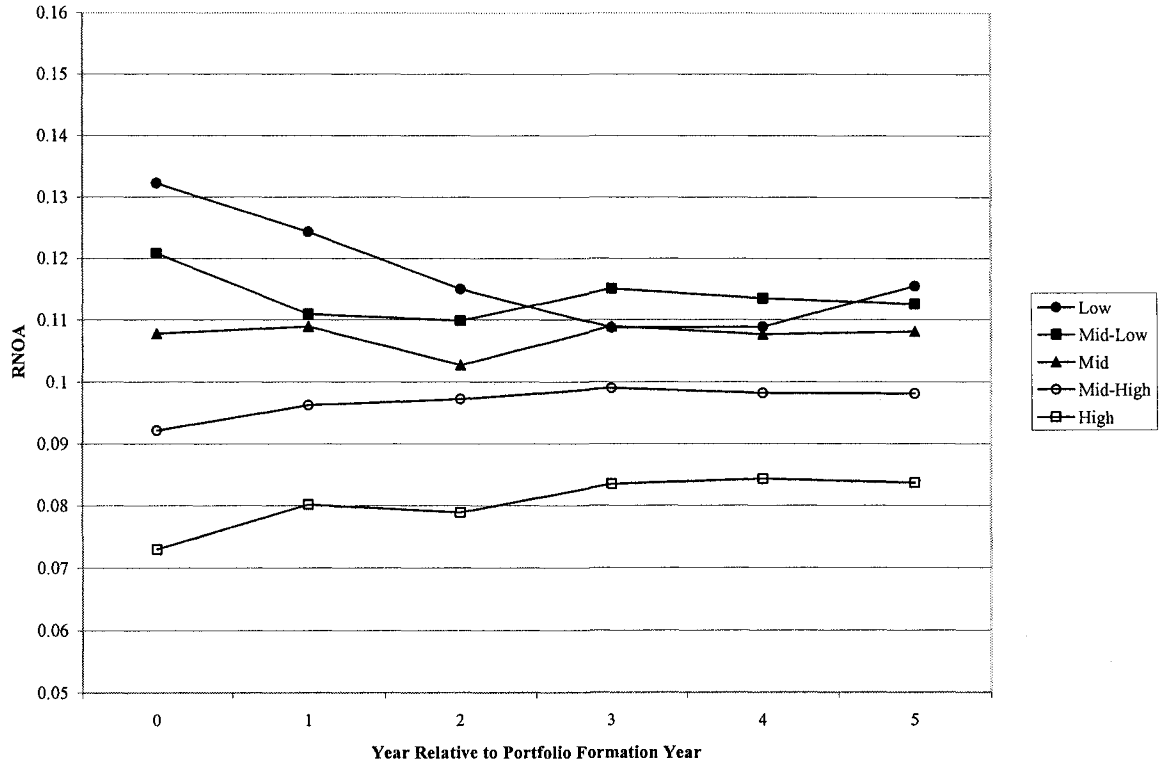

Fig. 6c. Evolution of RNOA over time by level of capital requirements (capital intensity).

Figure 6c displays the results for RNOA by capital intensity portfolios. Capital intensity level has a monotonic and sustainable positive effect on profit margins, however, this effect is dominated by a negative monotonic effect on asset turnover. This leads to a damper on profitability as the level of capital intensity increases and the RNOA difference between high and low portfolios is still a substantial three percent at the end of the analysis period.

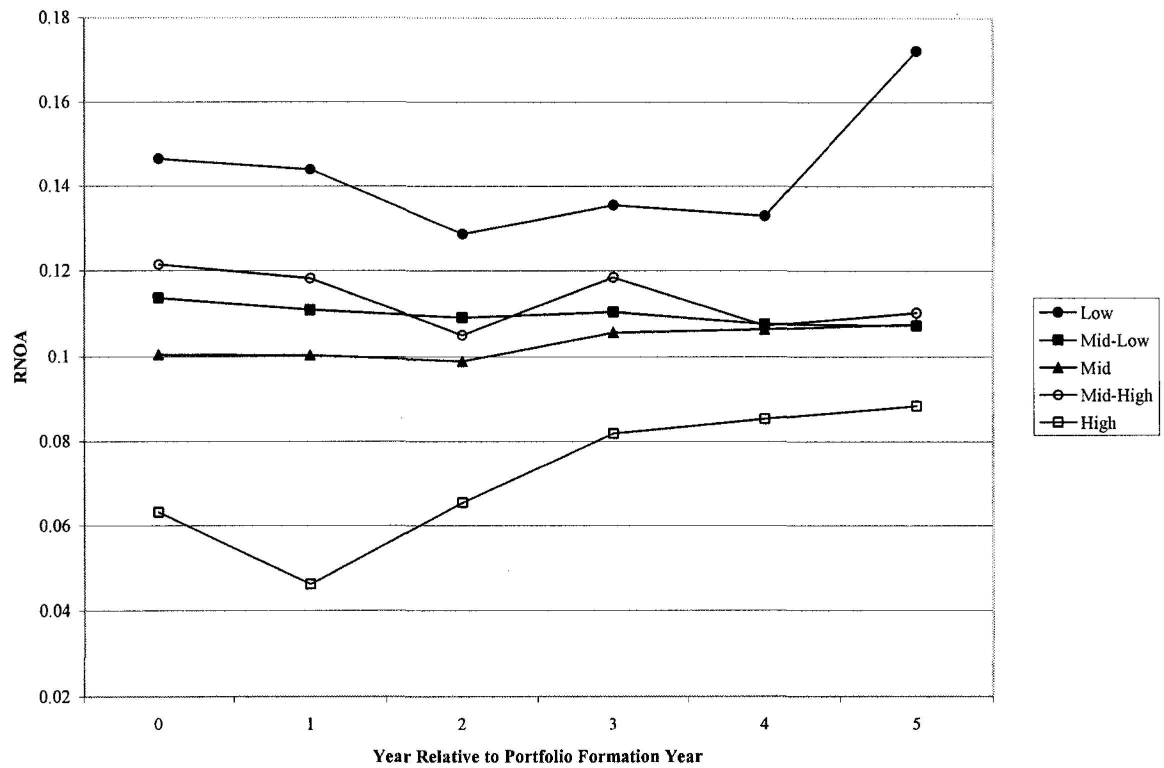

Fig. 6d. Evolution of RNOA over time by level of proprietary technology (intangible intensity).

The highest levels of intangible intensity provide the persistently lowest returns whereas the lowest level of intangible intensity maintains the highest return throughout the sample period (see Figure 6d). It is possible that the five year window examined here is not long enough to realize the returns to the highest level of intangible investments. Any permanent differences among the intangible quintiles are driven by the asset turnover, as opposed to profit margin. Clearly, those firms with the lowest level of intangible intensity are the most efficient firms and this variation is sustainable. In the industry-adjusted analysis, the middle portfolio (those intangible expenditures closest to the industry average) result in the highest RNOA and this difference is persistent over the subsequent five years. Consequently, the level of intangible intensity is shown to be ineffective as a BTE, but investing in the industry-average amount of intangibles protects profitability. Indeed, firms appear to achieve an industry-wide optimum in terms of intangible property expenditures.

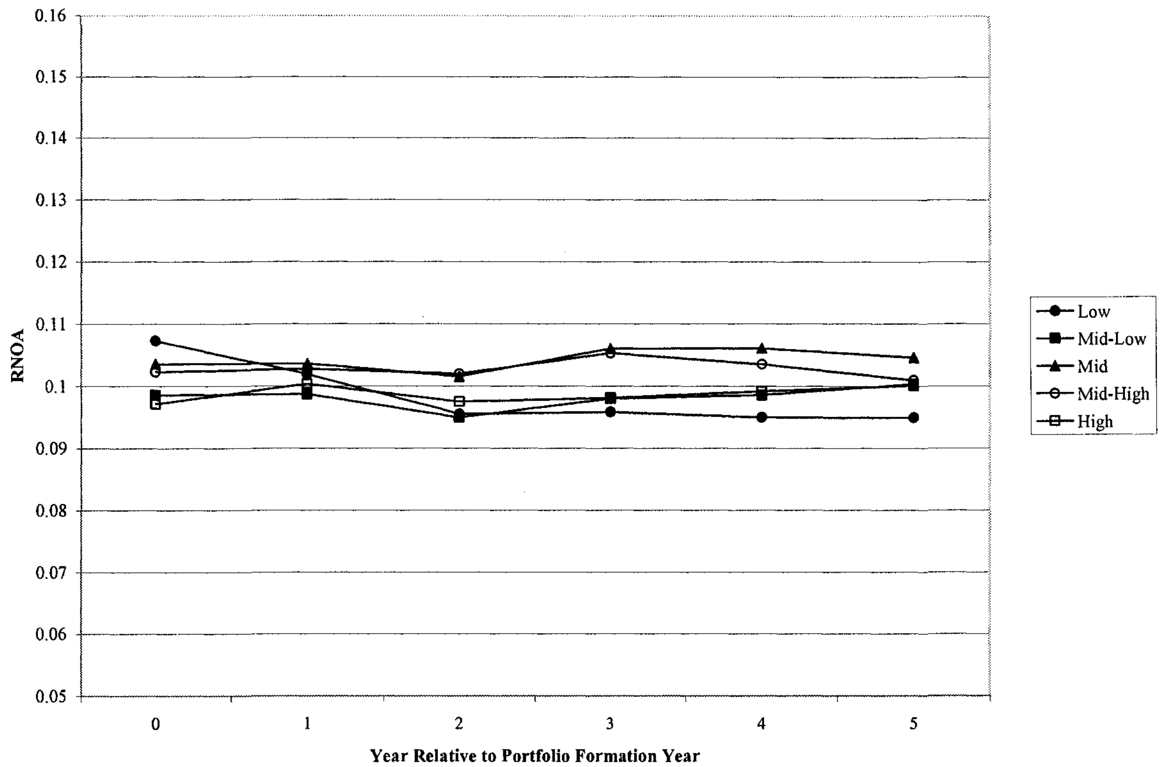

Fig. 6e. Evolution of RNOA over time by learning/experience curve (firm age).

Figure 6e examines the convergence over time of firm age that proxies for the experience/learning curve of a firm. Age has no effect on overall profitability, however older firms appear to have higher profit margins. This is consistent with product quality associated with the learning curve and by product entrenchment effects that stem from prolonged brand recognition. However, these persistent differences translate into only about a one percent difference in RNOA between the oldest and remaining age quintiles. The oldest firms also have substantially lower NOAT (approximately .25) than the other age quintiles which is consistent with bureaucratic entrenchment. There is little, if any, efficiency differences between the other age quintiles which calls into question the ability of firm age to proxy for a firm's learning or experience curve.

