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Capital structure decisions: Evidence from deregulated industries ☆

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ABSTRACT

Deregulation significantly affects the firms' operating environment and leverage decisions. Firms experience a significant decline in profitability, asset tangibility and a significant increase in growth opportunities following deregulation. Firms respond by reducing leverage. Deregulation also significantly affects the cross-sectional relation between leverage and its determinants. Leverage is much less negatively correlated with profitability and market-to-book and much more positively (negatively) correlated with firm size (earnings volatility) following deregulation. These results are consistent with the dynamic tradeoff theory of capital structure. Also consistent with the dynamic tradeoff theory, those firms that are more likely to be above their target capital structure issue significantly more equity in the first few years following deregulation.

1. Introduction

The finance literature has traditionally offered two theories of capital structure. In the tradeoff theory, firms pick target leverage by weighing the benefits and costs of an additional dollar of debt. The benefits of debt include the tax deductibility of interest and the reduction of the free cash flow problem (Jensen, 1986). The costs of debt include the expected financial distress costs and the costs arising from the agency conflict between shareholders and bondholders. At target leverage, the benefit of the marginal dollar of debt exactly equals the cost.

In the pecking order theory of Myers (1984), the costs of issuing new securities dominate other considerations. These costs arise because management possesses private information about the value of risky securities and uses this information when making issuing decisions. Because of these costs, firms use internal capital to finance new projects. When internal capital is insufficient, firms issue safe and then risky debt. Equity is issued as a last resort.

Despite significant research in this area, our understanding of capital structure decisions is far from complete. Neither theory is capable of explaining all regularities in capital structure decisions. Previous research has found leverage to be related to profitability, market-to-book, firm size, asset tangibility, and industry leverage in a manner consistent with either one or the other theory. It is not clear whether target leverage exists and, assuming that it does, there is disagreement about how quickly firms adjust to the target. Interestingly, firms are not inactive in their refinancing decisions but the decisions that they make appear to contradict either the tradeoff or the pecking order theory. Firms appear to fail to take full advantage of the tax deductibility of debt. Firms also appear to fail to counteract the effects of stock prices on leverage, so changes in market leverage are significantly related to stock prices, and past

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market-to-book ratios predict current leverage.[1] Empirical tests are further complicated by the fact that capital structure appears highly persistent in the time-series, which makes identification of factors relevant for capital structure decisions more challenging (Lemmon, Roberts, and Zender, 2008).

This paper attempts to address this challenge and further our understanding of capital structure dynamics by studying the evolution of capital structure in response to economic deregulation. Economic deregulation is a significant shock that considerably affects the operating environment of firms, so it is natural to ask whether and how capital structure evolves in response to such a shock. Because deregulation permanently and (at least in some industries) dramatically transforms the operating environment, capital structure should evolve in a non-trivial way unless it is strictly fixed or irrelevant. Thus, by documenting the capital structure response to changes in the operating environment brought by deregulation, I attempt to isolate factors that are important for leverage decisions.

Some economists assert that the wave of economic deregulation of U.S. industries in the 1970s, 80s, and 90s represents one of the (if not, the) most significant experiments in modern economic policy. Winston (1993), citing the 1991 Survey of Current Business, reports that fully regulated industries produced 17% of U.S. Gross National Product (GNP) in 1977. By 1988, that percentage had been reduced to 6.6% of GNP. Viscusi, Harrington, and Vernon (2005) provide a summary of major deregulatory initiatives adopted at the federal level between 1971 and 2000. The list includes over 40 initiatives affecting such industries as transportation, telecommunications, entertainment, utilities, petroleum and natural gas, and financial services. Dozens more deregulatory initiatives have been adopted at the state level, effectively deregulating a significant portion of the U.S. economy. Thus, deregulation provides a rich laboratory to study firm policies.

Before proceeding, it is appropriate to define the type of deregulation that is the focus of this paper. Economic deregulation is defined as deregulation of entry, exit, price, and quantity. Deregulation of entry allows entry into an industry by new firms or by existing regulated firms and increases industry competition. Deregulation of exit allows existing firms to exit unprofitable lines of business and shed excess capacity. Deregulation of price and quantity allows firms to set prices and production quantities at competitive levels. A substantial body of evidence, summarized in Winston (1993, 1998), indicates that deregulation has had a significant impact on deregulated industries by affecting market structure, prices and price volatility, service quality, industry profits, growth opportunities, wages, employment, and, finally, consumer welfare. For example, the passage of the Motor Carrier Act of 1980 resulted in a significant increase in the number of motor carriers in the industry. McMullen and Stanley (1988) show that between 1978 and 1985 the number of motor carriers doubled from 16,874 to 33,823, while over 6,000 carriers failed. Similarly, Moore (1991) reports that by 1990 the total number of licensed carriers exceeded 40,000 compared with 17,000 authorized carriers in 1980. Viscusi, Harrington, and Vernon (2005), using data from the Dun and Bradstreet's Business Failure Record, report that the number of bankruptcies among trucking companies increased substantially from an average of <250 bankruptcies per year between 1974 and 1979 to over 350 in 1980, to over 550 in 1981, to over 950 in 1982, and approached 1,550 per year by 1985. In terms of industry efficiency improvements, Winston (1998) reports that deregulated industries substantially improved their productivity and reduced real operating costs from 25% to 75%.

Under both the tradeoff and the pecking order theories, firm leverage should respond in a predictable way to changes in the firms' operating environment brought by deregulation. I explore the comparative statics arising from this natural experiment. I find a significant decline in deregulated firms' leverage following deregulation. The market leverage ratio declines from an average of 42.3% prior to deregulation to an average of 31.9% following deregulation. I find significant contemporaneous declines in deregulated firms' profitability and asset tangibility and an improvement in deregulated firms' growth opportunities. These changes are not merely time effects. When I compare the evolution of leverage and its determinants for deregulated firms with the evolution of leverage and its determinants for size, growth, and profitability matched firms, I do not find similar patterns for the latter group.

Next, I analyze whether the time-series changes in leverage and leverage determinants are a result of changes in the existing firms' decision making or a simple manifestation of the changing composition of the industry brought by deregulation. For example, deregulation of entry is likely to increase the inflow of new firms into the affected industries and the outflow of less competitive firms out of those industries. New firms have higher growth opportunities (Fama and French, 2001) and are, therefore, likely to pick low leverage to control the underinvestment problem (Barclay, Smith, and Watts, 1995). Exiting firms that exit due to bankruptcy have much higher leverage (White, 1989; Bris, Welch, and Zhu, 2006; Frank and Goyal, 2008) and, by definition, much lower profitability prior to their exit. So, it is possible that the decline in leverage following deregulation may result, at least in part, from the entry of new high growth-opportunities firms into the deregulated industries and

[1] See Bradley, Jarrell, and Kim (1984), Titman and Wessels (1988), Smith and Watts (1992), Rajan and Zingales (1995), Fama and French (2002), Flannery and Rangan (2006), and Lemmon, Roberts, and Zender (2008), among others, for evidence of a cross-sectional relation between leverage and its determinants; Welch (2004) and Fama and French (2005) for inconsistencies of issuing decisions with the tradeoff and the pecking order theories; Fama and French (2002) and Flannery and Rangan (2006) for estimates of the speed of adjustment toward target leverage; Miller (1977) and Graham (2000) for the firms' failure to take full advantage of the tax deductibility of debt; Welch (2004) for the importance of stock prices in explaining changes in leverage; Baker and Wurgler (2002) for the importance of past market-to-book ratios for current leverage. Frank and Goyal (2008) provide a more complete review of the capital structure literature.

from the exit of less competitive bankrupt firms from the deregulated industries.

I split the sample of deregulated firms into surviving, acquired, bankrupt, and new firms, and show that surviving and acquired firms decrease leverage and experience a decline in profitability, but no notable change in growth opportunities. At the same time, new firms characterized by low leverage, low profitability, and high growth opportunities enter deregulated industries while non-surviving bankrupt firms characterized by high leverage, low profitability, and low growth opportunities exit deregulated industries. Thus, newly deregulated industries increasingly tilt toward firms with low leverage, low profitability, and high growth opportunities. Contemporaneously, surviving and acquired firms experience a decline in profitability, and respond by actively rebalancing toward lower leverage. The time-series results are consistent with the tradeoff theory of capital structure. Declining profitability following deregulation increases the expected bankruptcy cost and lowers the agency cost of free cash flow (Jensen, 1986). Increasing growth opportunities increase the agency costs of debt [underinvestment (Myers, 1977), asset substitution and asset dilution (Jensen and Meckling, 1976)] thus making debt less attractive. Declining asset tangibility increases the expected bankruptcy cost and increases the asset substitution incentives of managers. Firms respond by reducing leverage.

My next set of tests focuses on the cross-sectional relation between leverage and its determinants and on the extent to which this relation evolves in response to deregulation. I find a strong positive relation between leverage and firm size following deregulation but no relation between leverage and firm size during the regulated period. I also find a strong negative relation between leverage and earnings volatility following deregulation and a strong *positive* relation between leverage and earnings volatility during the regulated period. Larger firms are more likely to be diversified and less likely to fail. Firms with more volatile earnings are more likely to encounter financial distress. Thus, the positive relation between leverage and size and the negative relation between leverage and earnings volatility following deregulation is consistent with bankruptcy costs playing an important role in leverage decisions. The fact that no relation between leverage and size exists and the fact that the relation between leverage and earnings volatility is of the "wrong" sign prior to deregulation suggests that bankruptcy considerations are less relevant for regulated firms. This result seems plausible since regulated firms have fewer incentives to operate efficiently and face a lower threat of costly reorganization or liquidation than unregulated firms operating in a more competitive environment.

In addition to size and earnings volatility results, I also find that leverage of deregulated firms is much more negatively correlated with profitability and market-to-book during the regulated period; the correlation, while still negative and statistically significant, becomes much less economically significant following deregulation. The more negative relation between leverage and market-to-book during the regulated period is particularly striking considering that regulation helps control the underinvestment problem (Smith and Watts, 1992). These results are consistent with the dynamic version of the tradeoff theory (Fischer, Heinkel, and Zechner, 1989; Leary and Roberts, 2005; Strebulaev, 2007). Unlike the static tradeoff theory, which implicitly assumes that firms always stay at target leverage by continuously adjusting leverage to the target, the dynamic version recognizes that financing frictions make it suboptimal for firms to continuously adjust leverage to the target. Under the dynamic tradeoff theory, firms weigh the benefit of adjusting against the adjustment cost and make leverage adjustments only when the benefit outweighs the cost. Consequently, leverage wanders away from target leverage until readjustment. In the cross-section, variables that mechanically affect leverage in the absence of readjustment (profits and stock prices, for example) will be correlated with leverage. Moreover, the less frequent the readjustment, the higher the correlation of leverage with these variables. It seems reasonable that leverage adjustment to target leverage is less frequent when firms are regulated. This is because regulated firms are not forced to operate efficiently, so the benefit of adjusting leverage to the target is likely to be small relative to the adjustment cost. As a result, regulated firms make leverage adjustments less frequently and instead let it move mechanically with profits and stock prices. The more negative cross-sectional correlation of leverage with profitability and of leverage with market-to-book during the regulated period is, therefore, consistent with the dynamic tradeoff theory.

When I examine the predictions of the dynamic tradeoff theory further, I find evidence consistent with dynamic adjustment to target leverage. I find that deregulated firms become more active in their financing activity in response to deregulation and issue substantially more equity. Recently deregulated firms also increase their debt retirement activity in response to deregulation. In cross-sectional tests, I find that those firms that are more likely to be above their target leverage, such as high leverage firms and firms with leverage substantially above industry median leverage, issue significantly more equity following the beginning of deregulation.

Overall, the results in this paper indicate that deregulation has a significant impact on the firms' operating environment, which, in turn, significantly affects capital structure. Firms respond to lower profitability, higher growth opportunities, and higher bankruptcy cost considerations resulting from deregulation by lowering leverage, a behavior that is consistent with the tradeoff theory of capital structure. This result is important in light of evidence on aggregate leverage in Frank and Goyal (2008) who report that capital structure has been remarkably stationary in the 20th century.[2] The authors argue that this capital structure stationarity is a serious

[2] Lemmon, Roberts, and Zender (2008) use firm-level data and similarly report that capital structure exhibits a significant permanent component.

warning sign for the tradeoff as well as the pecking order theories. Using firm-level data and a sample of firms that experienced a significant shock to their operating environment, I show that capital structure does respond to changes in the external environment. In this sense my results are similar to Korajczyk and Levy (2003) who find that capital structure of firms responds to changes in macroeconomic conditions. My results also indicate that firms make capital structure adjustments in a manner consistent with the dynamic tradeoff theory of capital structure. Deregulation has the effect of "speeding up" capital structure adjustments, and those firms that are more likely to be above their target leverage are more likely to issue equity in the few years following deregulation.