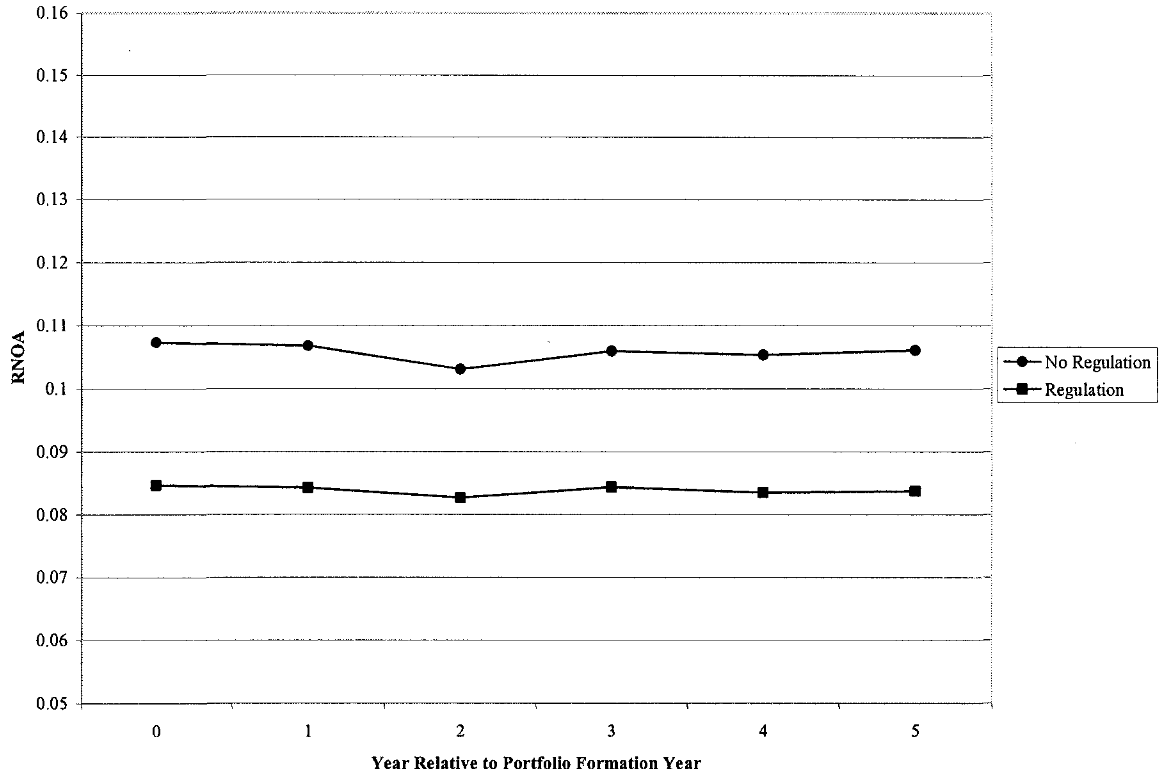

Fig. 6f. Evolution of RNOA over time by regulatory environment.

Regulation has a permanent and negative effect on RNOA and this effect is driven by offsetting effects on the RNOA components (Figure 6f). Regulation is effective at protecting substantially higher profit margins for regulated firms over the entire five-year period and the range of this difference is approximately five percentage points. Conversely, the NOAT for regulated firms is substantially lower than that of non-regulated firms and this effect dominates the overall effect on profitability.

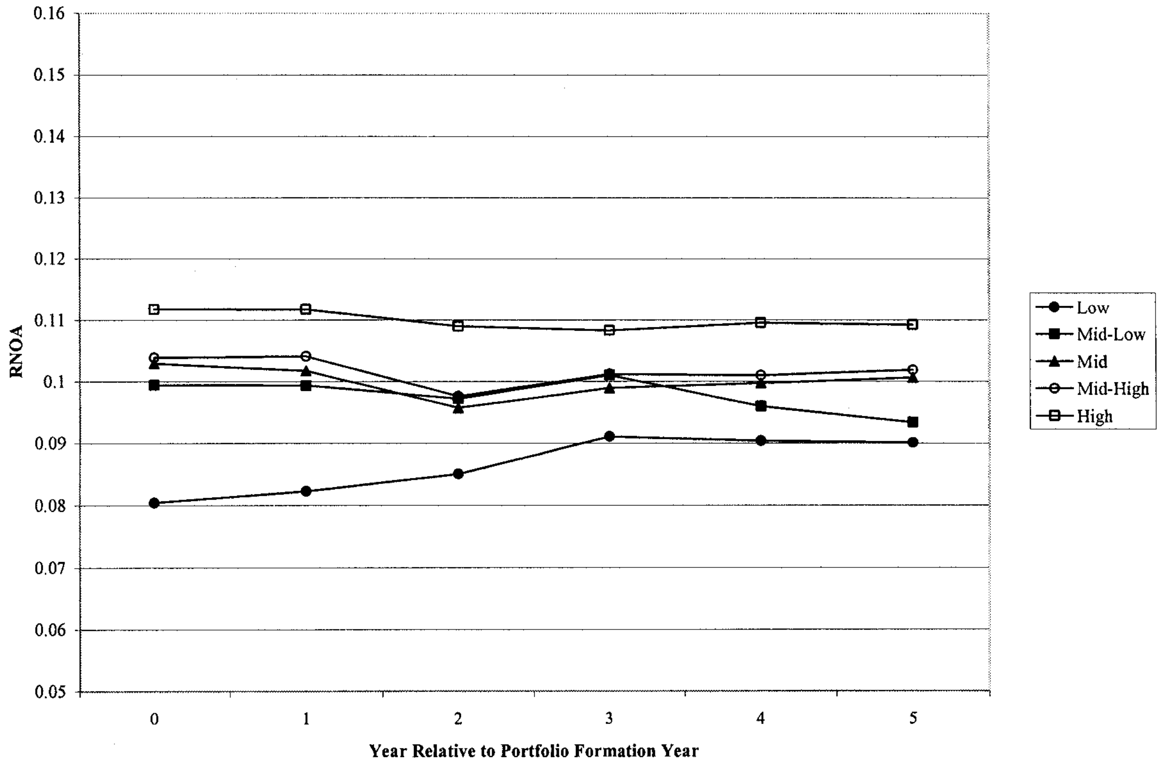

Fig. 6g. Evolution of RNOA over time by expected retaliation (market share).

Figure 6g contains the convergence test for market share, which is an indicator of expected retaliation. Only the top market share portfolio earns higher RNOA over the subsequent years of one percent over the other market share portfolios and this difference is driven by NOPM. Firms in the lowest market share portfolio experience persistently lower profitability than firms in other portfolios. This result is driven by the fact that low market share firms also have low levels of NOAT. This is consistent with life cycle theory that suggests firms will concentrate on profit margins while building market share and then turn to increases in efficiency once they are fully entrenched in their market.

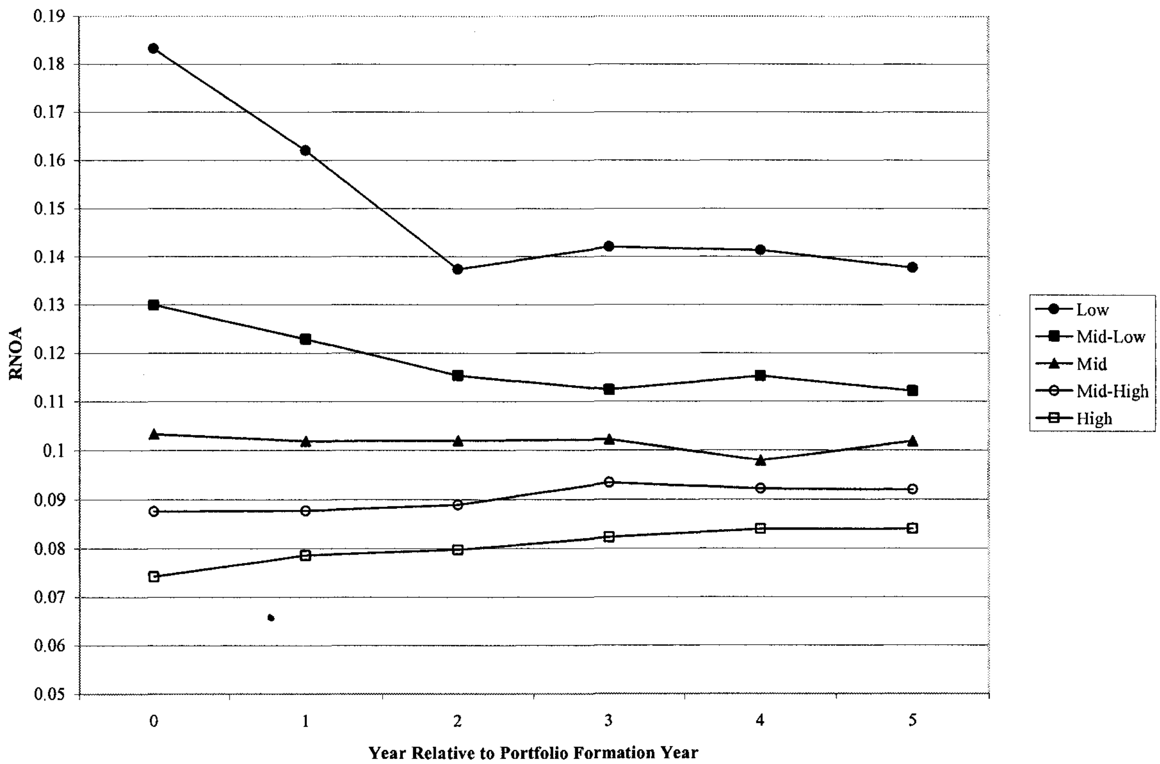

Fig. 6h. Evolution of RNOA over time by expected retaliation (leverage).

Borrowing capacity (Figure 6h), as measured by low levels of leverage, results in monotonically and substantially increasing profitability (an 11 percent range between high and low portfolios), although this difference in profitability partially mean-reverts to a six percent difference over the subsequent five years. This result is driven by efficiency gains via NOAT and NOPM has an offsetting effect: firms with the highest degree of leverage have the highest profit margins. Similar results obtain for OLLEV (Figure 6i) such that high levels of OLLEV result in persist high levels of RNOA and this result is driven by efficiencies (NOAT).

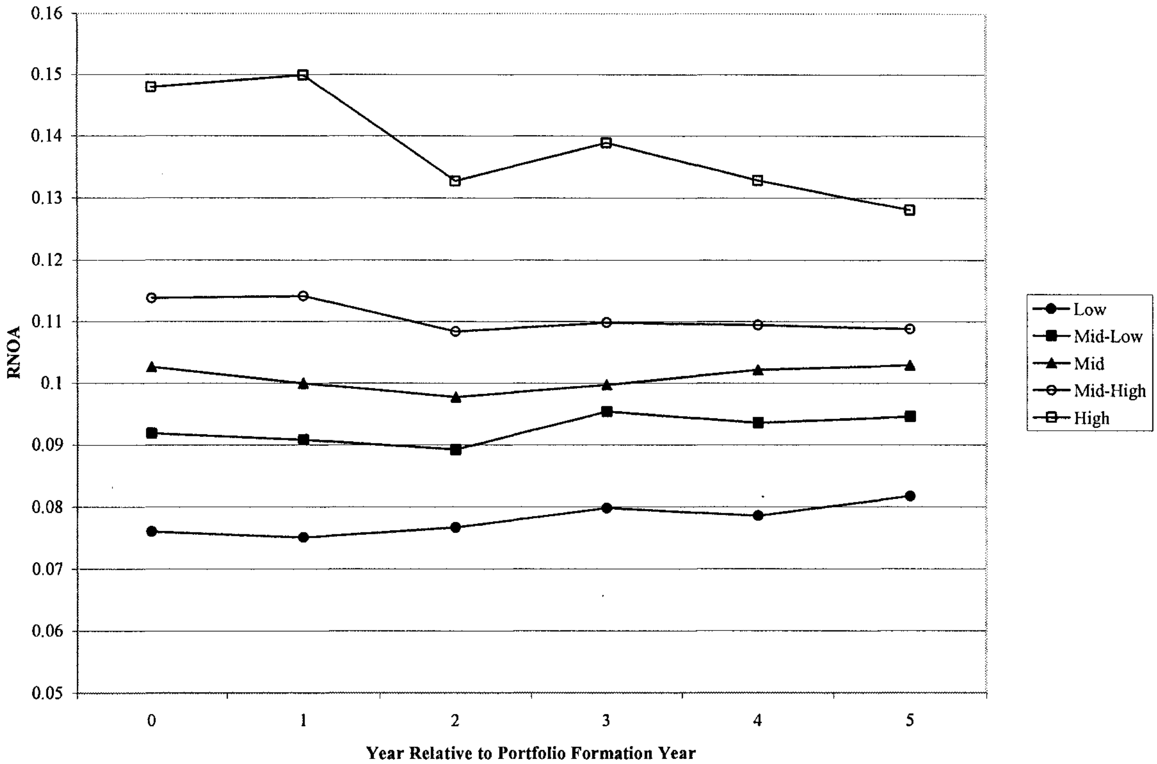

Fig. 6i. Evolution of RNOA over time by expected retaliation (operating liability leverage).