The rest of the paper is organized as follows. Section 2 develops the hypotheses of the effects of deregulation on capital structure decisions. Section 3 describes the sample, and Section 4 presents time-series evidence of the evolution of leverage and its determinants in response to deregulation. Section 5 presents cross-sectional evidence of the relation between leverage and its determinants and the extent to which this relation evolves in response to deregulation. Section 6 analyzes specific capital structure adjustments of deregulated firms and whether the adjustment behavior is consistent with the dynamic tradeoff theory. Section 7 concludes.

2. Hypotheses

The regulatory environment is expected to have a significant impact on firm leverage. Under both the tradeoff and the pecking order theories of capital structure, firm leverage varies with profitability and investment opportunities. As both are significantly affected by regulation and deregulation, leverage should vary in a predictable way across different regulatory regimes. In my discussion below, I draw on a large literature in regulatory economics that focuses on the effects of economic regulation (i.e., regulation of entry, exit, price, and quantity) on firm policies.[3] My focus is on the effects of regulatory reform on firm profitability, investment, and other characteristics, and on the impact of changes in these characteristics on firms' leverage decisions.

2.1. Profitability

Economists generally agree that deregulation raises firm profitability in some industries and has little effect on or lowers firm profitability in other industries. The reason for increased profitability following deregulation stems from inefficiencies created by regulation and the resulting higher costs of production. For example, exit regulation may prevent firms, such as railroads, from exiting unprofitable lines of business and builds excess capacity. Entry regulation may prevent firms, such as financial institutions, from achieving the optimal economies of scale and scope. In the Averch and Johnson (1962) model, price regulation forces firms to overinvest in capital because regulators determine the firm's profit by the "fair rate of return" on capital investment criterion.[4] As the regulatory barriers are removed through deregulation, productive inefficiencies are eliminated. This may lead to increased firm profitability unless increased competition forces all savings to be passed on to consumers.

Winston (1998) summarizes the empirical evidence on industry efficiency improvements following deregulation. Airlines, trucking, railroads, banking, and natural gas industries all experienced substantial cost improvements as a result of deregulation. Railroads have abandoned one-third of their track miles following deregulation and have reduced real operating costs by 60%. Pipelines have significantly improved their capacity utilization and reduced real operating and maintenance expenses by roughly 35%. Banking branch deregulation led to an 8% reduction in operating costs in the long run. There is also evidence that at least some of these cost reductions led to increased firm profitability in certain industries. For example, Winston (1998) reports that railroads have experienced an increase in the return on equity from $<3\%$ before deregulation to over 8% following deregulation. Similarly, Gomez-Ibanez, Oster, and Pickrell (1983) report that the airlines' losses resulting from the recession and spiking fuel costs during 1979–1981 would have been much greater if the industry remained regulated.

Profitability may also decrease following deregulation. Entry and price regulations insulate industry firms from market competition and allow abnormal profits to be earned, especially in industries that are inherently highly competitive. Deregulation in this case opens an industry to competition and forces abnormal profits to zero. For example, the consensus among economists is that deregulation decreased profitability among trucking companies that had earned abnormal profits under regulation (Winston, Corsi, Grimm, and Evan, 1990; Winston, 1993).

Translated to firms' leverage decisions, increases (decreases) in profitability following deregulation cause firm leverage to increase (decrease) under the tradeoff theory and decrease (increase) under the pecking order theory. Under the tradeoff theory, more profitable firms face lower expected costs of financial distress. More profitable firms also use more debt to shield taxable income and to control the agency cost of free cash flow (Jensen, 1986). Thus, debt is more attractive for profitable firms, and leverage is higher. Under the pecking order theory, holding investment fixed, more profitable firms have less need to finance new projects with external debt capital as the level of internal capital is higher. Thus, given investment outlays, leverage is lower for more profitable firms.

2.2. Growth opportunities

Deregulation is expected to stimulate investment. Deregulation provides for greater operating freedom and

[3] Winston (1993, 1998) reviews this literature.

[4] Entry regulation may also have the opposite effect and create firms that are excessively large if it limits potential competition. I thank the referee for pointing this out.

a more competitive environment. Deregulation may also increase the expected profitability of future projects because future profits are no longer captured by the government and because firms are no longer forced (or encouraged) to operate inefficiently. For example, Viscusi, Harrington, and Vernon (2005), citing evidence in Hubbard and Weiner (1986), argue that the government control of natural gas prices reduced companies' incentive to invest in exploration of new reserves. They show that gas reserves, while rising steadily during the 1948–1967 period, actually declined under gas price controls and were 31% lower in 1980 than in 1970. This evidence is especially compelling given the extraordinary high oil prices, a natural gas substitute, and the rising gas prices that were recorded over the same time period.

Similarly, citing the Willig and Baumol (1987) study, Viscusi, Harrington, and Vernon (2005) report that railroads, subject to exit regulation, by the late 1970s postponed $15 billion of investment on track maintenance. Following the passage of the Staggers Rail Act of 1980, which gave firms freedom to exit unprofitable markets, railroads spent $27 billion on railroad structures, roadways, and maintenance during 1981–1985, and spent an additional $30 billion over the same time period on rail cars, locomotives, and other equipment.

The increased incentive to invest reduces leverage under the tradeoff theory and possibly under a complex version of the pecking order theory but increases leverage under a simple version of the pecking order theory. Under the tradeoff theory and with risky debt outstanding, the need to control the stockholder–bondholder conflict [underinvestment (Myers, 1977), asset substitution and asset dilution (Jensen and Meckling, 1976)] is greater the higher the growth opportunities of firms. Firms respond by reducing leverage. Note that even if the investment opportunity set of deregulated firms does not change following deregulation, firms may still adopt a low leverage policy. If deregulation increases managerial discretion over the firm's projects (Smith and Watts, 1992), the expected cost of underinvestment, asset substitution, and asset dilution increases, thus making debt less attractive.

If firms follow the pecking order predictions for leverage, the relation between growth opportunities and leverage depends on whether firms only care about current period investment or whether they are concerned about future investment as well. In the former case, firm leverage increases with the increase in growth opportunities as firms are more likely to finance new projects with debt holding profitability fixed. In the latter case, firm leverage may decrease if firms worry about their debt capacity and try to keep leverage low in anticipation of future investment opportunities.

In addition to profitability and investment, regulatory reform impacts the firms' ex ante probability of financial distress, the level of information asymmetries between insiders and outside investors, and the degree of product market competition. Changes in these characteristics, in turn, may also impact firms' leverage decisions.

2.3. Probability of financial distress

Deregulation is expected to increase the ex ante probability of costly financial distress. Entry regulation hinders competition and allows inefficient firms, that otherwise would have been driven out of the market, to survive. Exit regulation prevents exit (including through bankruptcy) because the government deems the product or service produced by the regulated firms important for public welfare. Price regulation often suppresses cost considerations and gives preferential treatment to some customers at the expense of others. Deregulation then aligns prices with costs, promotes price competition through new entry, and increases variation in prices and firm profitability (Winston, 1993). The result of increased profit variability is an increase in the probability that a future state of the world will take place in which a firm's cash flows are insufficient to service its debt obligations (Bradley, Jarrell, and Kim, 1984).

An increase in the ex ante probability of financial distress makes leverage decisions more costly and pushes firms toward lower leverage under the tradeoff theory. An increase in the firms' earnings volatility also pushes firms toward a lower leverage policy because the expected payoffs from interest shields are lower (DeAngelo and Masulis, 1980).

2.4. Quality signaling

Deregulation is expected to increase the firm's need to signal its quality. Regulated firms are more transparent to regulators and the marketplace, so information asymmetries between insiders and the outside investors are lower. After deregulation, information asymmetries are likely to increase because (i) regulators no longer monitor the firm, or (ii) increased competition encourages firms to keep information away from new competitors.

Ross (1977) develops a signaling model, in which firms signal quality with leverage. High quality firms choose higher leverage to signal their quality because issuing debt exposes the firm to costly financial distress. If deregulation increases quality for some firms, the incentive to signal higher quality for these firms increases following deregulation. In addition, the quality of the signal improves following deregulation because the expected costs of financial distress from extra leverage are higher. Therefore, leverage of higher quality firms increases following deregulation.[5]

2.5. Product market competition

Finally, deregulation is expected to increase the product market competition. In response, firm leverage may increase or decrease. On one hand, leverage may increase because firms signal their commitment to future production in order to discourage future competition.

[5] Measuring firm quality is not a straightforward task. However, as long as firm quality improves for at least some firms following deregulation, the average firm leverage should increase.

On the other hand, leverage may decrease because firms are concerned that high leverage is perceived as a sign of industry weakness, which may result in predatory behavior by new competitors emerging after deregulation.

2.6. Adjustment costs

In my discussion of the predictions of the tradeoff theory, leverage changes come about because of changes in target leverage. However, the one-for-one mapping from target leverage changes to actual leverage changes is only valid so long as firms continuously adjust to target leverage. In a dynamic environment with financing frictions, actual firm leverage is likely to deviate from target leverage. This is because firms adjust leverage to the target only when the expected benefit of being at the target exceeds the adjustment cost. Therefore, under the dynamic tradeoff theory of capital structure (Fischer, Heinkel, and Zechner, 1989; Leary and Roberts, 2005; Strebulaev, 2007), deregulation affects actual leverage only if it has a significant effect on (i) target leverage, (ii) the cost of leverage adjustment to target leverage, or (iii) the expected benefit of leverage adjustment to target leverage. Among the theories that I discuss, the last two predictions are unique to the dynamic tradeoff theory.

Deregulation is predicted to increase the expected benefit of leverage adjustment to the target relative to the adjustment cost. Regulation allows inefficient firms to survive either by thwarting competition or by explicitly prohibiting firms to exit. As a result, firms have little incentive to operate efficiently and to continuously adjust their leverage to the target especially in the presence of financing frictions. Deregulation improves these efficiency incentives which forces firms to adjust leverage to the target sooner. Thus, firms should "speed up" their leverage adjustment immediately following the beginning of deregulation. Moreover, if firms follow a dynamic adjustment strategy, those firms that are more likely to be above (below) target leverage before deregulation, should decrease (increase) their leverage following deregulation.

Changes in the relative benefits and costs of leverage adjustment created by deregulation should also alter the cross-sectional relation between leverage and its determinants. Because firms operating in a more competitive environment created by deregulation are forced to adjust their leverage to the target more frequently, leverage does not wander far from the target. Thus, factors that induce a mechanical leverage movement away from the target, such as profitability and stock prices, should be less correlated with leverage in the cross-section following deregulation. The rest of the paper analyzes the hypotheses developed in this section. First, I describe my sample.

3. Sample

My sample consists of all non-financial firm-year observations in the annual Compustat database for the period January 1966–December 2006. I require that all firm-years have non-missing data for book assets, profitability, market-to-book, depreciation, and fixed assets. I further require both book and market leverage to lie in the closed unit interval. All other variables are Winsorized at the upper and lower one-percentiles. The construction of all variables is described in Appendix A. The final sample consists of 173,190 firm-year observations.

From this sample, I select all firms in deregulated industries. These industries include entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. I exclude financial intermediaries from the deregulated industries set because these firms' financing decisions may reflect fundamentally different factors than financing decisions of other firms. Table 1 summarizes the major federal deregulatory initiatives affecting these industries and Appendix B describes the regulatory reform in each industry in greater detail. Industry definitions follow Fama-French 48 industry classifications from Ken French's Web site. The sample of deregulated firms consists of 31,595 firm-year observations.

Table 1
Major deregulatory initiatives affecting entertainment, petroleum and natural gas, utilities, telecommunications, and transportation industries, 1966–2006.
Source: Viscusi, Harrington, and Vernon (2005).

Year	Initiative
Entertainment	
1980	Deregulation of cable television (FCC)
1981	Deregulation of radio (FCC)
1984	Cable Communications Policy Act
Petroleum and natural gas	
1978	Natural Gas Policy Act
1981	Decontrol of crude oil and refined petroleum products (executive order)
1989	Natural Gas Wellhead Decontrol Act
1992	FERC Order 636
Utilities	
1988	Proposed rules on natural gas and electricity (FERC)
1992	Energy Policy Act
1996	FERC Order 888
1999	FERC Order 2000
Telecommunications	
1979	Deregulation of satellite earth stations (FCC)
1980	Deregulation of cable television (FCC)
1980	Deregulation of customer premises equipment and enhanced services (FCC)
1981	Deregulation of radio (FCC)
1982	AT&T settlement
1984	Cable Television Deregulation Act
1988	Proposed rules on price caps (FCC)
1996	Telecommunications Act
Transportation	
1976	Railroad Revitalization and Reform Act
1977	Air Cargo Deregulation Act
1978	Airline Deregulation Act
1980	Motor Carrier Reform Act
1980	Household Goods Transportation Act
1980	Staggers Rail Act
1980	International Air Transportation Competition Act
1982	Bus Regulatory Reform Act
1984	Shipping Act
1986	Trading of airport landing rights
1987	Sale of Conrail
1993	Negotiated Rates Act
1994	Trucking Industry and Regulatory Reform Act
1995	ICC Termination Act

Some readers may object to industry classifications based on Fama-French industry definitions as too broad. Table 1 indicates that often industries are deregulated one segment at a time, so treating firms in those industry segments that are not directly affected by a deregulatory initiative as deregulated may be inappropriate. My view is that deregulation impacts all firms in an industry even if it deals directly with only a specific industry segment. For example, a legislative initiative that removes entry barriers in trucking is likely to impact trucking as well as other transportation firms, such as railroads and airlines. Similarly, decontrol of oil prices is likely to affect petroleum as well as natural gas producers. So, broad industry definitions, such as those based on Fama-French classifications, seem appropriate for the current analysis. Nevertheless, I replicated my analysis using four-digit Standard Industry Classification (SIC) code definitions. The results are similar to the results reported here and are available upon request.