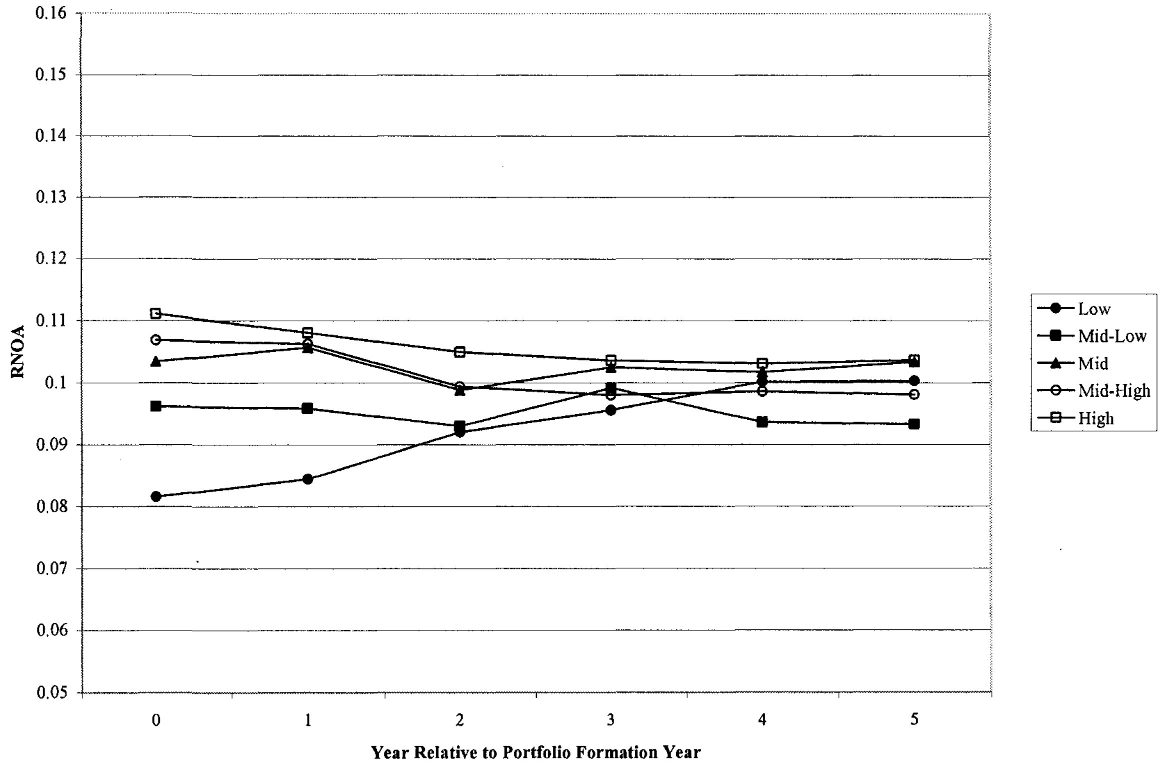

Fig. 6j. Evolution of RNOA over time by power over customers (receivables turnover).

The receivables turnover (Figure 6j) and inventory turnover (Figure 6k) ratio graphs demonstrate that power over customers or suppliers have little long-term effect on profitability. Firms with high receivables turnover have extremely high asset turnovers, but they also have dampened profit margins. The combined effect is that increases in receivables turnover do not result in increased overall profitability. The inventory turnover has no discernible relation to profitability. Mid-levels of inventory turnover result in the highest profitability levels for all metrics: RNOA, NOPM, and NOAT.

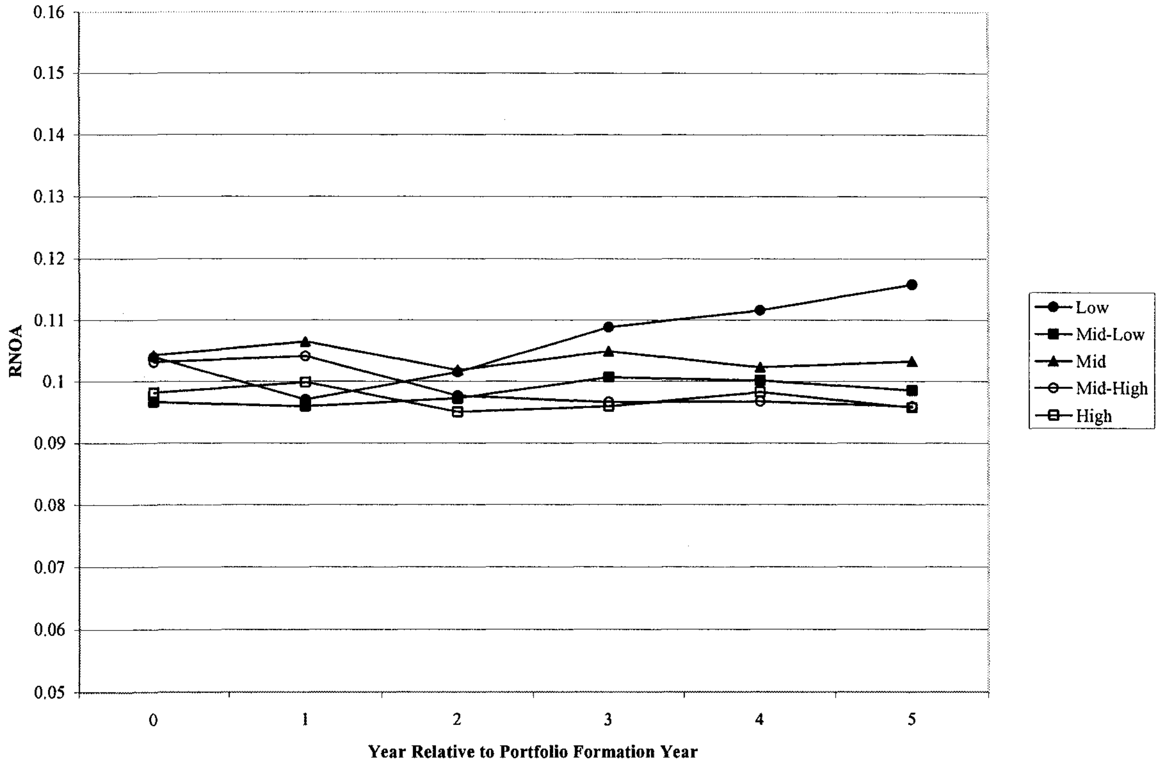

Fig. 6k. Evolution of RNOA over time by power over suppliers (inventory turnover).

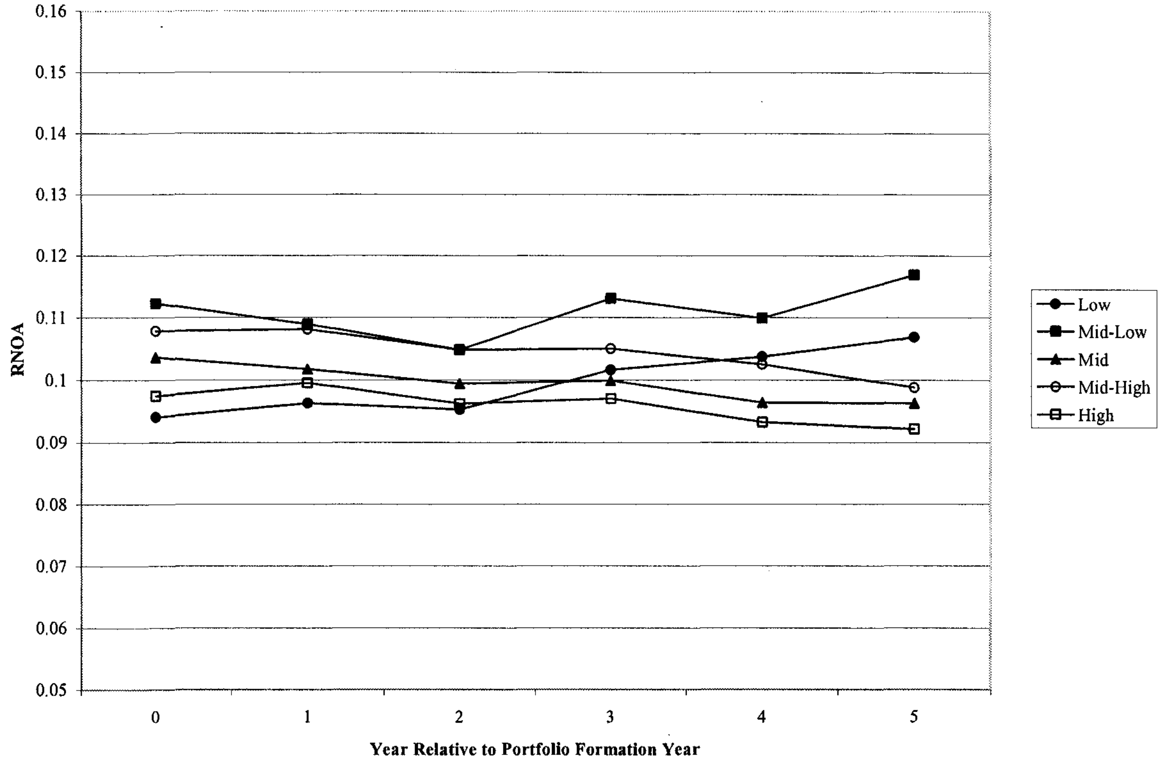

Fig. 61. Evolution of RNOA over time by level of industry revenue growth.

Slow industry revenue growth is expected to deter entry and this variable is examined in Figure 61. The level of industry revenue growth has no significant effect on differences in firm profitability. Low and high industry growth have both the highest NOPM and the lowest NOAT. This is consistent with rapid growth accompanying low efficiency and low growth protecting profit margins which are both theoretical economic assertions from prior literature.

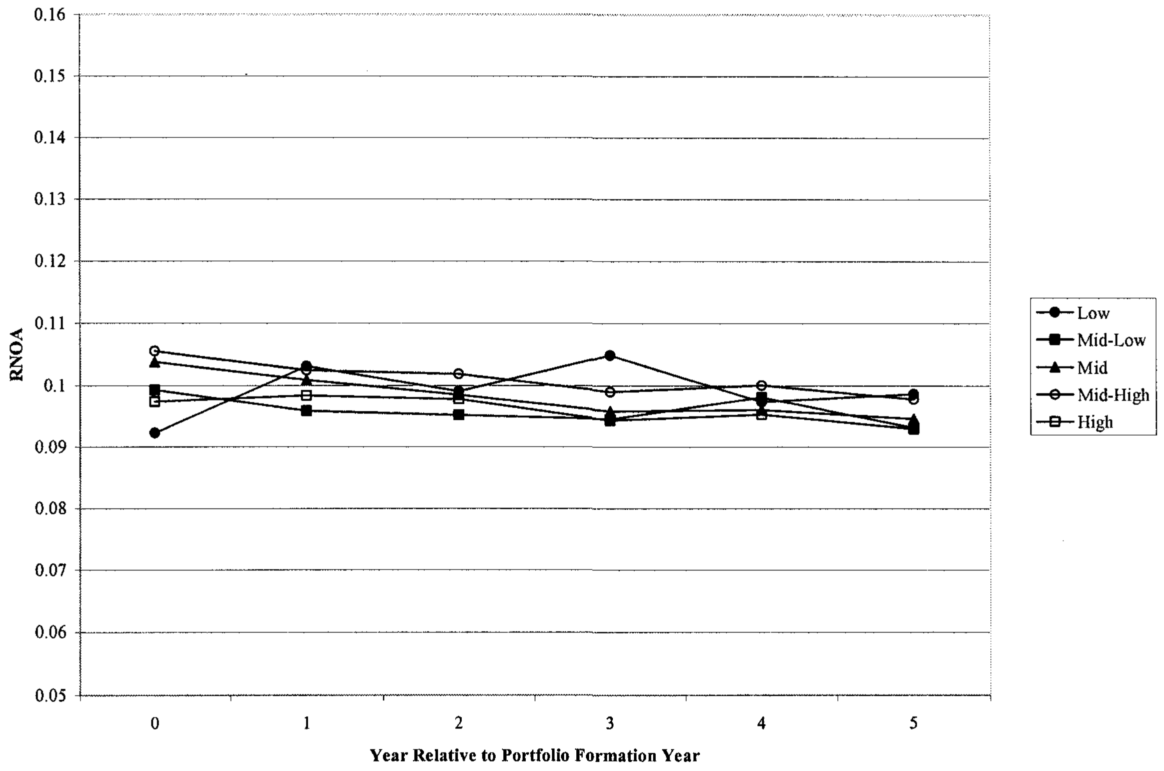

Fig. 6m. Evolution of RNOA over time by firm size.

Firm size does not substantially affect profitability for any portfolio (Figure 6m). The overall result of no relation between firm size and profits stems from offsetting effects on profit margin and asset turnover. Firm size significantly and monotonically affect profit margins, however there is a negative correlation between asset turnover and firm size.

Regression Analysis

To test the explanatory role of BTEs and BTMs for future profitability, a regression of one year-ahead change in RNOA (and alternatively NOPM and NOAT) on variables related to entry barriers is examined. Table 17 reports the correlation coefficients among the regression variables. Table 18 reports the regression coefficients for the benchmark and full models that are estimated on an annual basis. Model 1 estimates the future change in RNOA (NOPM, NOAT) against the benchmark variables, while Model 2 adds the barrier variables to the regression. All specifications are estimated using a base model to test for BTEs and with industry dummy variables to test for BTMs. The RNOA benchmark model (Model 1a) achieves an adjusted R^2 of 24.36% and all variables are of the predicted sign and statistically significant with the exception of ΔNOPM. In the industry-adjusted model, all variables are of the predicted sign and significant with the exception of ΔOLLEV (t = 0.68) and the adjusted R^2 is 20.96%. Consistent with prior research, the sign of the current level of the profitability metric is negative implying reversion to the mean, and the negative coefficient on growth in NOA (t = -10.30) reveals mean reversion in asset growth such that the current level of growth is not sustainable.

Model 2a incorporates the barrier variables and consequently, the adjusted R^2 increases with the inclusion of the barrier variables by 6.5% to 25.94 for the base model and by 4.4% to 21.89% for the BTM model. The BTE variables that significantly affect future ΔRNOA are economies of scale (Δ in gross profit margin, t = 7.83), product differentiation (advertising intensity, t = 2.70), experience/learning (firm age, t = 2.57), leverage over suppliers (OLLEV, t = 3.57) and bargaining power over customers (receivables turnover, t = 2.72). Note that high capital requirements (capital intensity ratio) has a negative relation (t = -3.65) to future ΔRNOA, which suggests that most firms have excess capacity and any additional investment has a negative effect of future profitability (Porter, 1980; Lieberman, 1987). Also, growth in industry revenues has a positive effect (t = 1.75) on future ΔRNOA such that the industries are able to absorb new entrants without curtailing the profitability of individual firms. Proprietary technology (intangible intensity), regulation, market share, borrowing capacity (leverage), and size are not effective as barriers-to-entry. The effect of the inventory turnover ratio is insignificant, which could be because the OLLEV variable subsumes its effect.

When controlling for industry, the advertising intensity variable is no longer significant which suggests that it is not a barrier against existing competitors (BTM). Market share, however, is a BTM (t = 3.79) where it did not protect against potential competitors as a BTE. Also, the leverage variable has a positive and significant effect (t = 4.17) on future ΔRNOA which is contrary to the predicted sign. It seems that firms that have greater access to financial capital (and make use of that capital) are able to erect a financial BTM against existing competitors. Finally, firms that are larger than their industry peers have lower future profitability (t = -3.49). This is consistent with size hindering adaptability in the face of competition.

TABLE 17

Correlation Coefficients Across Variables – Barrier Variables

n = 70,017	$\Delta RNOA_{t+1}$	$\Delta NOPM_{t+1}$	$\Delta NOAT_{t+1}$	RNOA	NOPM	NOAT	ΔRNOA	ΔNOPM	ΔNOAT	OLLEV	ΔOLLEV	G^{NOA}
$\Delta RNOA_{t+1}$	1.000	0.678	0.378	-0.417	-0.278	-0.096	-0.171	-0.142	0.058	-0.019	0.104	-0.155
$\Delta NOPM_{t+1}$		1.000	0.165	-0.302	-0.382	-0.015	-0.154	-0.225	0.029	0.036	0.068	-0.107
$\Delta NOAT_{t+1}$			1.000	-0.259	-0.108	-0.285	-0.086	-0.053	0.079	-0.115	0.200	-0.303
RNOA				1.000	0.736	0.296	0.244	0.173	0.039	0.133	-0.042	0.091
NOPM					1.000	-0.008	0.150	0.236	0.020	-0.015	-0.054	0.018
NOAT						1.000	0.097	0.048	0.112	0.407	0.067	0.072
ΔRNOA							1.000	0.591	0.385	0.097	0.037	0.026
ΔNOPM								1.000	0.138	0.028	-0.016	0.060
ΔNOAT									1.000	0.175	0.373	-0.316
OLLEV										1.000	0.237	-0.003
ΔOLLEV											1.000	-0.531
G^{NOA}												1.000

	ΔGPM	AdvInt	CapInt	IntanInt	Age	MktShare	Leverage	Rec T/O	Inv T/O	IndGrowth	Size
$\Delta RNOA_{t+1}$	-0.027	0.017	0.049	0.050	0.015	0.000	0.057	-0.006	-0.009	-0.040	-0.031
$\Delta NOPM_{t+1}$	-0.033	0.048	0.078	0.087	0.000	-0.004	0.050	-0.003	-0.005	-0.045	-0.022
$\Delta NOAT_{t+1}$	-0.030	-0.011	0.067	0.016	0.032	-0.001	0.067	-0.034	-0.032	-0.044	-0.020
RNOA	0.065	-0.065	-0.294	-0.258	0.039	0.042	-0.083	0.053	0.019	0.100	0.082
NOPM	0.070	-0.135	-0.285	-0.376	0.103	0.056	0.053	0.003	0.020	0.105	0.153
NOAT	0.022	0.022	-0.354	-0.061	-0.093	-0.023	-0.271	0.281	0.096	0.052	-0.151
ΔRNOA	0.271	-0.020	-0.014	-0.004	-0.002	-0.003	-0.021	0.005	0.011	0.039	-0.005
ΔNOPM	0.415	0.000	-0.023	-0.051	-0.013	-0.008	-0.024	0.010	-0.002	0.031	-0.019
ΔNOAT	0.060	-0.008	-0.008	-0.026	0.035	0.011	0.000	0.006	0.026	0.044	0.008
OLLEV	0.042	0.060	-0.090	0.043	0.000	0.016	-0.142	-0.036	0.057	0.024	0.166
ΔOLLEV	-0.007	0.018	0.016	0.030	0.008	0.005	-0.019	0.000	0.006	-0.004	0.010
G^{NOA}	0.032	0.040	0.009	0.055	-0.136	-0.043	-0.014	-0.008	0.003	0.082	-0.004

TABLE 17 CONTINUED

Correlation Coefficients Across Variables – Barrier Variables

	ΔGPM	AdvInt	CapInt	IntanInt	Age	MktShare	Leverage	Rec T/O	Inv T/O	IndGrowth	Size
ΔGPM	**1.000**	**0.038**	**0.034**	**-0.024**	-0.005	**-0.007**	**-0.024**	0.006	**-0.022**	0.006	-0.006
AdvInt		**1.000**	**0.042**	**0.105**	**0.053**	**0.051**	**-0.068**	**-0.027**	**-0.031**	**-0.021**	**0.076**
CapInt			**1.000**	**0.384**	**-0.018**	**-0.039**	**0.139**	**-0.093**	**0.036**	**-0.077**	**0.164**
IntanInt				**1.000**	**-0.059**	**-0.036**	**-0.060**	**-0.044**	**-0.029**	**-0.027**	-0.005
Age					**1.000**	**0.351**	**0.045**	**-0.010**	**0.017**	**-0.054**	**0.480**
MktShare						**1.000**	**0.036**	0.005	**0.040**	-0.006	**0.441**
Leverage							**1.000**	**0.009**	**0.095**	**0.010**	**0.219**
Rec T/O								**1.000**	**0.153**	**0.023**	**0.060**
Inv T/O									**1.000**	**0.025**	**0.176**
IndGrowth										**1.000**	**-0.043**
Size											**1.000**

For firm years 1970 - 2003.
** Bold figures represent significant correlation coefficients at .05 or better.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Size = log of total assets.