In the time-series analysis in Section 4, I use a matching firm procedure to draw inferences about deregulated firms. Matching firms are selected from all non-regulated industries as follows. I first compute the average value of total assets, market-to-book, and profitability for all firms in each deregulated industry in the year prior to the year when the first significant deregulatory initiative is adopted. Second, I sort all non-regulated firms into dependent quartile sorts based on assets, market-to-book, and profitability, with firms with the lowest value of each variable placed in quartile one and firms with the highest value of each variable placed in quartile four. I therefore create 64 portfolios on size (i.e., assets), growth (i.e., market-to-book), and profitability (SGP). Third, I calculate portfolio breakpoints in the year prior to deregulation. Fourth, from the set of 64 SGP portfolios, I select the portfolio of firms in the same asset, market-to-book, and profitability quartile as the average deregulated firm in the year prior to deregulation. I match on assets, market-to-book, and profitability because these variables are important predictors of leverage under both the tradeoff and the pecking order theories and have been found to be consistently related to firm leverage (Rajan and Zingales, 1995; Fama and French, 2002; Flannery and Rangan, 2006, Lemmon, Roberts, and Zender, 2008). Fama and French (2005) argue that the profitability and growth characteristics are important in evaluating firms' financing decisions, and Fama and French (2001) find that size, profitability, and growth opportunities are important determinants of firms' payout policy.

4. Time-series analysis

I begin my analysis by describing the time-series evolution of leverage and its determinants for all deregulated firms in entertainment, petroleum and natural gas, utilities, telecommunications, and transportation industries. After presenting the results for all deregulated firms, I further focus my analysis on subsamples of surviving firms as well as newly entering and exiting firms. In the last subsection, I focus on the industry-by-industry analysis.

4.1. All deregulated firms

Table 2 describes the full sample as well as the subsamples of deregulated and SGP firms. The results in Panel A for the full sample are consistent with other studies analyzing large panels of firm leverage (Welch, 2004; Flannery and Rangan, 2006; Lemmon, Roberts, and Zender, 2008, for example). Panel B takes three separate snapshots of deregulated and SGP firms during the regulated and two post-deregulation periods. The regulated period is the five-year period immediately preceding the year when the first significant deregulatory initiative is adopted. The first post-deregulation period, which I refer to as the partial deregulation period, is the five-year period immediately following the year when the first deregulatory initiative is adopted. The second post-deregulation period, which I refer to as the complete deregulation period, is the five-year period immediately following the year when the last deregulatory initiative is adopted. For example, the transportation industry was deregulated over a 20-year period, with the first legislation, the Railroad Revitalization and Regulatory Reform Act, passed in 1976 and the last legislation, the ICC Termination Act, passed in 1995. So, I consider the years 1971–1975 as the regulated period, the years 1977–1981 as the partial deregulation period, and the years 1996–2000 as the complete deregulation period.

As the transportation industry example illustrates, regulated and completely deregulated periods are often separated by more than a few years, sometimes even decades. Thus, particular care must be taken when comparing firms before and after deregulation as contemporaneous changes in the business cycle, technological trends, and supply and demand shocks also affect firm policies and performance. I compare changes in deregulated firms' performance with changes in SGP firms' performance to draw inferences about the effects of deregulation on the operating environment and, ultimately, financing policy of deregulated firms. To the extent that the matching procedure described above allows me to accurately capture firm behavior in the absence of deregulation, any differences in firm performance between deregulated and SGP firms can be attributed to deregulation.[6] I first compute annual cross-sectional median statistics for deregulated and SGP firms and then average these medians over the five-year

[6] I have experimented with using a propensity score matching procedure for identifying matching firms. I use the propensity scores from a probit model that includes all control variables in Table 2 to identify five nearest neighbors for each deregulated firm in the year immediately preceding the first year of deregulation. Using this matching sample produces similar results to those reported in Tables 2 and 3. Because the matching is performed only on those deregulated firms that are present in the sample in the year prior to the first year of deregulation, the sample size of deregulated and matching firms is greatly reduced. This procedure also forces me to look only at existing firms and does not allow examination of the effect of deregulation on changes in industry composition. For this reason, I rely on comparing average firm characteristics of *all* deregulated firms with average firm characteristics of SGP firms in most of my analysis.

Table 2
Descriptive statistics, 1966–2006.

The sample consists of all nonfinancial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. Panel A describes the full sample. Panel B compares deregulated firms with size, growth, and profitability (SGP) matched firms. SGP firms are firms in the same size, growth, and profitability quartile portfolio as the average deregulated firm in the year immediately preceding the year when the first significant deregulatory initiative is adopted. Comparisons of deregulated and SGP firms are done during three separate periods. The regulated period is the five-year period immediately preceding the year when the first significant deregulatory initiative is adopted. The partial deregulation period is the five-year period immediately following the year when the first deregulatory initiative is adopted. The complete deregulation period, is the five-year period immediately following the year when the last deregulatory initiative is adopted. For each period, the numbers reported are averages of annual median statistics. *T*-statistics in Panel B are computed under the null hypothesis of no difference between deregulated and SGP firms in each period analyzed. N is the number of firm-year observations in each five-year period. All variables are defined in Appendix A.

Panel A: *Full sample characteristics*

Variable	Mean	Median	St dev	Min	Max
Market leverage	0.281	0.222	0.254	0.00	1.00
Book leverage	0.253	0.233	0.204	0.00	1.00
Assets ($ mil)	1,674	160	5,210	0.135	69,554
Market equity ($ mil)	1,407	113	5,211	0.209	79,650
Profitability	0.045	0.115	0.353	−6.091	0.465
Market-to-book	1.677	0.992	2.73	0.147	55.411
Dep-to-assets	0.048	0.038	0.041	0.00	0.571
Fixed assets-to-assets	0.337	0.277	0.247	0.00	0.946
R&D-to-assets	0.039	0.000	0.100	0.00	102.01
N	173,190				

Panel B: *Comparisons of deregulated firms with SGP-matched firms*

	Regulated period			Partial deregulation period			Complete deregulation period		
Variable	Deregulated firms	SGP firms	*t*-Stat diff	Deregulated firms	SGP firms	*t*-Stat diff	Deregulated firms	SGP firms	*t*-Stat diff
Market leverage	0.423	0.293	4.16	0.369	0.337	0.81	0.319	0.293	0.79
Book leverage	0.343	0.254	5.17	0.330	0.259	4.06	0.318	0.269	2.50
Assets ($ mil)	902	1,310	−1.70	951	1,872	−2.81	1,217	4,189	−6.31
Market equity ($ mil)	393	845	−3.12	442	1,233	−3.20	588	3,400	−8.39
Profitability	0.150	0.145	0.44	0.124	0.140	−1.62	0.105	0.133	−4.85
Market-to-book	0.797	0.842	−0.80	0.868	0.791	1.35	1.037	0.971	1.16
Dep-to-assets	0.043	0.036	2.70	0.048	0.040	2.50	0.054	0.045	2.39
Fixed assets-to-assets	0.678	0.325	12.65	0.659	0.331	10.84	0.561	0.309	8.88
R&D-to-assets	0.000	0.007	−13.98	0.000	0.008	−21.03	0.000	0.008	−9.56
N	3,157	1,003		3,843	897		4,658	575	

pre- and post-deregulation periods for each deregulated industry.

Deregulation appears to impact the operating environment and financing policy of firms in my sample significantly. Deregulated firms' market leverage declines from an average of 42.3% immediately preceding deregulation, to 36.9% during five years following the first year of deregulation, and declines further to 31.9% during five years following the last year of deregulation. The difference in average leverage between the regulated and the complete deregulation periods is statistically significant. The decline in leverage is not merely a time effect, as SGP firms' leverage remains relatively constant across the same time period (29.3% vs. 33.7% vs. 29.3% during the three snapshot periods). Rather, deregulated firms' leverage converges to the level of leverage of SGP firms. While the difference between deregulated and SGP firms' leverage prior to deregulation is statistically significant and economically large (42.3−29.3%=13%; *t*-statistic=4.16), it becomes much smaller as soon as the deregulatory process begins (36.9−33.7%=3.2%; *t*-statistic=0.81), and almost disappears following complete deregulation (31.9−29.3%=2.6%; *t*-statistic=0.79).

The results for book leverage are qualitatively similar. Deregulated firms' book leverage declines from an average of 34.3% prior to deregulation, to 33% during five years following the first year of deregulation, and declines further to 31.8% during five years following the last year of deregulation. As a result, the gap between deregulated and SGP firms' book leverage contracts from 8.9% (34.3−25.4%=9.9%; *t*-statistic=5.17) prior to deregulation, to 7.1% during the partial deregulation period, to 4.9% during the complete deregulation period. The results for book leverage are important given the Myers (1977) argument that managers may focus more on book leverage because debt is better supported by assets in place than by growth opportunities. Frank and Goyal (2008) also suggest that managers may be more likely to focus on book leverage because market leverage is more variable given stock price fluctuations.

To further gauge the economic significance of the results, I analyze how deregulation moves the affected

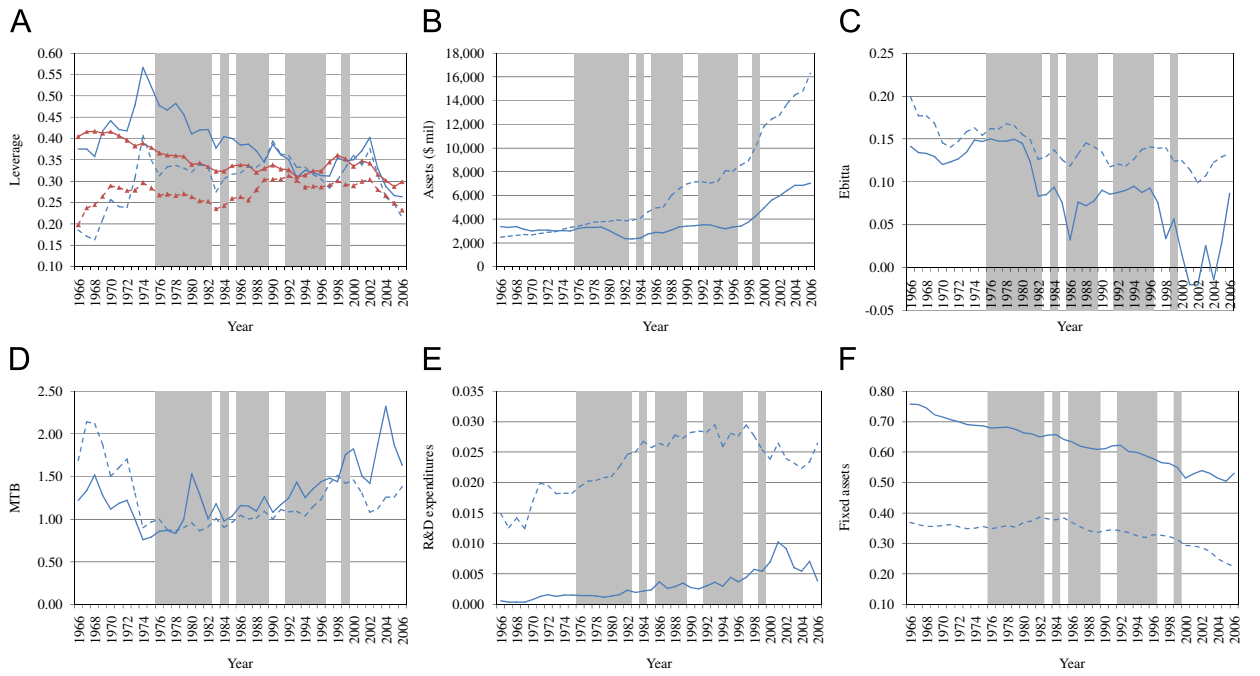

Fig. 1. Time-series evolution of leverage and its determinants for deregulated firms, 1966–2006. The sample consists of all non-financial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The figure plots various firm characteristics for deregulated firms (solid lines) and size, growth, and profitability (SGP) matched firms (dashed lines) over the sample period. SGP firms are firms in the same size, growth, and profitability quartile portfolio as the average deregulated firm in the year immediately preceding the year when the first significant deregulatory initiative is adopted. Shaded areas are years when significant deregulatory initiatives are adopted. Panel A presents the results for leverage. Unmarked lines track market leverage. Lines with a triangular marker track book leverage. Panel B presents the results for total assets, in December 2006 dollars. Panel C presents the results for profitability. Panel D presents the results for market-to-book. Panel E presents the results for the ratio of R&D expenditures-to-assets. Panel F present the results for the ratio of fixed assets-to-assets. All variables are defined in Appendix A.

firms in the market and book leverage distributions of the SGP firms. The reduction in average market leverage from 42.3% prior to deregulation to 31.9% during the complete deregulation period moves the median deregulated firm from the 71st to the 54th percentile of the SGP firms' market leverage. Similarly, the reduction in average book leverage from 34.3% prior to deregulation to 31.8% during the complete deregulation period moves the median deregulated firm from the 75th to the 62nd percentile of the SGP firms' book leverage. The reduction in leverage following deregulation appears substantial.