TABLE 18

Regression Results of Entry and Mobility Barriers on Future Changes in Profitability

Model 1a:

$$\Delta RNOA_{t+1} = \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + e_{t+1}$$

Model 2a:

$$\Delta RNOA_{t+1} = \alpha + \beta_1 RNOA_t + \beta_2 \Delta RNOA_t + \beta_3 \Delta NOPM_t + \beta_4 \Delta NOAT_t + \beta_5 OLLEV_t + \beta_6 \Delta OLLEV + \beta_7 G_t^{NOA} + \beta_8 \Delta GPM_t + \beta_9 AdvInt_t + \beta_{10} CapInt_t + \beta_{11} IntgInt_t + \beta_{12} Age_t + \beta_{13} D^{reg}{}_t + \beta_{14} Mktshare_t + \beta_{15} Lev_t + \beta_{16} IndGr_t + \beta_{17} RecT/O_t + \beta_{18} InvT/O_t + \beta_{19} Size_t + e_{t+1}$$

Regression Results of Entry and Mobility Barriers on Future Changes in RNOA

n = 70,017	Pred. Sign	Unadjusted for Industry Effects				Controlling for Industry Effects			
		Base	*t-statistic*	**Full**	*t-statistic*	**Base**	*t-statistic*	**Full**	*t-statistic*
α		0.0307	**10.52**	0.0357	**6.31**	0.0117	**2.41**	0.0360	**6.20**
$RNOA_t$	–	-0.3387	**-28.30**	-0.3658	**-27.15**	-0.3401	**-40.56**	-0.3654	**-42.05**
$\Delta RNOA_t$	–	-0.1042	**-7.54**	-0.1057	**-7.21**	-0.0677	**-6.29**	-0.0619	**-5.76**
$\Delta NOPM_t$	–	-0.0357	-1.58	-0.0677	**-2.96**	-0.0438	**-2.49**	-0.0757	**-4.22**
$\Delta NOAT_t$	+	0.0194	**10.69**	0.0197	**10.78**	0.0187	**8.41**	0.0178	**8.03**
$OLLEV_t$	+	0.0120	**3.99**	0.0115	**3.57**	0.0103	**4.56**	0.0112	**4.72**
$\Delta OLLEV_t$	+	0.0129	**2.31**	0.0143	**2.70**	0.0027	0.68	0.0050	1.24
G^{NOA}_t	–	-0.0316	**-10.30**	-0.0276	**-9.48**	-0.0357	**-12.09**	-0.0328	**-11.16**
ΔGross Profit $Margin_t$	+			0.1954	**7.83**			0.1705	**6.20**
Advertising $Intensity_t$	+			0.0859	**2.70**			-0.0002	0.00
Capital $Intensity_t$	+/–			-0.1398	**-3.65**			-0.3337	**-11.87**
Intangible $Intensity_t$	+			0.0136	0.45			-0.0164	**-1.71**
Age_t	+			0.0002	**2.57**			0.0003	**5.07**
Regulated $Industry_t$	+			-0.0038	-0.84			-0.1156	**-7.49**
Market $Share_t$	+			0.0135	0.67			0.0711	**3.79**
$Leverage_t$	–			0.0062	0.50			0.0262	**4.17**
Receivables $Turnover_t$	+			0.0001	**2.72**			0.0002	**4.55**
Inventory $Turnover_t$	+			0.0000	0.32			0.0000	-0.29
Growth Industry $Revenue_t$	+/–			0.0262	**1.75**			-0.0012	-0.14
$Size_t$	–			-0.0008	-0.95			-0.0023	**-3.49**
Adusted R^2		**24.36**		**25.94**		**20.96**		**21.89**	

TABLE 18 CONTINUED

Regression Results of Entry and Mobility Barriers on Future Changes in Profitability

Model 1b:

$$\Delta NOPM_{t+1} = \alpha + \beta_1 NOPM_t + \beta_2 \Delta NOPM_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + e_{t+1}$$

Model 2b:

$$\Delta NOPM_{t+1} = \alpha + \beta_1 NOPM_t + \beta_2 \Delta NOPM_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + \beta_6 \Delta GPM_t + \beta_7 AdvInt_t + \beta_8 CapInt_t + \beta_9 IntgInt_t + \beta_{10} Age_t + \beta_{11} D^{reg}{}_t + \beta_{12} Mktshare_t + \beta_{13} Lev_t + \beta_{14} IndGr_t + \beta_{15} \mathrm{Rec}T/O_t + \beta_{16} InvT/O_t + \beta_{17} Size_t + e_{t+1}$$

Regression Results of Entry and Mobility Barriers on Future Changes in NOPM

		Unadjusted for Industry Effects				**Controlling for Industry Effects**			
		Base	*t-statistic*	**Full**	*t-statistic*	**Base**	*t-statistic*	**Full**	*t-statistic*
α		0.0144	**7.34**	0.0038	1.33	0.0021	0.86	0.0035	1.17
$NOPM_t$	–	-0.2859	**-21.54**	-0.3314	**-20.77**	-0.2922	**-31.23**	-0.3115	**-32.35**
$\Delta NOPM_t$	–	-0.1450	**-10.85**	-0.1587	**-10.56**	-0.1209	**-12.36**	-0.1411	**-13.59**
$OLLEV_t$	+	0.0017	**1.86**	0.0012	1.28	0.0024	**3.14**	0.0031	**3.83**
$\Delta OLLEV_t$	+	0.0022	1.29	0.0031	**2.03**	-0.0028	**-1.67**	-0.0022	-1.32
$G^{NOA}{}_t$	–	-0.0164	**-6.70**	-0.0133	**-5.72**	-0.0238	**-12.14**	-0.0228	**-11.57**
ΔGross Profit Margin$_t$	+			0.1468	**8.52**			0.1439	**7.34**
Advertising Intensity$_t$	+			0.0450	**2.54**			0.0257	0.79
Capital Intensity$_t$	N/A			0.0005	0.01			-0.1216	**-5.71**
Intangible Intensity$_t$	+			-0.0036	-0.23			-0.0113	-1.55
Age$_t$	+			0.0001	**2.53**			0.0002	**4.74**
Regulated Industry$_t$	+			0.0147	**6.07**			-0.0472	**-7.11**
Market Share$_t$	+			0.0028	0.26			0.0376	**3.24**
Leverage$_t$	–			0.0227	**3.11**			0.0355	**9.54**
Receivables Turnover$_t$	N/A			0.0000	-1.19			0.0000	1.28
Inventory Turnover$_t$	N/A			-0.0001	**-3.70**			-0.0001	**-2.95**
Growth Industry Revenue$_t$	+/–			0.0140	1.63			-0.0012	-0.24
Size$_t$	N/A			0.0008	1.43			-0.0004	-1.02
Adusted R^2		**20.40**		**23.73**		**18.64**		**19.54**	

TABLE 18 CONTINUED

Regression Results of Entry and Mobility Barriers on Future Changes in Profitability

Model 1c:

$$\Delta NOAT_{t+1} = \alpha + \beta_1 NOAT_t + \beta_2 \Delta NOAT_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + e_{t+1}$$

Model 2c:

$$\Delta NOAT_{t+1} = \alpha + \beta_1 NOAT_t + \beta_2 \Delta NOAT_t + \beta_3 OLLEV_t + \beta_4 \Delta OLLEV + \beta_5 G_t^{NOA} + \beta_6 \Delta GPM_t + \beta_7 AdvInt_t + \beta_8 CapInt_t + \beta_9 IntgInt_t + \beta_{10} Age_t + \beta_{11} D^{reg}{}_t + \beta_{12} Mktshare_t + \beta_{13} Lev_t + \beta_{14} IndGr_t + \beta_{15} RecT/O_t + \beta_{16} InvT/O_t + \beta_{17} Size_t + e_{t+1}$$

Regression Results of Entry and Mobility Barriers on Future Changes in NOAT

		Unadjusted for Industry Effects				**Controlling for Industry Effects**			
		Base	*t-statistic*	**Full**	*t-statistic*	**Base**	*t-statistic*	**Full**	*t-statistic*
α		0.2464	**20.54**	0.3688	**15.35**	0.4222	**25.43**	0.6169	**27.13**
$NOAT_t$	–	-0.0777	**-12.33**	-0.0957	**-15.07**	-0.1224	**-33.53**	-0.1350	**-32.73**
$\Delta NOAT_t$	–	-0.0048	-0.46	-0.0007	-0.07	0.0106	1.41	0.0121	1.61
$OLLEV_t$	+	-0.0297	**-1.74**	0.0055	0.32	0.0271	**3.01**	0.0498	**5.31**
$\Delta OLLEV_t$	+	0.2616	**6.62**	0.2489	**6.27**	0.1349	**8.43**	0.1337	**8.42**
G^{NOA}_t	–	-0.3600	**-17.08**	-0.3570	**-17.15**	-0.3100	**-33.56**	-0.3015	**-32.38**
ΔGross Profit $Margin_t$	+			-0.2415	**-4.93**			-0.1800	**-3.31**
Advertising $Intensity_t$	N/A			0.0652	0.45			0.1719	1.20
Capital $Intensity_t$	+/–			-0.4503	**-7.71**			-0.3269	**-5.52**
Intangible $Intensity_t$	N/A			0.0375	0.52			0.0237	**2.25**
Age_t	+			0.0003	1.23			0.0005	**2.50**
Regulated $Industry_t$	+			-0.0883	**-7.53**			-0.0726	-1.35
Market $Share_t$	N/A			-0.0166	-0.27			0.5597	**7.56**
$Leverage_t$	N/A			0.0851	**3.52**			0.0405	**2.36**
Receivables $Turnover_t$	+			0.0018	**5.50**			0.0018	**6.84**
Inventory $Turnover_t$	+			0.0008	**2.11**			0.0011	**3.26**
Growth Industry $Revenue_t$	N/A			-0.0052	-0.11			-0.1118	**-4.24**
$Size_t$	–			-0.0216	**-7.48**			-0.0361	**-16.44**
Adusted R^2		**18.76**		**20.02**		**18.59**		**19.14**	

For firm years 1970 - 2003.

** Bold figures represent regression coefficients of .10 significance or better.

The regression coefficients are the mean of annual regression coefficients. T-statistics are based on the time-series of the White's standard errors corrected for heteroskedasticity.

RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities

(OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Size = log of total assets.

When future ΔNOPM is the dependent variable, the increase in adjusted R^2 from adding the barrier variables is much higher (from 20.40% to 23.73%, an increase of 16 percent). However, the increase in adjusted R^2 is modest in the industry-adjusted model (from 18.59% to 19.14%). The BTE variables that significantly affect future ΔNOPM are economies of scale (Δ in gross profit margin, t = 8.52), product differentiation (advertising intensity, t = 2.54), experience/learning (firm age, t = 2.53), and leverage over suppliers (specifically the change in OLLEV rather than the level, t = 2.03). Proprietary technology (intangible intensity), regulation, market share, borrowing capacity (leverage), and industry growth are not effective as barriers-to-entry. Interestingly, leverage is positively related to future profit margins (and this effect is more pronounced as a BTM in the industry-controlled analysis). The effect of the inventory turnover ratio is significantly negative (t = -3.70), which implies that frequent contracting with suppliers depresses profit margins.

When controlling for industry, the advertising intensity variable is no longer significant which suggests that it is not a profit margin barrier against existing competitors (BTM). Capital intensity ratio greater than the industry average has a strong negative relation to future ΔNOPM (t = -5.71). As with the RNOA model, market share acts as a BTM rather than a BTE (t =3.24).

The final specification using ΔNOAT as the dependent variable yields an increase in adjusted R^2 from adding the barrier variables of 6.7% (from 18.76% to 20.02%). The BTE variables that significantly affect future ΔNOAT are leverage over suppliers (ΔOLLEV and inventory turnover, t = 6.27 and t = 2.11, respectively) and bargaining power over customers (receivables turnover, t = 5.50). Economies of scale has a negative effect on future efficiency (t

= -4.93), perhaps because the increase in economies are not sustainable. Since the ΔGPM and future ΔNOAT are linked through revenues, this suggests that increases in GPM due to price increases are mean-reverting to prior levels. Regulation and size have negative effects on future efficiency and once again, leverage is positively related to future ΔNOAT. When controlling for industry, proprietary technology (intangible turnover, t = 2.25)), experience/learning (firm age, t = 2.50), and market share (t = 7.56) are BTMs rather than BTEs.

A summary of the results in the median, convergence, and regression tests are presented in Table 19. The variables that emerge as successful BTEs and BTMs are economies of scale (Δ in gross profit margin), product differentiation (advertising intensity), experience/learning (firm age), leverage over suppliers (operating liability leverage), and bargaining power over customers (receivables turnover). High industry growth serves as profit margin protection, at least in the short-run. Market share appears to be more effective as a barrier to mobility than to entry. In the convergence tests where a longer time horizon is examined, borrowing capacity also plays a barrier role. However, capital requirements (capital intensity), proprietary technology (intangible intensity), regulation, and size are not effective barriers to entry or mobility.