In rows 3 and 4 in Panel B of Table 2, deregulated firms grow following deregulation, although at a much slower pace than do SGP firms. Deregulated and SGP firms are (by construction) of similar sizes prior to deregulation, but deregulated firms grow to become less than one-third the size of SGP firms by the time industry deregulation is complete ($1.2 billion vs. $4.2 billion in assets for deregulated and SGP firms, respectively; *t*-statistic for the difference=−6.31). The results for market equity are even more significant. The slower growth pace for newly deregulated firms stems partly from the inflow of new firms into the recently deregulated industries. New firms tend to be smaller (Fama and French, 2001). When I exclude new firms, defined as those firms that do not exist prior to deregulation but emerge after the beginning of deregulation, average assets of existing deregulated firms grow from $902 million prior to deregulation, to $1.1 billion during the partial deregulation period, to $2.3 billion during the complete deregulation period. The slower growth pace of existing deregulated firms is consistent with them shedding inefficient operations and excess capacity created by regulation, especially in the years immediately following the beginning of deregulation.

In rows 5–9, the reduction in leverage for deregulated firms coincides with a significant decrease in profitability (row 5), a significant increase in growth opportunities as measured by market-to-book (row 6), and a significant decrease in asset tangibility as measured by the ratio of fixed assets to assets (row 8). Again, these changes are not simply time effects, as SGP firms do not undergo changes similar in magnitude in profitability, growth opportunities, and asset tangibility over the same time period.

Fig. 1 "fills in the gaps" in the time-series evolution of leverage, profitability, growth opportunities, and other firm characteristics for deregulated and SGP firms. I expand the analysis window to include the entire sample period, 1966–2006. The shaded areas in each panel are years when deregulatory legislation initiatives in one or more deregulated industries are adopted. Solid lines track deregulated firms; dashed lines track SGP

firms. Corroborating Table 2 leverage results, there is considerable convergence in leverage between deregulated and SGP firms following deregulation in Panel A. Deregulated firms reduce their market (book) leverage from an average annual ratio of 43.7% (40.1%) in the years prior to deregulation to an average annual ratio of 32.4% (31.8%) in the years following deregulation.[7] Over the same period, SGP firms increase their market (book) leverage from an average ratio of 24.2% (26.3%) in the years prior to deregulation to an average annual ratio of 30.1% (27.4%) in the years following deregulation. Thus, the majority of leverage convergence comes from deregulated firms' leverage reduction. This is consistent with the hypothesis that rising costs of debt resulting from deregulation push deregulated firms toward lower leverage.

The rest of Fig. 1 provides clues as to where the rising costs of debt may come from. Compared to their counterparts, deregulated firms grow much slower (Panel B) and experience a significant decline in profitability following deregulation (Panel C). Because of declining profitability, the (unreported) interest coverage ratio also declines following deregulation. There also appears some evidence that following deregulation, growth opportunities of deregulated firms improve. The market-to-book ratio in Panel D increases above the level of SGP firms' market-to-book in the first three years following the first year of deregulation. The Research and Development (R&D) expenditures-to-assets ratio in Panel E increases as well, although to a still much lower level than that of SGP firms. Finally, asset tangibility in panel F decreases. These results closely mirror Table 2 results. Overall, the results for deregulated firms are consistent with the predictions of the tradeoff theory. A decline in profitability resulting from industry deregulation increases the expected bankruptcy cost and lowers the agency cost of free cash flow. An increase in growth opportunities increases the underinvestment, asset substitution, and asset dilution incentives of managers. A decline in asset tangibility increases the expected bankruptcy cost and increases the asset substitution incentives of managers (Frank and Goyal, 2008). These changes in bankruptcy and agency costs push firms to lower leverage following deregulation.

4.2. Surviving, new, and exiting firms

The time-series evolution in average firm characteristics documented above may represent changes in the existing firms' decision making, or it may represent the changing composition of the industry itself. For example, deregulation of entry increases the inflow of new firms into the industry and the outflow of existing less competitive firms out of the industry. Entering new firms are likely to have higher growth opportunities, so they may prefer low leverage to control the underinvestment problem. Exiting firms that exit due to bankruptcy are likely to have high leverage and low profitability prior to their exit. Therefore, the average changes in the operating environment shown in Table 2 and Fig. 1 may come from changes in characteristics of firms comprising the industry prior to deregulation and/or changes in the industry composition resulting from deregulation.

Fig. 2 examines these two explanations in detail. I sort all deregulated firms into four portfolios: (i) surviving firms, i.e., those firms that exist prior to the beginning of deregulation and continue to exist after deregulation is complete; (ii) new firms, i.e., those firms that do not exist prior to but emerge after the beginning of deregulation; (iii) exiting bankrupt firms, i.e., those firms that exist prior to the beginning of deregulation but exit the sample due to Chapter 11 or Chapter 7 bankruptcy; and (iv) exiting acquired firms, i.e., those firms that exist prior to the beginning of deregulation but exit the sample due to a merger or an acquisition. For each of the four portfolios, Fig. 2 plots the time-series of leverage and its determinants. Solid lines track surviving firms; lines with a triangular marker track new firms; dashed lines track exiting bankrupt firms; dashed lines with a square marker track exiting acquired firms.

Several important results stand out. First, surviving firms' leverage in Panels A and B declines considerably following deregulation and appears to converge to the level of leverage of new firms, which, in turn, appears relatively stable through time. Surviving firms' market (book) leverage declines from an average of 53.1% (38.9%) in 1975, the year immediately preceding the first year of deregulation, to 33.4% (33.8%) in 1997 before climbing again to 40.8% (35.5%) in 2000, the year immediately following the last year of deregulation. In comparison, new firms' leverage does not display any discernible pattern but varies randomly around its mean of 29.7% for market leverage and 30.4% for book leverage.

Second, acquired firms' leverage displays a very similar time-series pattern compared to that of surviving firms' leverage. Similar to surviving firms' leverage, acquired firms' market (book) leverage declines from an average of 52.8% (38.1%) in 1975 to 39.4% (36.3%) in 1999, the last year when acquired firms exit the sample. Contrast this with the leverage dynamics of bankrupt firms. Bankrupt firms' market (book) leverage increases from an already high 60.7% (42.5%) in 1975 to an even higher 83.7% (65.8%) in 1991, when the last set of bankrupt firms exit the sample.[8] Based on these results, it appears that non-bankrupt firms are better able to adapt their financing policy to the changing economic environment, which may play a role in these firms' survival.[9] The results also indicate that the decline in leverage shown in Fig. 1 is partially driven by

[7] The reduction in book leverage is greater in Fig. 1 than in Table 2. In Fig. 1, I compute average leverage ratios during all regulated and all deregulated years, while in Table 2, I focus on the five years immediately preceding and the five years immediately following deregulation. It appears, therefore, that firms begin reducing their book leverage several years prior to deregulation, perhaps anticipating the upcoming deregulatory reform. The decline in book leverage prior to deregulation in Fig. 1 is consistent with this explanation.

[8] To provide meaningful estimates, I require that each portfolio consist of at least five firms.

[9] Zingales (1998) finds that firms with higher leverage are less likely to survive the deregulation shock in the trucking industry.

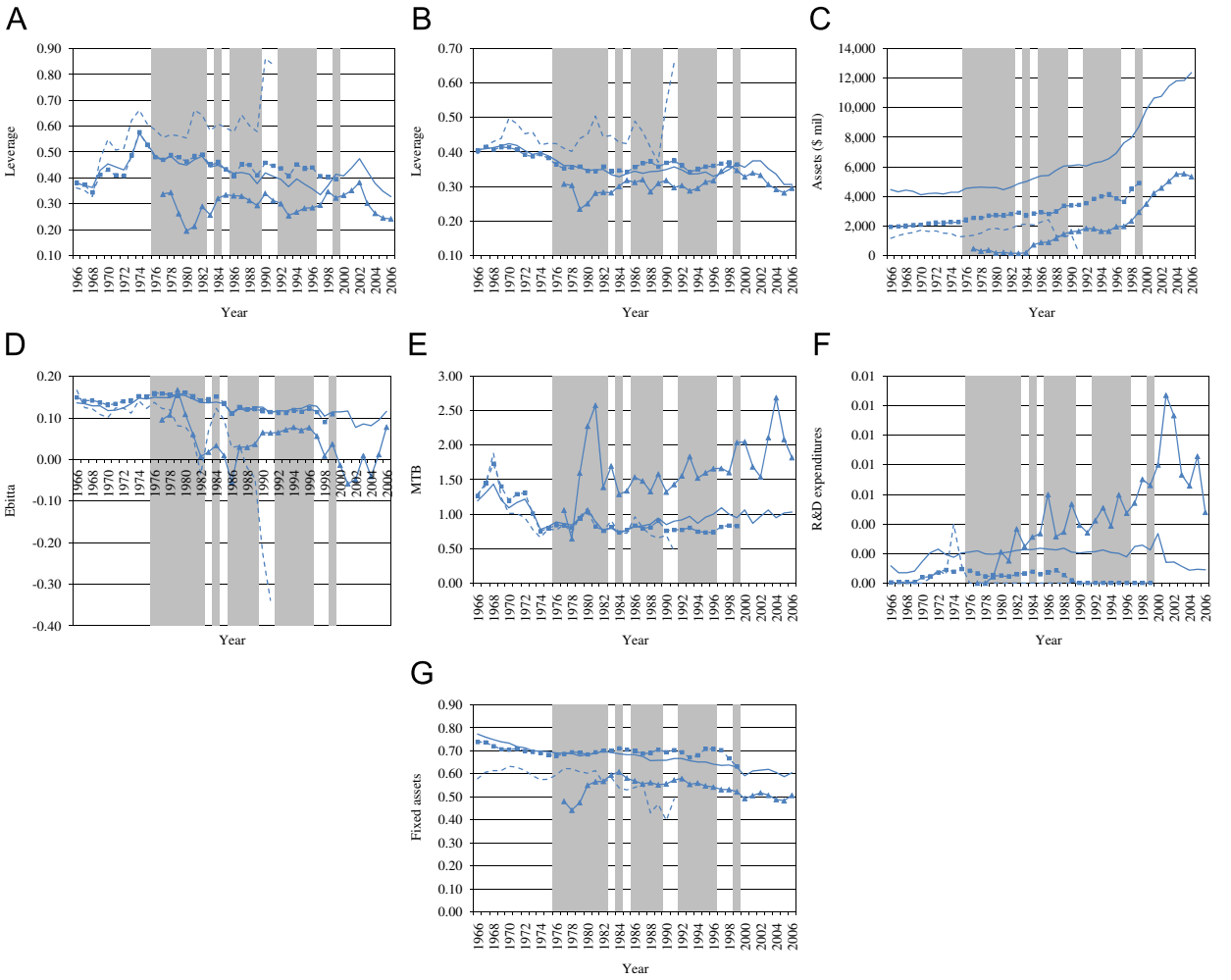

Fig. 2. Time-series evolution of leverage and its determinants for surviving, new firms, firms exiting due to bankruptcy, and firms exiting due to M&A, 1966–2006. The sample consists of all non-financial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The figure plots various firm characteristics for deregulated firms separated into four subsamples. The solid line tracks surviving firms, i.e., those firms that exist prior to the beginning of deregulation and continue to exist after deregulation is complete. The line with a triangular marker tracks new firms, i.e., those firms that do not exist prior to but emerge after the beginning of deregulation. The dashed line tracks exiting bankrupt firms, i.e., those firms that exist prior to the beginning of deregulation but exit the sample due to Chapter 11 or Chapter 7 bankruptcy. The dashed line with a square marker tracks exiting acquired firms, i.e., those firms that exist prior to the beginning of deregulation but exit the sample due to a merger or an acquisition. Shaded areas are years when significant deregulatory initiatives are adopted. All variables are defined in Appendix A. Panel A: Market leverage. Panel B: Book leverage. Panel C: Total assets. Panel D: Profitability. Panel E: Market-to-book. Panel F: R&D expenditures. Panel G: Fixed assets-to-assets.

the disappearance of high-leverage bankrupt firms from the sample.