TABLE 19

Summary of Test Results

BTE Panel A	Median Tests	Primary Driver	Convergence Tests	Primary Driver	Regression Tests	Primary Driver
ΔGross Profit $Margin_t$	Yes	Both	Yes	NOPM	Yes	NOPM
Advertising $Intensity_t$	Yes	NOPM	Yes	NOPM	Yes	NOPM
Capital $Intensity_t$	No		No		No	
Intangible $Intensity_t$	No		No		No	
Age_t	No		No		Yes	Both
Regulated $Industry_t$	N/A		No		No	
Market $Share_t$	No		Yes	NOPM	No	
Borrowing $Capacity_t$	Yes	NOPM	Yes	NOAT	No	
$OLLEV_t$	Yes	NOAT	Yes	NOAT	Yes	Both
Receivables $Turnover_t$	Yes	NOAT	No		Yes	NOAT
Inventory $Turnover_t$	No		No		No	
Growth Industry $Revenue_t$	Yes	NOPM	No		Yes	NOPM
$Size_t$	No		No		No	

BTM Panel B	Median Tests	Primary Driver	Convergence Tests	Primary Driver	Regression Tests	Primary Driver
ΔGross Profit $Margin_t$	Yes	Both	No		Yes	NOPM
Advertising $Intensity_t$	Yes	NOPM	Yes	NOPM	No	
Capital $Intensity_t$	No		No		No	
Intangible $Intensity_t$	No		No		No	
Age_t	No		No		Yes	NOAT
Market $Share_t$	Yes	NOPM	Yes	NOPM	Yes	Both
Borrowing $Capacity_t$	Yes	NOAT	Yes	NOAT	No	
$OLLEV_t$	Yes	NOAT	Yes	NOAT	Yes	Both
Receivables $Turnover_t$	Yes	NOAT	No		Yes	NOAT
Inventory $Turnover_t$	No		No		No	
$Size_t$	No		No		No	

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities

(OL)/ Net operating assets (NOA); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Size = log of total assets.

A final step in the process is to evaluate the predictive ability of the barrier information in forecasting future change in RNOA. However, the modest increases in explanatory power between Models 1 and 2 may impede the effectiveness of incorporating barrier information into a prediction model. An estimation model was computed based on the years 1970 to 2002 and those coefficients were applied to a holdout sample from 2003 to forecast changes in RNOA for 2004. The difference in absolute forecasting errors between the benchmark and life cycle models (standardized by mean $\Delta RNOA_{t+1}$) is .03 (a three percent improvement), which is insignificant ($t = 0.50$). Therefore, while the preceding analysis is useful for understanding the effectiveness of barriers to entry and mobility and quantifying the magnitude of that effect, Model 2 contains too much noise to be effective as a forecasting tool. Future research should focus on developing industry-specific BTE/BTM models to improve forecasting future profitability with respect to those barriers.

Sensitivity Analyses

Industry-Specific Analysis

The industry-adjusted analyses presented throughout the paper demonstrate that entry barriers are not limited to being an industry phenomenon. However, industry membership will affect *which* barriers lead to sustained abnormal profitability. For the purpose of documentation, typical values of entry barriers by industry are provided in Table 20.[47] Sustained industry profits

[47] The Fama-French (1997) 48 industry classifications are used throughout the industry-level analysis.

suggest permanent BTEs and this analysis determines which barrier variables are effective (or ineffective in the case of abnormally low profitability) by industry.

To provide additional information about sustainability of profitability by industry, industries with extreme performance are identified. Abnormally high and low industries are presented in Table 21 and the accompanying barrier variables are noted if those values represented extreme expenditures relative to the sample.[48] The effectiveness of the various BTE variables depends on the industry to which a firm belongs. For example, consistently high profitability industries include agriculture, beer/liquor, tobacco, printing, consumer goods, pharmaceuticals, defense, insurance and trading.[49] Abnormally low profitability industries include textiles, coal, real estate, and utilities and communication, both of which are regulated industries.

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[48] Extreme performance is indicated when the profitability or barrier variable > |1 standard deviation| from the median profitability or barrier variable over the sample interval.

[49] Because a minimum of three consecutive years are needed to be included in the sample, the pharmaceutical companies presented in this analysis are greater than three years old. However, the excluded firms have low profitability such that the median RNOA for the entire industry drops from 12.9% to 9.3% when they are included.

TABLE 20

Means of the Yearly Median Barrier-to-Entry (BTE) Variables by Industry

	#Obs	RNOA	NOPM	ATO	ΔGPM	AdvInt	CapInt	IntanInt	Age	MktSh	OLLEV	IndRev Growth	Size	Lev	RecT/O	InvT/O
Pooled	**2,149**	**0.100**	**0.052**	**2.019**	**0.0003**	**0.0188**	**0.0325**	**0.0249**	**10.83**	**0.0034**	**0.369**	**0.086**	**5.134**	**0.24**	**6.574**	**4.221**
Agriculture	6	0.160	0.059	2.579	0.0032	0.0204	0.0354	0.0797	8.42	0.0633	0.366	0.075	4.982	0.21	11.944	10.543
Food Products	56	0.115	0.039	2.869	0.0018	0.0281	0.0245	0.0052	14.15	0.0043	0.372	0.059	5.387	0.25	12.719	6.107
Candy/Soda	5	0.094	0.050	1.960	0.0057	0.0292	0.0422	0.0051	13.41	0.0859	0.321	0.095	5.971	0.36	11.694	9.905
Beer/Liquor	10	0.117	0.066	1.778	0.0018	0.0816	0.0363	0.0226	13.20	0.0351	0.378	0.086	6.353	0.25	10.065	4.745
Tobacco	4	0.194	0.109	1.868	0.0050	0.0393	0.0236	0.0137	54.00	0.0489	0.413	0.127	6.312	0.31	14.699	2.132
Recreation	19	0.102	0.049	2.234	0.0009	0.0373	0.0244	0.0304	10.25	0.0141	0.335	0.062	4.358	0.24	5.534	3.553
Entertainment	21	0.101	0.076	1.383	0.0013	0.0346	0.0551	0.0040	8.71	0.0161	0.332	0.114	6.014	0.39	13.095	10.498
Printing	29	0.130	0.075	1.831	0.0029	0.0397	0.0393	0.0351	13.80	0.0186	0.415	0.085	6.004	0.20	6.980	10.404
Consumer Goods	53	0.120	0.049	2.392	0.0000	0.0474	0.0228	0.0180	12.65	0.0031	0.379	0.071	4.878	0.19	6.586	3.946
Apparel	42	0.108	0.045	2.503	0.0025	0.0291	0.0156	0.0074	13.16	0.0075	0.307	0.062	4.429	0.21	6.921	3.382
Healthcare	25	0.096	0.062	1.587	-0.0011	0.0064	0.0349	0.0300	6.45	0.0196	0.257	0.168	4.796	0.37	5.707	9.731
Medical Equip.	61	0.103	0.057	1.802	0.0028	0.0136	0.0335	0.0652	8.20	0.0063	0.299	0.098	4.125	0.16	5.174	2.552
Pharmaceuticals	57	0.129	0.070	1.650	0.0032	0.0470	0.0374	0.1002	10.87	0.0083	0.350	0.097	5.346	0.15	5.702	2.332
Chemicals	57	0.111	0.059	1.861	-0.0006	0.0186	0.0382	0.0284	17.00	0.0058	0.377	0.066	6.064	0.25	6.243	4.503
Plastics	34	0.104	0.047	2.165	-0.0007	0.0158	0.0338	0.0169	10.98	0.0092	0.320	0.063	4.288	0.26	6.947	5.099
Textiles	21	0.078	0.036	2.040	0.0009	0.0152	0.0318	0.0176	12.68	0.0324	0.296	0.043	5.293	0.28	6.482	4.556
Bldg. Mat.	78	0.102	0.049	1.908	0.0001	0.0135	0.0323	0.0116	15.71	0.0042	0.324	0.058	5.044	0.25	7.126	4.487
Construction	24	0.104	0.039	2.487	-0.0021	0.0155	0.0142	0.0127	10.10	0.0136	0.458	0.110	5.531	0.30	6.457	5.533
Steel	46	0.090	0.047	1.872	-0.0018	0.0174	0.0366	0.0105	16.18	0.0066	0.342	0.060	5.751	0.25	7.323	4.929
Fabrication	13	0.083	0.042	2.037	0.0005	0.0268	0.0299	0.0093	15.70	0.0388	0.353	0.057	4.623	0.26	6.785	4.786
Machinery	10	0.101	0.048	2.023	-0.0005	0.0123	0.0290	0.0257	11.27	0.0018	0.381	0.065	4.690	0.21	5.604	3.309
Electrical	47	0.106	0.052	2.039	-0.0003	0.0128	0.0282	0.0303	12.67	0.0036	0.334	0.047	4.369	0.20	6.125	3.285
Autos	49	0.107	0.043	2.429	-0.0009	0.0129	0.0287	0.0163	15.19	0.0015	0.428	0.065	5.393	0.24	7.100	5.761
Aircraft	21	0.099	0.049	1.938	0.0002	0.0095	0.0329	0.0244	21.90	0.0071	0.464	0.066	5.815	0.23	6.329	3.508
Ships/RR	6	0.111	0.043	2.844	0.0008	0.0115	0.0287	0.0242	17.78	0.0556	0.647	0.053	5.824	0.24	7.294	5.661
Defense	5	0.130	0.054	2.277	0.0036	0.0135	0.0316	0.0245	28.79	0.1202	0.579	0.071	6.532	0.23	6.852	5.968
Precious Metals	10	0.104	0.093	0.835	-0.0151	0.0114	0.1135	0.0165	20.99	0.0620	0.250	0.119	5.534	0.14	11.347	4.943
Mining	10	0.090	0.081	1.187	0.0001	0.0027	0.0680	0.0075	18.67	0.0513	0.282	0.056	6.105	0.22	7.133	4.604
Coal	3	0.074	0.056	1.423	-0.0046	0.0011	0.0806	0.0163	9.93	0.1953	0.499	0.110	5.860	0.31	8.078	13.877
Petroleum	89	0.088	0.082	0.899	-0.0006	0.0157	0.1471	0.0068	13.13	0.0008	0.344	0.084	6.098	0.27	5.724	7.401