As regards other firm characteristics, the rest of Fig. 2 indicates that surviving firms are much bigger than exiting bankrupt and acquired firms prior to deregulation ($4.3 billion in assets for surviving firms, compared to $1.2 billion for exiting bankrupt firms, and to $2.2 billion for exiting acquired firms in 1975) and, not surprisingly, tend to grow faster (Panel C). Also not very surprising are the results in Panel D that surviving and acquired firms are, on average, more profitable than new and bankrupt firms. The average (across all years) Earnings Before Interest and Taxes (EBIT)-to-assets ratio equals 12.4% and 13.3% for surviving and acquired firms, respectively, compared with the average EBIT-to-assets ratio of 3.9% for new firms and 5.8% for bankrupt firms. In the time-series, firm profitability tends to decline for all firms, with the most significant decline taking place for a portfolio of bankrupt firms. For these firms, the average EBIT-to-assets ratio declines from 12.2% in 1975 to −33.9% in 1991. In contrast, the average EBIT-to-assets ratio declines much more modestly for surviving firms (a decline of 11.4−14.5%=−3.11% from 1975 to 2000), acquired firms (a decline of 10.8−15.0%=−4.2% from 1975 to 1999), and new firms (a decline of −1.4−9.5%=−10.9% from 1977 to 2000).

In Panels E and F, new firms have significantly stronger growth opportunities compared to surviving and exiting (both bankrupt and acquired) firms. In Panel E, the market-to-book ratio of new firms is, on average, 81% above the market-to-book ratio of surviving firms; the market-to-book premium of new firms is positive in all years except 1978 and never falls below 23%. Similarly, the R&D-to-assets ratio of new firms in Panel F is, on average, 191% above the R&D-to-assets ratio of surviving firms; the R&D premium is positive post-1981 and never falls below 9%. Fama and French (2001) report similar evidence that newly listed firms display lower profitability and stronger growth opportunities than existing firms. Finally, there appears a general improvement through time in growth opportunities of new firms, while no pronounced change is evident in growth opportunities of surviving and exiting firms. Overall, the evidence in Panels C–G points to significant differences between (i) new firms, (ii) surviving firms and acquired firms, and (iii) bankrupt firms. The results for surviving and acquired firms are similar, which suggests that acquired firms are not taken over because they are in distress.

The portfolio of surviving firms is relatively stable through time with 242 firms per year in the portfolio, on average (it varies only when a new industry is deregulated), while the portfolios of new and exiting firms vary through time by construction. As new firms enter deregulated industries, the new firms portfolio grows from five firms in 1977 to 774 firms in 2000 before declining to 564 firms in 2006. Conversely, the exiting bankrupt (acquired) firms portfolio contracts from 20 (172) firms in 1966 to five (30) firms in 1991 (in 1999).[10] Thus, deregulated industries increasingly tilt away from the few poorly performing high leverage firms that eventually exit through bankruptcy toward many new firms with low leverage, low profitability, and strong growth opportunities. At the same time, surviving and acquired firms themselves reduce leverage and experience a decline in profitability and no notable change in growth opportunities. It appears, therefore, that the time-series evolution of leverage and its determinants shown in Table 2 and Fig. 1 results from changes in surviving firms' characteristics *as well as* changes in industry composition toward low leverage, low profitability, and high growth-opportunities firms.

4.3. Industry-by-industry analysis

The results above represent average changes in firm characteristics across all deregulated industries. It is likely, however, that the effect of deregulation on firm performance is not uniform but rather is industry specific. For example, as I argue in Section 2, deregulation may raise firm profitability in some industries if regulatory practices in those industries force firms to operate inefficiently. Deregulation may have the opposite effect on profitability in other industries if regulatory practices there insulate firms from market competition and keep prices above marginal cost. Similarly, deregulation is expected to stimulate investment but to various degrees in different industries. For example, the Averch-Johnson (1962) bias toward capital intensity may actually stimulate innovation in industries subject to the "rate-of-return" regulation, such as utilities. Other characteristics of regulation, however, may impede innovation. Therefore, the impact of deregulation on investment in such industries is more ambiguous and is probably lower than in other industries where the effect is expected to be more pronounced.

Table 3 analyzes changes in the operating environment and financing policy of firms around deregulation separately for each industry. I employ the difference-in-differences approach, which is particularly useful when studying the effects of significant changes in the economic environment on firm policies (Gruber and Poterba, 1994; Lemmon and Roberts, 2009, for example). For each firm in the deregulated and SGP samples, I first compute the average value of each variable during the regulated and the post-deregulation periods. I then calculate the difference between the post-deregulation average and the regulated average. This difference is then averaged over all deregulated firms and, separately, over all SGP firms. The difference-in-differences estimator is the difference between the average difference for deregulated firms and the average difference for SGP firms. Note that the difference-in-difference estimator requires examining only surviving firms. The number of survivors in each deregulated industry tends to be much smaller than the initial sample of firms because the regulated and the deregulated periods are usually separated by quite a few years (Table 1).[11] Because power is likely to be an issue here, I focus on the economic rather than on the statistical significance of the results in my discussion below. The first five columns in Table 3 report the difference-in-differences estimates separately for each deregulated industry. For completeness, the last five columns report the corresponding *t*-statistics for the null hypothesis that the estimates are zero. To account for multiple observations for each firm, *t*-statistics are clustered by firm. Panel A measures the relative change in firm characteristics from the regulated to the partial deregulation period; Panel B measures the relative change in firm characteristics from the regulated to the complete deregulation period.

The industry results indicate that many of the trends documented above show up consistently across all deregulated industries. Some of the trends differ by industry, however. In panel A, market leverage declines consistently across all industries relative to changes experienced by SGP firms. The relative leverage decline is particularly strong in utilities (10.2% relative decline;

[10] Similar to my findings, Frank and Goyal (2008) report that bankruptcy is infrequent, with Chapters 11 and 7 liquidations constituting only 6.8% and 3.5% of all exits, respectively. In my sample, bankruptcies constitute 6.5% of all exits.

[11] Survivors constitute 5.3% of firms in entertainment (20 out of 378 firms), 7% of firms in petroleum and natural gas (71 out of 1,008 firms), 28.8% of firms in utilities (111 out of 386 firms), 2% of firms in telecommunications (2 out of 100 firms), and 4.6% in transportation industries (50 out of 1,079 firms).

Table 3
Difference-in-differences estimation of the effect of regulatory changes on firm leverage and other characteristics, 1966–2006.

The sample consists of all nonfinancial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The table presents the results from the difference-in-differences analysis of growth rates in each variable for deregulated firms compared to SGP firms. SGP firms are defined in Table 2. The difference-in-differences estimator is computed as follows. For each firm in the deregulated and SGP samples, I first compute the average value of each variable during the regulated and the post-deregulation periods. I then calculate the difference between the post-deregulation average and the regulated average. This difference is then averaged over all deregulated firms and, separately, over all SGP firms. The difference-in-differences estimator is the difference between the average differences for deregulated firms and the average difference for SGP firms. The *t*-statistic is computed under the null hypothesis that the difference-in-differences estimator is zero. All variables are defined in Appendix A.

	Difference-in-differences					*t*-Statistic				
Variable	Entnmt	Pet and nat gas	Utilities	Telecomm	Transport	Entnmt	Pet and nat gas	Utilities	Telecomm	Transport
Panel A: *Partial deregulation–regulation*										
Market leverage	−0.0020	−0.0712	−0.1017	−0.0097	−0.0503	−0.04	−2.36	−2.97	−0.11	−2.17
Book leverage	0.0228	0.0235	−0.0576	0.0343	−0.0016	0.60	1.03	−2.44	0.67	−0.11
Assets	−1,057	302	−1,410	−489	−199	−3.48	1.27	−2.19	−2.68	−1.04
Market equity	−907	1,007	−124	−417	412	−2.71	2.47	−0.35	−3.05	1.89
Profitability	−0.0220	0.0189	−0.0104	0.0006	−0.0078	−1.28	1.39	−1.39	0.02	−1.08
Market-to-book	−0.0174	0.5481	−0.0185	0.3920	0.1092	−0.19	5.19	−0.61	2.10	2.35
Dep-to-assets	0.0026	0.0029	0.0035	−0.0150	−0.0002	0.34	1.20	1.43	−1.22	−0.09
Fixed assets-to-assets	−0.0239	0.0205	0.0010	−0.0194	−0.0084	−0.72	1.40	0.07	−0.61	−0.71
R&D-to-assets	−0.0076	−0.0041	0.0012	0.0060	0.0020	−3.95	−1.84	0.75	0.87	1.49
Panel B: *Complete deregulation–regulation*										
Market leverage	−0.0436	−0.1225	−0.0693	0.1159	−0.0974	−0.56	−2.58	−1.47	1.07	−1.20
Book leverage	0.0560	−0.0410	−0.0264	0.1128	−0.0730	0.90	−0.99	−0.82	1.39	−1.16
Assets	−2,108	−3,026	−159	−5,382	5,463	−2.73	−1.82	−0.09	−3.13	3.13
Market equity	−2,057	−1,933	−2,554	−5,739	5,506	−2.52	−1.25	−1.52	−2.31	2.64
Profitability	−0.0239	0.0010	−0.0236	−0.0206	−0.0046	−0.81	0.05	−2.60	−1.52	−0.21
Market-to-book	0.0438	0.1884	−0.1808	0.0009	0.1034	0.30	1.01	−1.89	0.01	0.61
Dep-to-assets	0.0118	0.0180	0.0059	0.0053	0.0027	0.77	2.95	1.48	0.38	0.46
Fixed assets-to-assets	−0.0522	0.1202	−0.1000	0.0447	−0.1399	−0.96	3.11	−3.36	0.64	−3.15
R&D-to-assets	−0.0119	−0.0069	0.0045	−0.0187	−0.0019	−3.51	−1.58	1.34	−1.75	−0.29

t-statistic=−2.97), petroleum and natural gas (7.1% relative decline; *t*-statistic=−2.36), and transportation industries (5.0% relative decline; *t*-statistic=−2.17). Moreover, the effect of deregulation on leverage persists in these industries until the complete deregulation period. In Panel B, the relative decline in market leverage from the regulated period to the complete deregulation period remains economically (albeit, not statistically) significant for all three industries. This implies that the effect of deregulation on firm leverage is permanent in these industries.

The slower growth rate in assets and market equity for deregulated firms shown above is also evident in Table 3. Firms in all industries except petroleum and natural gas grow slower than their counterparts in the short run following deregulation (i.e., from the regulated period to the partial deregulation period); the slower growth rate in the long run (i.e., from the regulated period to the complete deregulation period) is evident in all but transportation industries, where firms appear to grow much faster than their counterparts.

Relative profitability declines in entertainment, utilities, and transportation industries in the short run and also in telecommunications in the long run. There is some evidence that profitability increases in petroleum and natural gas, although the effect is temporary. Finally, growth opportunities, measured by market-to-book, improve in the short run in petroleum and natural gas, telecommunications, and transportation, while in the long run the relative improvement in growth opportunities in telecommunications disappears. Utilities experience a decline in growth opportunities, both in the short and the long run. The growth in the R&D expenditure-to-assets ratio is generally slower for deregulated firms, corroborating evidence in Fig. 1 that deregulated firms lag their peers in investing in new technologies. Overall, the results in Table 3 indicate that deregulation has an important impact on the operating environment of deregulated firms and pushes firms in all industries toward lower leverage.

To summarize Section 4 results, deregulated firms' leverage declines considerably following deregulation. This decline in leverage coincides with a decline in firm profitability and an improvement in firms' growth opportunities. These changes come about because of changes in existing firms' characteristics as well as because of changes in industry composition toward low leverage, low profitability, and high growth-opportunities firms. Finally, the decline in leverage is uniform across all deregulated industries, while the effect of deregulation on other firm characteristics is more industry-specific. I noted above that the results in this

section are most consistent with the tradeoff theory. It is difficult, however, to reconcile the results with the pecking order theory. Higher growth opportunities and lower profitability should push firms to higher leverage under the simple version of the pecking order theory, and lower profitability should push firms to higher leverage under the complex version of the pecking order theory. Instead, leverage declines in Table 2 and Fig. 1. Moreover, the leverage result appears inconsistent with the Ross (1977) signaling hypothesis. If firms with higher growth opportunities are characterized by greater information asymmetries between insiders and outside investors (Smith and Watts, 1992), deregulation and the resulting increase in growth opportunities should push firms to higher leverage. Instead, leverage is lower post-deregulation.

5. Leverage regressions

If firms care about their target leverage and operate in a dynamic environment with financing frictions, leverage adjustment is not continuous but takes place when the expected benefit of adjusting leverage to the target exceeds the adjustment cost. I argue above that deregulation should increase the expected benefit of adjustment relative to the adjustment cost, which forces firms to respond by adjusting to target leverage more frequently. In the cross-section, factors that mechanically induce leverage to move away from the target should be less correlated with leverage following deregulation.

In Table 4, I estimate the following cross-sectional leverage regressions:

$$MktLev_{it} = \alpha + v_t + \beta_1(X_{it-1}) + \beta_2(X_{it-1} \times Deregind_{it}) + \beta_3(X_{it-1} \times Deregind_{it} \times \mathrm{Reg}_{it}) + \varepsilon_{it}, \quad (1)$$

$$BkLev_{it} = \alpha + v_t + \beta_1(X_{it-1}) + \beta_2(X_{it-1} \times Deregind_{it}) + \beta_3(X_{it-1} \times Deregind_{it} \times Reg_{it}) + \varepsilon_{it}, \quad (2)$$

where i and t index firms and years, respectively, $MktLev_{it}$ and $BkLev_{it}$ are market and book leverage ratios, X_{it-1} is a set of year $t-1$ explanatory variables from Table 2, $Deregind_{it-1}$ is an indicator variable set to one if a firm operates in one of the five deregulated industries in Table 1, and zero otherwise, Reg_{it-1} is an indicator variable set to one if a firm operates in a deregulated industry during the period preceding the year when the first significant deregulatory initiative affecting the industry is adopted, and zero otherwise, v_t is a year fixed effect, and ε_{it} is a random error term assumed to be possibly heteroskedastic and correlated within firms (Petersen, 2009).[12] The vector X_{it-1} includes all variables in Table 2. I also include an earnings volatility variable, the time-series standard deviation of firm's earnings, $StDev(Ebitta)_{it-1}$, as a measure of the expected costs of financial distress. Fama and French (2002) and Rajan and Zingales (1995) use firm size as a proxy for the expected costs of financial distress but acknowledge that size may proxy for other factors, such as the ability to access external capital markets. Because of this ambiguity, I use earnings volatility as well as firm size to measure the expected costs of financial distress.[13] Panel A presents the results for all deregulated firms; Panel B presents the results for surviving firms identified in Section 4.2. To facilitate comparison, I scale each coefficient by its standard deviation, so that each number in the table represents the change in leverage for a one standard deviation change in its respective determinant.

The coefficients of interest are β_2 and β_3, which measure differences in the financing decisions of deregulated and unregulated firms. Deregulated firms operate initially in the regulated environment but become deregulated over the sample period. So, the coefficient β_2 captures differences in the financing decisions of deregulated and unregulated firms during periods when neither group is subject to regulation; hence, it captures fundamental differences (if any) in the financing decisions of deregulated firms and firms that have never been subject to regulation. The coefficient β_3 captures differences in the financing decisions of deregulated and unregulated firms during periods when the former group is regulated; hence, it captures the effect of regulation on these firms' financing decisions.

The first regression in Panel A compares the average leverage ratios of regulated and unregulated firms without controls for leverage determinants. In both market and book leverage regressions, average leverage of deregulated firms is significantly higher than that of unregulated firms, especially during the regulated period. In the market leverage regression in the first column, the average market leverage ratio of unregulated firms is 26.5%. The average market leverage ratio of deregulated firms is 36.2% (26.5+9.7%; t-statistic for the difference=18.00) during the deregulated period and 43.7% (26.5+9.7+7.5%; t-statistic for the difference=10.45) during the regulated period. Thus, following deregulation, deregulated firms' leverage declines 17.2% (7.5%/43.7%) from its pre-deregulation level, although it still remains 36.6% (9.7%/26.5%) above the level of leverage of unregulated firms. The results for book leverage are similar.

Next, I incorporate leverage determinants into the estimation of Eqs. (1) and (2). The coefficient β_1, which measures the cross-sectional correlation of leverage with its determinants for unregulated firms, is largely consistent with previous evidence. Leverage is inversely and significantly related to profitability, market-to-book, earnings volatility, and the ratio of R&D expenditures-to-assets.[14] Leverage is positively and significantly related to

[12] Lemmon, Roberts, and Zender (2008) report that the inclusion of firm fixed effects reduces the economic significance of leverage determinants in Eqs. (1) and (2). None of my conclusions are sensitive to the inclusion of firm fixed effects.

[13] Other variables used in the literature to capture the expected costs of financial distress include stock return volatility and firm age. The inclusion of these variables does not affect my results below.

[14] The negative relation between book leverage and market-to-book is consistent with the proposition that the debt capacity of growth options is negative. Market leverage regressions are not acceptable for this test because of low power (Barclay, Smith, and Morellec, 2006).

Table 4
Leverage regressions, 1966–2006.

The sample consists of all nonfinancial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The table presents parameter estimates, scaled by the standard deviation of the underlying variable, from panel Ordinary Least Squares (OLS) regressions of market and book leverage on their determinants. Panel A presents the results for all deregulated firms. Panel B presents the results for surviving deregulated firms. Each regression specification includes year fixed effects. The *t*-statistics are robust to clustering at the firm level and heteroskedasticity. All variables are defined in Appendix A.

	Market leverage				Book leverage			
Variable	β	$t(\beta)$	β	$t(\beta)$	β	$t(\beta)$	β	$t(\beta)$
Panel A: All deregulated firms								
Intercept	0.265	124.73	0.149	22.54	0.233	146.33	0.093	15.94
$Intercept \times Deregind_{it-1}$	0.097	18.00	−0.092	−4.01	0.096	21.59	−0.115	−4.84
$Intercept \times Deregind_{it-1} \times Reg_{it-1}$	0.075	10.45	0.241	5.74	0.044	8.04	0.136	3.61
$Ebitta_{it-1}$			−0.069	−27.45			−0.042	−22.07
$Ebitta_{it-1} \times Deregind_{it-1}$			0.021	2.41			0.018	3.05
$Ebitta_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.318	−10.59			−0.239	−9.46
Mtb_{it-1}			−0.057	−28.70			−0.020	−16.31
$Mtb_{it-1} \times Deregind_{it-1}$			−0.003	−0.50			0.011	2.93
$Mtb_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.140	−4.97			0.011	0.60
$Depta_{it-1}$			−0.003	−1.56			0.004	2.31
$Depta_{it-1} \times Deregind_{it-1}$			0.004	1.13			0.000	0.10
$Depta_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.004	−0.42			0.002	0.9
$Ln(Assets)_{it-1}$			0.022	10.48			0.016	9.65
$Ln(Assets)_{it-1} \times Deregind_{it-1}$			0.012	2.70			0.005	1.35
$Ln(Assets)_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.028	−4.50			−0.026	−4.87
$St\ Dev(Ebitta)_{it-1}$			−0.018	−9.62			−0.006	−3.23
$St\ Dev(Ebitta)_{it-1} \times Deregind_{it-1}$			0.008	0.72			−0.005	−0.55
$St\ Dev(Ebitta)_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.048	4.66			0.053	5.52
$Fata_{it-1}$			0.027	10.61			0.034	15.64
$Fata_{it-1} \times Deregind_{it-1}$			0.007	1.45			−0.001	−0.26
$Fata_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.010	1.38			0.012	1.80
$R\&D\ Indicator_{it-1}$			0.014	7.47			0.011	7.17
$R\&D\ Indicator_{it-1} \times Deregind_{it-1}$			−0.006	−1.15			−0.009	−1.91
$R\&D\ Indicator_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.008	−1.15			−0.018	−3.00
$R\&D_{it-1}$			−0.032	−22.27			−0.018	−12.95
$R\&D_{it-1} \times Deregind_{it-1}$			−0.001	−0.07			−0.008	−1.12
$R\&D_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.005	0.07			−0.026	−0.44
$Ind\ Lev_{it-1}$			0.076	30.89			0.068	23.69
$Ind\ Lev_{it-1} \times Deregind_{it-1}$			0.001	0.16			0.040	4.40
$Ind\ Lev_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.004	−0.57			−0.006	−0.50
Year fixed effects	Yes		Yes			Yes	Yes	
R^2	0.108		0.299			0.063	0.186	
N	154,232		154,232			154,232	154,232	
Panel B: Surviving firms								
Intercept	0.265	124.84	0.150	22.55	0.233	146.33	0.093	15.95
$Intercept \times Deregind_{it-1}$	0.132	12.84	−0.004	−0.05	0.102	12.57	−0.085	−1.63
$Intercept \times Deregind_{it-1} \times Reg_{it-1}$	0.046	4.88	0.198	2.28	0.043	5.92	0.165	2.72
$Ebitta_{it-1}$			−0.070	−27.38			−0.042	−22.00
$Ebitta_{it-1} \times Deregind_{it-1}$			−0.012	−0.26			0.013	0.53
$Ebitta_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.279	−4.62			−0.213	−5.32
Mtb_{it-1}			−0.058	−28.69			−0.020	−16.26
$Mtb_{it-1} \times Deregind_{it-1}$			−0.099	−1.87			0.008	0.61
$Mtb_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.066	−1.02			0.009	0.34
$Depta_{it-1}$			−0.003	−1.65			0.003	2.21
$Depta_{it-1} \times Deregind_{it-1}$			−0.009	−0.99			−0.007	−0.95
$Depta_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.002	−0.12			−0.000	−0.02
$Ln(Assets)_{it-1}$			0.021	10.29			0.015	9.51
$Ln(Assets)_{it-1} \times Deregind_{it-1}$			0.006	0.68			−0.007	−0.95
$Ln(Assets)_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.024	−2.38			−0.023	−2.78
$St\ Dev(Ebitta)_{it-1}$			−0.018	−9.69			−0.006	−3.29
$St\ Dev(Ebitta)_{it-1} \times Deregind_{it-1}$			0.065	4.18			0.038	2.36
$St\ Dev(Ebitta)_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.001	0.11			0.013	0.72
$Fata_{it-1}$			0.025	10.69			0.031	15.69
$Fata_{it-1} \times Deregind_{it-1}$			−0.004	−0.45			0.002	0.25
$Fata_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.023	1.98			0.018	1.89

Table 4 (*continued*)

Variable	Market leverage				Book leverage			
	β	$t(\beta)$	β	$t(\beta)$	β	$t(\beta)$	β	$t(\beta)$
$R\&D\ Indicator_{it-1}$			0.014	7.65			0.011	7.33
$R\&D\ Indicator_{it-1} \times Deregind_{it-1}$			−0.009	−0.89			−0.010	−1.01
$R\&D\ Indicator_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.000	−0.01			−0.013	−1.26
$R\&D_{it-1}$			−0.034	−22.26			−0.019	−12.94
$R\&D_{it-1} \times Deregind_{it-1}$			−0.117	−1.28			−0.070	−1.06
$R\&D_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			0.179	1.48			0.013	0.19
$Ind\ Lev_{it-1}$			0.074	29.89			0.066	23.35
$Ind\ Lev_{it-1} \times Deregind_{it-1}$			−0.001	−0.12			0.032	1.86
$Ind\ Lev_{it-1} \times Deregind_{it-1} \times Reg_{it-1}$			−0.015	−1.32			−0.023	−1.41
Year fixed effects	Yes		Yes		Yes		Yes	
R^2	0.099		0.290		0.044		0.169	
N	135,540		135,540		135,540		135,540	

assets, the ratio of fixed assets-to-assets, and industry leverage. Similar results are reported in Rajan and Zingales (1995), Baker and Wurgler (2002), Fama and French (2002), Frank and Goyal (2003), Flannery and Rangan (2006), and Lemmon, Roberts, and Zender (2008). See Harris and Raviv (1991) for a review of earlier papers conducting similar analyses.

The coefficient β_2 indicates that, absent regulation, firms operating in the five deregulated industries in my sample make financing decisions similarly to unregulated firms. The interactions of leverage determinants with a deregulated industry indicator are mostly insignificant. For example, the interaction of profitability with a deregulated industry indicator, while the most statistically significant result in both market and book leverage regressions, appears economically trivial. A one standard deviation increase in profitability is associated with a 6.9% decrease in market leverage for unregulated firms and a 4.8% (−6.9+2.1%) decrease in market leverage for deregulated firms. Similarly, a one standard deviation change in market-to-book, size, earnings volatility, fixed assets-to-assets, and R&D-to-assets ratios change market leverage by 5.7%, 2.2%, 1.8%, 2.7%, and 3.2% for unregulated firms, and by 6%, 3.4%, 1%, 3.4%, and 3.3% for deregulated firms, respectively. The results for book leverage are similar. Therefore, the financing decisions of deregulated firms that are no longer subject to regulation are similar to the financing decisions of unregulated firms.