TABLE 20 CONTINUED

Means of the Yearly Median Barrier-to-Entry (BTE) Variables by Industry

	#Obs	RNOA	NOPM	ATO	ΔGPM	AdvInt	CapInt	IntanInt	Age	MktSh	OLLEV	IndRev Growth	Size	Lev	RecT/O	InvT/O
Pooled	**2,149**	**0.100**	**0.052**	**2.019**	**0.000**	**0.019**	**0.032**	**0.025**	**10.831**	**0.003**	**0.369**	**0.086**	**5.134**	**0.239**	**6.574**	**4.221**
Utilities	129	0.082	0.122	0.695	-0.0025	0.0039	0.0748	0.0211	23.32	0.0089	0.336	0.119	6.935	0.41	8.250	12.196
Communication	53	0.072	0.101	0.722	0.0017	0.0230	0.1237	0.0287	9.54	0.0019	0.291	0.090	6.504	0.37	6.510	6.886
Personal Svcs.	17	0.104	0.050	1.989	-0.0032	0.0397	0.0384	0.0231	8.84	0.0358	0.347	0.111	4.800	0.26	7.756	3.941
Business Svcs.	156	0.109	0.040	2.788	0.0001	0.0167	0.0341	0.0806	6.91	0.0017	0.502	0.106	4.555	0.14	5.281	2.220
Computers	77	0.112	0.047	2.441	-0.0011	0.0152	0.0359	0.0864	6.93	0.0024	0.448	0.106	4.508	0.14	5.071	3.315
Electronics	138	0.095	0.043	2.084	0.0009	0.0115	0.0380	0.0639	9.52	0.0015	0.358	0.114	4.111	0.15	5.762	3.373
Lab Equip.	64	0.094	0.048	1.925	0.0018	0.0164	0.0316	0.0777	10.23	0.0045	0.339	0.077	4.014	0.15	4.807	2.557
Paper	56	0.104	0.052	2.074	-0.0011	0.0145	0.0363	0.0120	16.19	0.0050	0.347	0.077	5.649	0.25	8.049	6.214
Ship Containers	13	0.099	0.050	2.051	0.0000	0.0084	0.0415	0.0092	11.91	0.0433	0.341	0.055	6.284	0.30	8.989	6.609
Transportation	53	0.093	0.053	1.763	-0.0027	0.0145	0.0589	0.0004	11.09	0.0040	0.468	0.091	5.908	0.30	8.681	18.090
Wholesale	97	0.094	0.025	3.406	-0.0007	0.0117	0.0106	0.0015	9.44	0.0027	0.411	0.109	4.759	0.26	7.807	5.134
Retail	119	0.109	0.029	4.106	0.0009	0.0229	0.0165	0.0000	9.48	0.0016	0.476	0.093	5.309	0.21	29.624	4.659
Rest./Hospitality	29	0.106	0.054	2.092	0.0001	0.0311	0.0440	0.0006	9.02	0.0160	0.265	0.126	5.268	0.32	33.105	34.656
Banking	45	0.089	0.119	0.789	0.0090	0.0175	0.0130	0.0074	10.30	0.0138	2.816	0.133	7.618	0.39	0.193	4.445
Insurance	12	0.219	0.076	3.014	-0.0033	0.0117	0.0295	0.0587	7.71	0.0342	0.749	0.145	5.249	0.12	4.990	0.123
Real Estate	13	0.079	0.100	0.878	-0.0027	0.0349	0.0345	0.0113	10.95	0.0199	0.294	0.095	4.735	0.39	5.685	1.346
Trading	61	0.215	0.191	1.396	-0.0004	0.0282	0.0097	0.0003	8.47	0.0092	0.380	0.145	5.514	0.37	5.309	2.104

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Size = log of total assets.

TABLE 21

Barriers-to-Entry (BTE) Variables for High and Low Profitability Industries

	% of Total Obs	RNOA	NOPM	ATO	ΔGPM	AdvInt	CapInt	IntanInt	Age	MktSh	OLLEV	IndRev Growth	Size	Lev	RecT/O	InvT/O
Pooled	**2,149**	**0.100**	**0.052**	**2.019**	**0.0003**	**0.0188**	**0.0325**	**0.0249**	**10.83**	**0.0034**	**0.369**	**0.086**	**5.134**	**0.24**	**6.574**	**4.221**
High Profitability:																
Agriculture	0.28%	0.160	0.059	2.579	X			X		X				Low	X	X
Beer/Liquor	0.47%	0.117	0.066	1.778		X			X	X			Large		X	X
Tobacco	0.19%	0.194	0.109	1.868	X	X			X	X			Large		X	
Printing	1.35%	0.130	0.075	1.831	X	X	X	X	X	X			Large	Low	X	X
Consumer Goods	2.47%	0.120	0.049	2.392		X								Low		
Pharmaceuticals	2.65%	0.129	0.070	1.650	X	X		X		X				Low		
Defense	0.23%	0.130	0.054	2.277	X				X	X	X		Large			X
Insurance	0.56%	0.219	0.076	3.014				X		X	X			Low		
Trading	2.84%	0.215	0.191	1.396		X				X		X				
	11.03%															
Low Profitability:																
Textiles	0.98%	0.078	0.036	2.040						X						X
Coal	0.14%	0.074	0.056	1.423			X			X	X		Large		X	X
Utilities	6.00%	0.082	0.122	0.695			X		X	X			Large		X	X
Communication	2.47%	0.072	0.101	0.722		X	X						Large			X
Real Estate	0.60%	0.079	0.100	0.878		X				X						
	10.19%															

For firm years 1970 - 2003.
RNOA = Operating income (OI_t)/ Average net operating assets (NOA); NOPM = Operating income (OI) / Net sales; NOAT = Net sales / Average net operating assets (NOA); $Growth^{NOA}$ = (Net Operating Assets (NOA_t)/lagged Net Operating Assets (NOA_{t-1})) – 1; GPM = Gross profit / Net sales; Advertising intensity = Advertising expense / Net sales; Capital intensity = Depreciation expense / Net sales; Intangible intensity = (R&D + patent amortization expense) / Net sales; Firm age = number of years since first appearance on CRSP; Regulation is an indicator variable that equals 1 if the industry is in SIC codes 40XX-49XX, 60XX, 61XX, 62XX, 63XX; zero otherwise; Market share = Net sales / Industry net sales (where industry is defined using the Fama-French 48 industry classifications); Leverage = Debt / Total assets; Operating liability leverage = Operating liabilities (OL)/ Net operating assets (NOA); Industry growth = Change in industry net sales (where industry is defined using the Fama-French 48 industry classifications); Receivables T/O = Net sales / Average receivables; Inventory T/O = Cost of goods sold / Average inventory; Size = log of total assets.

An analysis of effective barriers by industry shows that an increase in economies of scale is an effective BTE for the agriculture, tobacco, printing, pharmaceutical and defense industries. A high level of advertising intensity is effective for many consumer-based industries such as beer/liquor, tobacco, printing, consumer goods, pharmaceuticals, and trading. Yet, product differentiation does not return high overall returns for the communications and real estate industries. High levels of capital intensity are not effective for any industries except for printing. Thus, capital intensity is likely a necessary cost of operations rather than an effective entry barrier. The high capital requirements of industries such as coal, utilities, and communications do not elevate profitability above other industries. Proprietary technology (intangible intensity) is a successful barrier variable for the agriculture, printing, and pharmaceutical industries.[50]

Firm age acts as a BTE in two ways. Age affects the profitability of consumer-based firms due to long-standing brand awareness as seen in the beer/liquor and tobacco industries. Other industries such as printing and defense benefit from the learning curves that accompany age. For the utilities industry, age is not an effective BTE due to its regulatory constraints.

Market share is high not only for all of the profitable industries (with the exception of consumer goods), but for most of the low-profitability industries, as well excluding the communications industry. This will occur if most industries are dominated by one or more market leaders. However, upon further inspection, only the printing industry showed a reliably positive correlation between RNOA and level of market share (results untabulated). In most industries, the dominant firms in terms of market share are not necessarily those firms with the highest profitability.

[50] Financial intangibles associated with insurance firms are a result of an accounting classification rather than the result of true research and development, and as such, insurance is not considered to benefit from proprietary technology in the strictest sense.

Industry growth leads to abnormally high profitability only for the trading industry. Further, size does not lead to profitability and in fact, can hinder profitability as seen in the coal, utilities, and communications industries. Borrowing capacity is associated with high profits in several industries including agriculture, printing, consumer goods, pharmaceuticals, and insurance.

Bargaining power over customers is effective for many consumer-based industries such as agriculture, beer/liquor, tobacco, and printing. However, it is not a barrier in industries that are required by regulatory bodies to provide services to customers (i.e., utilities). Finally, bargaining power over suppliers is most evident in defense contractors. The inventory turnover ratio is high for the agriculture, beer/liquor, and printing industries, but this is more due to the perishable nature of their inventory rather than power over suppliers.

Temporal Analysis

The next sensitivity analysis examines whether there have been structural shifts in the profitability function over time. Core, Guay and Van Buskirk (2003) examine market-to-book ratios during two hypothesized periods: the old and new economy time periods. They find some evidence that there has been a structural shift in the earnings-return relation over the past several decades. Similarly, Joos (2000) finds that capital intensity, market share and industry concentration are decreasing over time, which is indicative of increasing competitiveness among firms over time. For this reason, extreme performance among industries is re-examined over four time periods: 1970-1977, 1978-1986, 1987-1995, and 1996-2004. Table 22 presents the extremely profitable industries over those time intervals, while Table 23 presents the unprofitable industries over the same time intervals.

Note that several industries have permanent abnormally high profitability over the entire 35-year sample period including insurance, tobacco, printing, and consumer goods. The defense and ships/railroad industries have posted abnormal profits for the past three decades. Finally, the trading, apparel, aircraft, construction, and building material industries have enjoyed high profitability in recent years. Only the textiles industry has survived the entire sample period with abnormally low profitability. However, the coal, real estate, and utilities industries displayed low profitability in three out of the four time periods. Other industries are transient members on the low profitability list, which is consistent with the exercise of abandonment and/or adaptation options in response to sustained poor performance.

TABLE 22

High Profitability (RNOA) Industries by Time Interval

Industry	**1970-2004**	**1970-1977**	**1978-1986**	**1987-1995**	**1996-2004**
Mean RNOA	*10.0%*	*9.97%*	*11.1%*	*10.0%*	*8.6%*
Insurance	21.9	23.5	20.3	24.1	19.6
Trading	21.5			20.0	49.2
Tobacco	19.4	11.8	17.8	19.4	29.1
Agriculture	16.0		36.0		
Printing	13.0	12.9	15.2	12.2	11.5
Defense	13.0		16.7	13.9	11.4
Pharmaceuticals	12.9	17.4	18.8	12.6	
Consumer Goods	12.0	12.5	12.9	11.3	11.3
Beer/Liquor	11.7		13.7	13.0	
Precious Metals		15.8	22.6		
Coal		15.7			
Candy/Soda		14.0			
Computers			14.5	12.7	
Personal Services			14.4		
Business Services			13.2	12.0	
Food Products			13.0	12.4	
Retail			12.8		
Electrical			12.8		
Ships/Railroads			12.5	11.3	12.2
Chemicals				12.3	
Apparel				11.9	11.1
Autos/Trucks				11.7	
Medical Equipment				11.4	
Paper				11.3	
Aircraft					12.0
Construction					11.6
Building Materials					10.3

TABLE 23

Low Profitability (RNOA) Industries by Time Interval

Industry	**1970-2004**	**1970-1977**	**1978-1986**	**1987-1995**	**1996-2004**
Mean RNOA	*10.0%*	*9.97%*	*11.1%*	*10.0%*	*8.6%*
Communication	7.2	7.8		7.7	
Coal	7.4		7.0	2.0	6.4
Textiles	7.8	7.9	9.1	7.9	6.1
Real Estate	7.9	6.9		7.7	7.0
Utilities	8.2	7.5	8.8	8.7	
Banking		6.2		8.4	
Trading		6.3			
Agriculture		7.9			
Healthcare		8.1			
Personal Services		8.3			
Ships/Railroads		8.3			
Fabrication			7.4		6.9
Mining			7.4	8.6	
Steel			9.0		
Petroleum			9.6	6.2	
Candy/Soda				6.5	
Precious Metals				7.3	-5.3
Aircraft				7.8	
Construction				8.4	
Pharmaceuticals					2.1
Electronics					4.4
Computers					5.3
Business Services					6.7

In summary, several barriers are deemed effective and generalize to the entire sample studied in this thesis. Specifically, economies of scale (Δ in gross profit margin), product differentiation (advertising intensity), leverage over suppliers (operating liability leverage), and bargaining power over customers (receivables turnover) are successful entry and mobility barriers, which provide persistent operating returns even after five years. More importantly, their inclusion in a model of future profitability enhances explanatory power. Finally, market share serves as an effective barrier-to-mobility against existing competitors, but does not appear to deter entry with respect to potential competitors.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

This thesis examines the explanatory power and predictive value of economic variables related to industrial organization as they interact with firm profitability and growth. In doing so, a comprehensive framework is developed which can be used to evaluate and analyze a firm's performance conditional on its strategic positioning and interaction with other firms. An examination of firm profitability and growth, both in the cross-section and over time, is undertaken to determine the impact of firm life cycle and barriers-to-entry (BTEs) erected by the firm (two fundamental economic constructs).