The coefficient β_3 indicates that regulation has a significant impact on the firms' financing decisions. Regulation has a particularly strong effect on the cross-sectional relations between leverage and profitability, leverage and market-to-book, leverage and firm size, and leverage and earnings volatility. First, the positive relation between leverage and size and the negative relation between leverage and earnings volatility shown for unregulated firms disappears for firms subject to regulation. A one standard deviation increase in size increases market (book) leverage by 2.2% (1.6%) for unregulated firms, by 3.4% (2.1%) for deregulated firms following deregulation, and increases (decreases) market (book) leverage by 0.6% (0.5%) for firms subject to regulation. Similarly, a one standard deviation increase in earnings volatility decreases market (book) leverage by 1.8% (0.6%) for unregulated firms, by 1% (1.1%) for deregulated firms following deregulation, and increases market (book) leverage by 3.8% (4.2%) for firms subject to regulation. Larger firms are more likely to be diversified and less likely to fail (Rajan and Zingales, 1995; Fama and French, 2002). Firms with more volatile earnings are more likely to encounter financial distress (Fama and French, 2002; Frank and Goyal, 2008). The positive relation between leverage and firm size and the negative relation between leverage and earnings volatility for unregulated firms is, therefore, consistent with the expected costs of financial distress playing an important role in leverage decisions, with firms with higher expected costs of financial distress (i.e., smaller firms and firms with greater earnings volatility) choosing lower leverage. Moreover, the fact that the relation between leverage and firm size is not present and the fact that the relation between leverage and earnings volatility is of the "wrong" sign for firms subject to regulation suggests that financial distress costs are less relevant in leverage decisions of regulated firms. These findings are consistent with the arguments developed in Section 2.3.

Turning to other leverage determinants, the negative relation between leverage and profitability for unregulated firms is economically more significant for firms subject to regulation. A one standard deviation increase in profitability lowers market (book) leverage by 6.9% (4.2%) for unregulated firms but lowers market (book) leverage by 36.6% (26.3%) for firms subject to regulation. Similarly, the negative relation between market leverage and market-to-book for unregulated firms is more significant for firms subject to regulation. A one standard deviation increase in market-to-book lowers market leverage by 5.7% for unregulated firms and by 20% for firms subject to regulation. These results are particularly striking considering that over the regulated period, market leverage of regulated firms averages 47.9% with a standard deviation of 20.9%; book leverage averages 39.2% over the same period with a standard deviation of 15.1%. Thus, the profitability and market-to-book estimates above represent 175% (36.6%/20.9%) and 96% (20%/20.9%) of the typical unconditional variation in market leverage,

respectively; for book leverage the profitability estimate represents 174% (26.3%/15.1%) of the typical unconditional variation.

The profitability and market-to-book results are consistent with the arguments in Section 2.6. Firms operating in the regulated environment are less likely to adjust their leverage to target leverage because the benefit of being at the target when firms are regulated is likely to be small and outweighed by the adjustment cost. As a result, firms do not counteract the effects of current profits (which proxy for future profits and firm value) and current stock prices on leverage very frequently and instead let leverage vary inversely with profitability and proxies for stock prices, such as market-to-book. In the context of Leary and Roberts (2005) and Strebulaev (2007), regulated firms have very large "optimal leverage ranges" or "refinancing points" that are far apart and far away from target leverage. Deregulation shrinks the optimal leverage range and pushes refinancing points closer to target leverage. Newly deregulated firms respond by adjusting leverage to the target more frequently, which reduces the mechanical negative relation between leverage and profitability and between leverage and market-to-book.

A potential concern with the results in Panel A is that they again may reflect the changing composition of the industry resulting from deregulation as opposed to conscious choices made by newly deregulated firms to alter their financing decisions. The results in Panel B for surviving firms, which by definition do not suffer from the changing composition problem, help alleviate this concern. The results in Panel B are similar to the results for all deregulated firms in Panel A. Absent regulation, surviving firms make financing decisions no differently than unregulated firms. The coefficient β_2 on the interaction of leverage determinants with a deregulated industry indicator is insignificant for all variables except earnings volatility, which indicates that, at least from the leverage decisions point of view, deregulated surviving firms are fundamentally no different from unregulated firms. However, surviving firms' financing decisions are impacted significantly by regulation. The coefficient β_3 indicates that, similar to all deregulated firms, surviving firms' market leverage is unrelated to firm size and more negatively related to profitability during the regulated relative to the deregulated period. Surviving firms' market leverage also appears more negatively related to market-to-book during the regulated period, although the result is no longer statistically significant (t-statistic=−1.02). Finally, market and book leverage of deregulated surviving firms is positively related to earnings volatility in both the regulated and the deregulated periods. This result suggests that the expected costs of financial distress do not affect leverage decisions of deregulated surviving firms.

Overall, the cross-sectional results in Table 4 are consistent with the predictions of the dynamic tradeoff theory of capital structure. Firm leverage behaves as though firms care about target leverage and trade off the benefit of leverage adjustment to target leverage against the adjustment cost; leverage adjustment takes place when the benefit of adjusting to the target exceeds the adjustment cost. Prior to deregulation, the benefit of adjusting is likely to be small, so firms have very wide optimal leverage ranges and adjust infrequently. Deregulation increases the benefit of adjusting, which shrinks the optimal leverage range and induces firms to adjust their leverage to the target more often.

6. Capital structure adjustments

In this section, I examine the predictions of the dynamic tradeoff theory further. I first examine whether firms "speed up" their financing activity in response to deregulation. I then analyze whether firms make capital structure decisions in a manner consistent with dynamic adjustment. I focus on firm financing activity because Chang and Dasgupta (2009) point out that tests that focus on financing activity are more useful in identifying target behavior than, say, tests that focus on the "speed of adjustment" of leverage to the target. Leary and Roberts (2005) and Dudley (2008) also point out that the speed of adjustment tests fail to recognize that the adjustment process is not continuous in a dynamic environment in the presence of the economies of scale and fixed adjustment costs.

6.1. Financing activity in event time

I begin by examining deregulated firms' financing activity in event time. I center my analysis on the first year of deregulation (defined as year 0) and analyze financing activity of deregulated firms from five years before to five years after the beginning of deregulation. The results in Section 4 indicate that the most significant leverage change takes place in the first few years following the beginning of deregulation. I analyze whether this change results from firms actively managing their capital structure or from passive changes in firm leverage induced by changes in firm characteristics that determine leverage.

Fig. 3 reports the percentages of deregulated firms with no issuing activity in Panel A, equity issues in Panel B, debt issues in Panel C, equity repurchases in Panel D, debt retirements in Panel E, leverage decrease in Panel F, and leverage increase in Panel G. I follow a common convention in the literature (Hovakimian, Opler, and Titman, 2001; Hovakimian, Hovakimian, and Tehranian, 2004; Leary and Roberts, 2005) and consider equity or debt issues to have taken place if the net change in equity or long-term debt divided by lagged assets is $>5\%$. Similarly, equity repurchases (debt retirements) are considered to have taken place if the net change in equity (long-term debt) is $<-1.25\%$ (-5%).

Several important results stand out. First, newly deregulated firms become considerably more active in theirfinancing activity in response to deregulation. In Panel A, the proportion of deregulated firms with no financing activity hovers above the majority mark prior to deregulation but drops from 57.9% in the year immediately preceding the first year of deregulation to 54.5%, 49.2%, and 45.5% in the first, second, and third year following the first year of deregulation. The

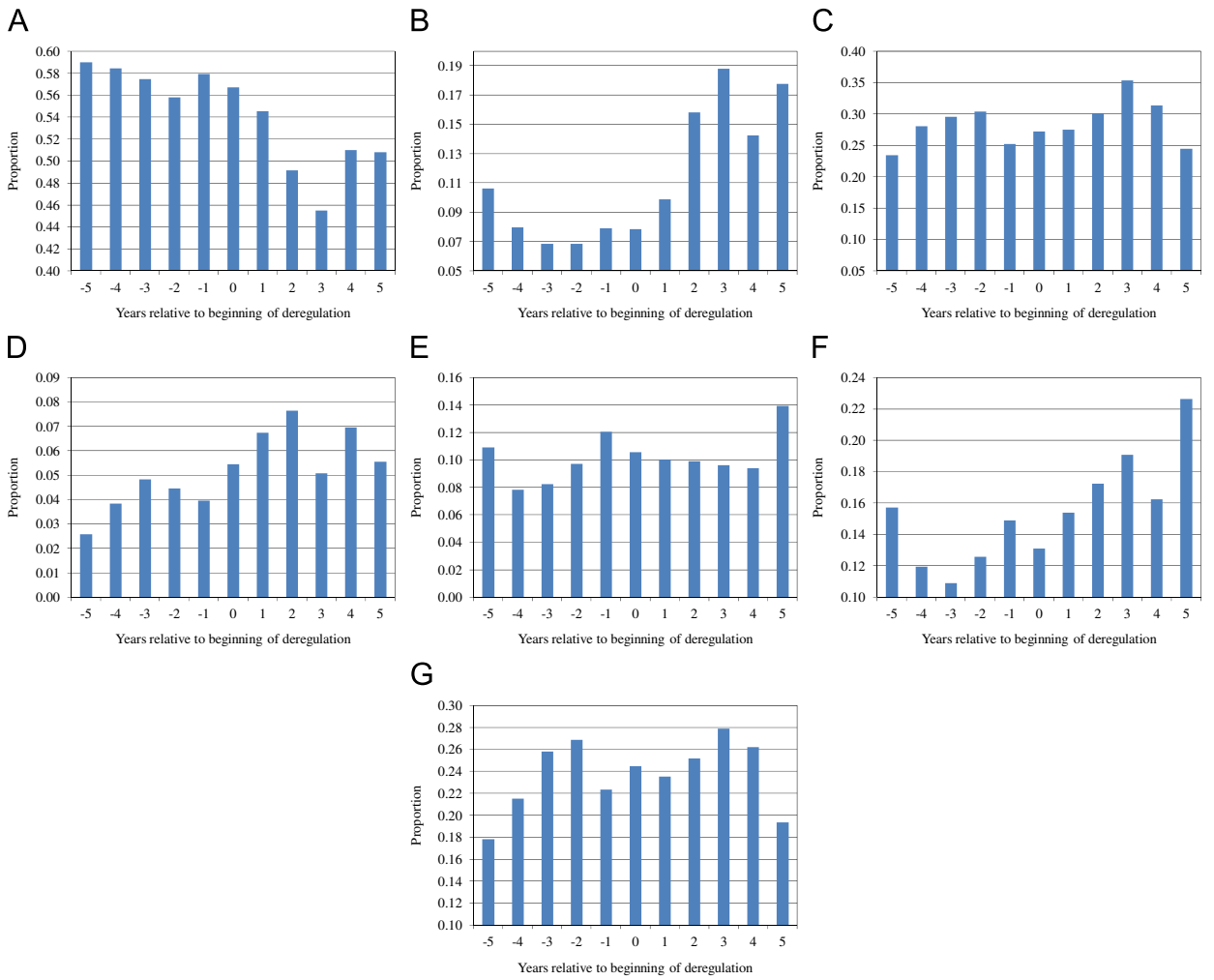

Fig. 3. Capital structure adjustments for deregulated and SGP firms following deregulation, 1966–2006. The sample consists of all non-financial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The figure plots financing activity of deregulated firms in event time centered on the year when the first significant deregulatory initiative is adopted (year 0). Panel A plots the percentage of firms with no issuing activity. Panel B plots the percentage of firms with equity issues. Panel C plots the percentage of firms with debt issues. Panel D plots the percentage of firms with equity repurchases. Panel E plots the percentage of firms with debt retirements. Panel F plots the percentage of firms with leverage decrease. Panel G plots the percentage of firms with leverage increase. Equity and debt issues are considered to have taken place if the net change in equity or long-term debt divided by lagged assets is $>5\%$. Equity repurchases and debt retirements are considered to have taken place if the net change in equity and long-term debt is $<-1.25\%$ and -5%, respectively. Leverage decrease is defined as the difference between net equity and net debt issues divided by lagged assets in excess of 5%. Leverage increase is defined as the difference between net debt and net equity issues divided by lagged assets in excess of 5%. All variables are defined in Appendix A.

proportion of firms with no financing activity increases to 50.9% and 50.8% in the fourth and fifth year. These results have two implications. First, firm financing activity is not continuous since a significant percentage of firms do not make capital structure adjustments in a given year. Second, deregulation has a noticeable impact on the adjustment behavior of firms by forcing firms to make capital structure adjustments fairly quickly (within the first three years following the beginning of deregulation).