Firm profitability and growth are hypothesized to be differentially impacted by firm life cycle and results are consistent with this prediction. First, the results indicate that differences across firm life cycle statistically affect profitability and growth in the cross-section. Profitability metrics such as return on common equity (ROCE), return on net operating assets (RNOA), and net operating profit margin (NOPM) display an inverted U-shaped pattern, which demonstrate that partitioning firms by performance does not adequately control for differences in firm life cycle. Second, convergence rates and the patterns of mean-reversion differ by life cycle stage as compared to the pooled results shown in Nissim and Penman (2001). Specifically, RNOA partially converges to a permanent range of approximately 4 to 11 percent. In addition, growth in net operating assets (NOA) temporarily collapses, but diverges again by the fifth year. Finally, differences in profit margin among life cycle stages are largely permanent, but the temporal behavior of asset turnover varies with life cycle stage. The valuation and forecasting implications are that growth rates and forecast horizons should be selected conditional on a firm's current life cycle stage.

This study also hypothesizes that life cycle stage affects the performance of RNOA decompositions in explaining future changes in RNOA. Results show that even after controlling for current profitability and growth, incorporating information about life cycle stage substantially improves the performance of the models. Additionally, current and past profitability, level of operating liability leverage (OLLEV), growth in NOA, and the changes in profit margin and asset turnover take on varying degrees of importance in explaining future profitability by life cycle stage. Changes in profit margins are positively, albeit insignificantly, associated with future profitability in the early life cycle stages whereas changes in asset turnover become more important as competitive pressures erode profit margins.

Finally, the impact of BTEs and barriers-to-mobility (BTMs) on firm and industry profitability is examined, both cross-sectionally and temporally. The economics literature has identified several variables that proxy for BTEs, defined as factors that allow a firm or industry to deter the entry of new competitors. Similarly, Porter (1980) defines barriers-to-mobility as those factors that allow a firm to shield its current level of profitability from existing competitors.

Profits and losses signal the existence of excess supply or demand (Mueller, 1986; Stigler, 1963). When firms are free to respond to these signals, they enter and exit markets until returns are equalized across markets. However, because of entry and mobility barriers, along with competitive uncertainty, this normalization never obtains in the short run. More importantly, the short-run deviations are sufficiently long in duration as to affect the performance of virtually all equity valuation models. For this reason, a richer analysis of the effects of barriers to entry and mobility on profitability yields insights that improve our understanding of the determinants of profitability.

Results show that there are several successful barrier variables that generalize across the entire sample including economies of scale (change in gross profit margin), product differentiation (advertising intensity), operating liability leverage (OLLEV) which captures a firm's power over its suppliers, and receivables turnover, which captures power over a firm's customers. Elevated levels of these barriers resulted in persistent profits above the norm even after five years. Additionally, contemporaneous levels of these variables had a positive effect on one-year-ahead RNOA, even after controlling for current profitability and growth in NOA. Market share serves within industries as barriers-to-mobility against existing competitors, but is ineffective as a BTE against potential competitors.

This research makes several contributions to the existing profitability and analysis literature. First, life cycle stage and barrier expenditures affect the incidence and rates of convergence of the drivers of profitability and growth. Consequently, the validity of constant growth rates (implicit in continuing value calculations) should be assessed conditional on a firm's life cycle stage and barrier expenditures. Second, modeling the behavior of operating income under various life cycle stages and conditional on the level of barrier expenditures enhances the explanatory power of the determinants of operating income. Third, the evidence reported in this paper provides empirical evidence with respect to profitability and growth patterns across life cycle stages, which contributes to building a unified framework of life cycle performance. This study also develops and applies an objective and parsimonious method based on cash flow patterns to classify firms according to life cycle stage.

With respect to the barrier analysis, the findings in this study are important in that they determine whether resources expended to erect barriers to entry and mobility result in persistent abnormal profits. For example, the evidence demonstrates that expanding economies of scale and erecting barriers by increasing capital intensity do not protect profitability from converging to an economy-wide and industry-wide mean. Investing in research and development and other intangible assets do not provide increases in profitability at least over the five-year window examined in the paper. Firm size is not a barrier against competitors, and in fact, it dampens profitability.

Subsequent research could further model the interaction between life cycle stage and barrier variables in valuation and forecasting settings. This paper demonstrates that firm life cycle is not synonymous with industry life cycle due to within-industry differences in endowments, rates of investment, obsolescence rates, learning and experience curves, adaptation, product-differentiation, and production efficiencies. Therefore, capturing differences in industry does not subsume the firm-specific effect of life cycle.

The study also reveals that industry membership has little incremental effect over the pooled BTE results, which contributes to the debate regarding whether industry analysis provides incremental contribution to profitability-based research. However, there were differences across industries as to which specific barrier variables were associated abnormally high profitability. Thus, the barrier mix varies by industry but that does not inhibit the generalizability of the barrier variables identified in this study.

In sum, this thesis documents the importance of differences across life cycle stage and levels of barrier expenditures for capturing the nonlinearities evident in profitability and growth metrics. The study provides a model explanatory power and predictive value of economic variables related to industrial organization as they relate to firm profitability and growth. Moreover, a comprehensive framework is developed which can be used to evaluate and analyze a firm's performance conditional on its strategic positioning and interaction with other firms.

APPENDIX

VARIABLE DEFINITIONS

The cash flow activity variables used to classify firms by life cycle stage are: Compustat variables: #308 Cash Flows from Operating Activities, #311 Cash Flows from Investing Activities, and #313 Cash Flows from Financing Activities. Only firms with an absolute value of greater than $1 million in each cash flow category are included in the sample.

Other variables are similar to those used in Nissim and Penman (2001) and are presented in alphabetical order:

Advertising Intensity = Advertising expense (Compustat #45) / Net sales (Compustat #12)

Capital Intensity = Depreciation expense (Compustat #14) / Net sales (Compustat #12)

Change in Gross Profit Margin (ΔNOAT) = Gross Profit Margin (GPM_t) minus lagged Gross Profit Margin (GPM_{t-1})

Change in Net Operating Asset Turnover (ΔNOAT) = Net Operating Asset Turnover ($NOAT_t$) minus lagged Net Operating Asset Turnover ($NOAT_{t-1}$)

Change in Net Operating Profit Margin (ΔNOPM) = Net Operating Profit Margin ($NOPM_t$) minus lagged Net Operating Profit Margin ($NOPM_{t-1}$)

Change in Return on Net Operating Assets (RNOA) = Return on Net Operating Assets ($RNOA_t$) minus lagged Return on Net Operating Assets ($RNOA_{t-1}$)

Common Equity (CSE) = Total common equity (Compustat #60) plus preferred treasury stock (Compustat #227) minus preferred dividends in arrears (Compustat #242)

Comprehensive Net Income (CNI) = net income (loss) (Compustat #172) minus preferred dividends (Compustat #19) plus the change in the marketable securities adjustment (Δ in Compustat #238) plus the change in the cumulative translation adjustment in retained earnings (Δ in Compustat #230)

Dividend Payout Ratio = Dividends per Share (DPS)/ Basic earnings per share EPS (Compustat #58)

Dividends per Share (DPS) = Common dividends (Compustat #21)/ Common shares outstanding (Compustat #54)

Excess Cash = Cash flows from operations (Compustat #308) / Net sales (Compustat #12)

Financial Assets (FA) = Cash and short-term investments (Compustat #1) plus Long-term receivables, investments and advances to affiliated companies (Compustat #32)

Financial Leverage (FLEV) = Net Financial Obligation (NFO)/Common Equity (CSE)

Financial Obligations (FO) = Debt in current liabilities (Compustat #34) plus total long-term debt (Compustat #9) plus preferred stock (Compustat #130) minus preferred treasury stock (Compustat #227) plus preferred dividends in arrears (Compustat #242)

Gross Profit = Net Sales (Compustat #12) minus Cost of Goods Sold (Compustat #41)

Gross Profit Margin = Gross Profit / Net sales (Compustat #12)

Growth in Common Equity (CSE) = (Common Equity (CSE_t)/ Lagged Common Equity (CSE_{t-1})) – 1

Growth in Net Operating Assets (NOA) = (Net Operating Assets (NOA_t)/ Lagged Net Operating Assets (NOA_{t-1})) – 1

Growth in Net Sales = (Net Sales $_t$/ Lagged Net Sales $_{t-1}$) – 1

Intangible Intensity = [Research and development expense (Compustat #46) plus Patent amortization expense (Compustat #65)] / Net sales (Compustat #12)

Leverage = [Debt in current liabilities (Compustat #34) plus total long-term debt (Compustat #9)] / Total assets (Compustat #6)

Marginal Tax Rate = Applicable highest federal tax rate + .02 to approximate state taxes. This definition is taken from Nissim and Penman (2001). The federal tax rates applicable to this sample are 34% for years 1989 – 1992 and 35% for 1993 – 2002.

Net Borrowing Cost (NBC) = Net Financial Expense (NFE_t)/ Average Net Financial Obligation (NFO)

Net Financial Expense (NFE) = (Interest expense (Compustat #15) * (1 minus the marginal tax rate)) plus preferred dividends (Compustat #19) minus (Interest income (Compustat #62) * (1 minus the marginal tax rate)) plus lagged marketable securities adjustment (Compustat #238 $_{t-1}$) minus current marketable securities adjustment (Compustat #238 $_t$)

Net Financial Obligation (NFO) = Financial Obligations (FO) minus Financial Assets (FA)

Net Operating Assets (NOA) = Net Financial Obligation (NFO) plus Common Equity (CSE) plus minority interest (Compustat #38) [This definition is used rather than the more common expression Operating Assets (OA) minus Operating Liabilities (OL) to be consistent with prior research and due to incomplete data in the Compustat variables related to operating liabilities.]

Net Operating Asset Turnover (NOAT) = Net sales (Compustat #12)/ Average Net Operating Assets (NOA)

Net Operating Profit Margin (NOPM) = Operating Income (OI) / Net sales (Compustat #12)

Operating Assets (OA) = Total assets (Compustat #6) minus Financial Assets (FA)

Operating Income (OI) = Comprehensive Net Income (CNI) plus Net Financial Expense (NFE)

Operating Liabilities (OL) = Operating Assets (OA) minus Net Operating Assets (NOA)

Operating Liability Leverage (OLLEV) = Operating Liabilities (OL)/ Net Operating Assets (NOA)

Return on Assets (ROA) = (Net income (loss) (Compustat #172) plus (Interest expense (Compustat #15) * (1 minus the marginal tax rate)))/ Average total assets (Compustat #6)

Return on Common Equity (ROCE) = Comprehensive Income (CNI_t) / Average Common Equity (CSE)

Return on Net Operating Assets (RNOA) = Operating Income (OI_t)/ Average Net Operating Assets (NOA)

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