Deregulated firms become more active equity and debt issuers following the beginning of deregulation. The results for equity issuers in Panel B are particularly noteworthy. The proportion of deregulated firms with equity issues doubles from 7.9% in the year preceding the first year of deregulation to 15.8% in the second year following the beginning of deregulation. That proportion increases further to 18.8% in the third year and remains relatively high in the fourth and fifth year following the beginning of deregulation. In Panel C, the proportion of deregulated firms with debt issues increases from 25.2% in the year preceding the first year of deregulation to 30.1% in the second year before peaking at 35.3% in the third year following the beginning of deregulation. This increase is economically significant but appears more modest than the increase in the proportion of equity

issuers in Panel B. Finally, the results in Panels D and E do not reveal any meaningful changes in the proportion of deregulated firms with equity repurchases and debt retirements following the beginning of deregulation.

The last two panels of Fig. 3 focus on the proportion of firms with leverage decrease and leverage increase. A firm that issues both debt and equity in the proportion equal to its current capital structure will not affect its leverage. So, I analyze whether newly deregulated firms' financing activity actually affects leverage. I define leverage increase (decrease) as the difference between net debt (equity) issues and net equity (debt) issues divided by lagged assets in excess of 5%. In Panel F, the proportion of deregulated firms with leverage decrease increases from 14.9% in the year preceding the first year of deregulation to 19.1% in the third year and increases further to 22.6% in the fifth year following the beginning of deregulation. In contrast, the proportion of deregulated firms with leverage increase in Panel G increases initially from 22.3% in the year preceding the first year of deregulation to 27.9% in the third year but drops noticeably to 19.3% in the fifth year following the beginning of deregulation.

When I split the sample of deregulated firms into surviving, bankrupt, acquired, and new firms, I find (results not reported) that new firms are largely responsible for the increase in equity issuing activity post-deregulation. In the first three years following deregulation, the average proportion of new firms issuing equity exceeds 30%, while the proportion of other firms issuing equity is lower and never exceeds 15%.[15] However, there is a notable increase in the proportion of surviving firms issuing equity from 2.8% in the first year of deregulation to 13.5% in the third year following the beginning of deregulation. There are no apparent trends in equity issuing activity of other firms. I also find that surviving firms increase their debt retirement activity in response to deregulation. The proportion of surviving firms retiring debt increases from 4.9% in the year preceding the first year of deregulation to 12.8% in the third year following the beginning of deregulation. Interestingly, new firms increase their debt retirement activity as well. In the first and second year following the beginning of deregulation, 20% and 17.4% of new firms, respectively, retire debt, likely using capital raised in the Initial Public Offering (IPO). Finally, over 30% of bankrupt firms retire debt in the first three years following the beginning of deregulation.

Fig. 4 provides evidence on the magnitude of various capital structure adjustments. Panel A reports the magnitude of equity issues; Panel B reports the magnitude of debt issues; Panel C reports the magnitude of equity repurchases; Panel D reports the magnitude of debt retirements. All magnitudes are scaled by lagged assets. Equity issues and debt retirements, both as percentages of assets, increase significantly following deregulation. The ratio of equity issues to assets increases from 9.4% in the year preceding the first year of deregulation to a peak of 27.8% in the third year before declining to 18.7% in the fifth year following the beginning of deregulation. Debt retirements increase from 8.1% in the year preceding the first year of deregulation to a peak of 12.5% in the second year following the beginning of deregulation. Finally, there appears a modest increase in the magnitude of debt issues and no noticeable pattern in the magnitude of equity repurchases following deregulation.

Overall, the results in Figs. 3 and 4 indicate that newly deregulated firms actively manage their capital structure in response to deregulation. Deregulated firms increase their equity issuance activity and, when they issue equity, increase the amount of capital raised through equity. Deregulated firms also increase the amount of debt retirements within the first two years following the beginning of deregulation. As a result, the proportion of firms experiencing leverage decrease rises steadily in the first three years following the beginning of deregulation.[16] These results complement the results in Table 2 and Fig. 1 and indicate that the decline in the average leverage ratio of deregulated firms is at least partially a result of active capital structure adjustments of newly deregulated firms.

6.2. Dynamic adjustment

Dynamic adjustment under the dynamic tradeoff theory of capital structure implies that firms adjust their capital structure as soon as they hit the "refinancing point", i.e., the point at which the expected benefit of being at optimal leverage exceeds the adjustment cost. Thus, holding everything else constant, firms with higher leverage and firms with past increases in leverage are more likely to hit the upper refinancing point in the near future and adjust their leverage down. Moreover, if deregulation pushes optimal leverage lower, as the results above suggest, newly deregulated firms should be even more likely to hit the upper refinancing point shortly after the beginning of deregulation and consequently adjust their leverage down.

In Table 5, I estimate the following regression:

$$\begin{aligned} EqShare_{it} = {} & \alpha + \nu_t + \beta_1 Deregind_{it} + \beta_2 BkLev_{it-1} \\ & + \beta_3 \Delta BkLev_{it-1} \\ & + \beta_4 (BkLev_{it-1} \times Deregind_{it} \times PostReg_{it}) \\ & + \beta_5 (\Delta BkLev_{it-1} \times Deregind_{it} \times PostReg_{it}) \\ & + \beta_6 \Delta X_{it} + \varepsilon_{it}, \end{aligned} \tag{3}$$

where i and t index firms and years, respectively, $EqShare_{it}$ is the equity share in total new issues defined as the ratio of total equity issues to the sum of total equity and total

[15] I find that new firms in other non-regulated industries are also more likely to issue equity around the time when regulated firms become deregulated. However, in comparison, new firms in deregulated industries are more frequent equity issuers even compared to other new firms in non-regulated industries.

[16] In unreported results, I extend my analysis window to 10 years following the beginning of deregulation and find that many of the trends continue past the first five years following the beginning of deregulation. I find that the percentage of firms issuing equity remains high (consistently above 13%) and the amount of equity issues remains high (consistently above 15.6%). The percentage of firms with leverage decrease remains high as well (consistently above 20%). I also compare financing activity of deregulated firms with financing activity of SGP firms and do not find similar patterns in financing activity of SGP firms.

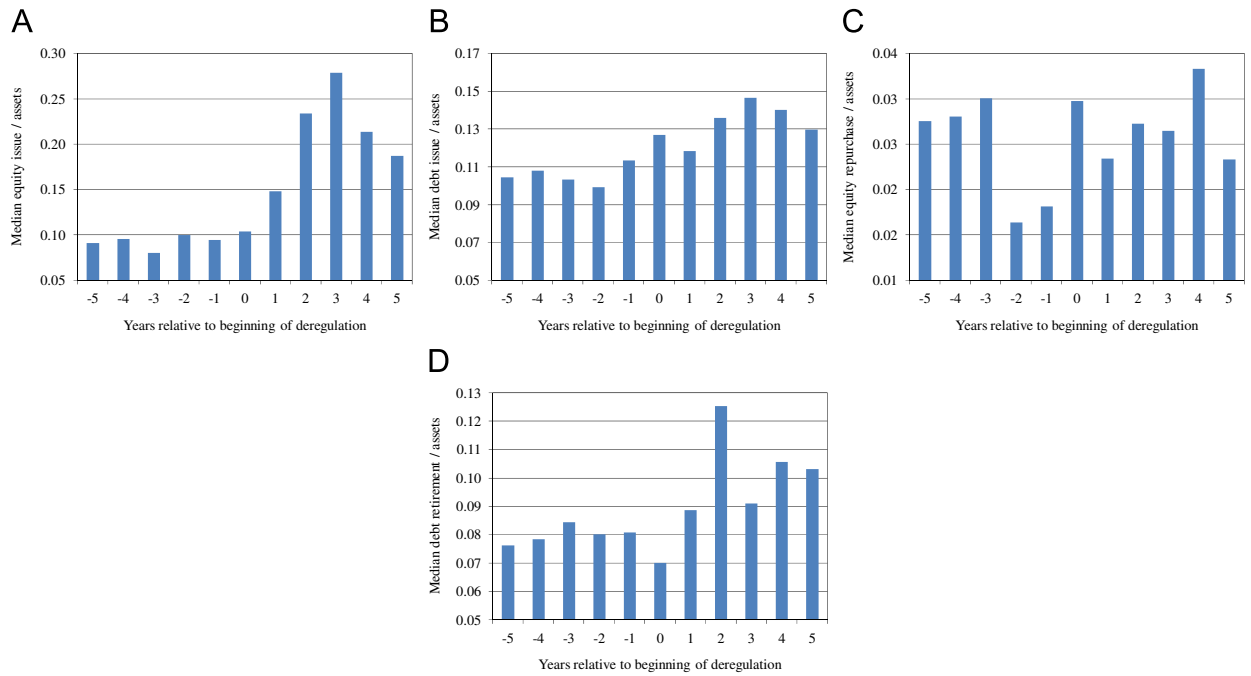

Fig. 4. Magnitudes of capital structure adjustments for deregulated and SGP firms following deregulation, 1966–2006. The sample consists of all non-financial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The figure plots the magnitudes of capital structure adjustments in event time on the year when the first significant deregulatory initiative is adopted (year 0). Panel A presents the median equity issues/assets ratio for firms with equity issues. Panel B presents the median debt issues/assets ratio for firms with debt issues. Panel C presents the median equity repurchases/assets ratio for firms with equity repurchases. Panel D presents the median debt retirements/assets ratio for firms with equity repurchases. All variables are defined in Appendix A.

debt issues, $\Delta BkLev_{it-1}$ is the change in book leverage from year $t-5$ to year $t-1$, $Deregind_{it-1}$ is an indicator variable set to one if a firm operates in one of the five deregulated industries in Table 1, and zero otherwise, $PostReg_{it}$ is an indicator variable set to one if a firm operates in a deregulated industry during the period immediately following the first year of deregulation, and zero otherwise, ΔX_{it} is the change in explanatory variables calculated contemporaneously with the equity share in total new issues, v_t is a year fixed effect, and ε_{it} is a random error term assumed to be possibly heteroskedastic and correlated within firms. To capture the effect of past leverage and leverage change on future cumulative issuing decisions, I compute the equity share in new issues over five different multi-year periods, ranging from three to seven years in length. As before, I scale each coefficient by its standard deviation to facilitate comparison across coefficients.

To capture the effect of deregulation on the adjustment behavior of deregulated firms, I interact past leverage and leverage change variables with a post-regulation indicator variable, $PostReg_{it}$, that is set to one for all deregulated firms one, two, three, four, or five years immediately following the first year of deregulation, and zero otherwise. By construction, these interaction terms single out the effects of pre-deregulation (i.e., year $t-1$) leverage and of pre-deregulation (i.e., year $t-5$ to year $t-1$) leverage change on the equity share in new issues from year $t-1$ to year $t+1$, to year $t+2$, and so on. Thus, the coefficients β_4 and β_5 on the interaction terms in Eq. (3) measure the incremental sensitivity of newly deregulated firms' financing decisions to past leverage and leverage changes for up to five years following the beginning of deregulation.

The results in Table 5 are consistent with the dynamic tradeoff theory of capital structure. The first five columns of Table 5 report the results from estimating Eq. (3) with only past leverage and leverage change as explanatory variables. In row 3, past leverage change of all non-regulated firms is positively correlated with the equity share in new issues. The results are statistically significant, although economically they appear trivial. The coefficient on leverage change is $<2\%$, which implies that a one standard deviation greater increase in past leverage is associated with a $<2\%$ greater equity share in subsequent new issues in the cross-section. The results for deregulated firms appear economically much stronger. In row 6, a one standard deviation greater increase in past leverage of deregulated firms is associated with an *additional* 8.6% equity share in new issues during the period from one year before to one year after the beginning of deregulation. Similarly, a one standard deviation greater increase in past leverage is associated with an additional 20.6%, 15.8%, 25.7%, and 6.5% equity share in new issues during periods from one year before to two, three, four, and five years after the beginning of deregulation, respectively. This is consistent with my prediction that the need for

Table 5
Equity share in net issues regressions, 1966–2006.

The sample consists of all nonfinancial firms in Compustat. After deleting firms with insufficient data to compute all required variables, the final sample consists of 173,190 observations over the period January 1966–December 2006. From this sample, I select all firms in deregulated industries. Deregulated industries are entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. The deregulated sample consists of 31,595 observations. The table presents parameter estimates, scaled by the standard deviation of the underlying variable, from panel OLS regressions of the equity share in net issues on lagged leverage, leverage change, the deviation of firm leverage, from industry median leverage, and other determinants. The equity share in net issues is computed from the year immediately preceding the first year of deregulation to one, two, three, four, and five years following the first year of deregulation. Changes in the determinants of the equity share in net issues are calculated contemporaneously with the equity share in net issues. Each regression specification includes year fixed effects. The *t*-statistics are robust to clustering at the firm level and heteroskedasticity. All variables are defined in Appendix A.

	Years relative to deregulation year					Years relative to deregulation year					Years relative to deregulation year				
Variable	(−1;+ 1)	(−1;+ 2)	(−1;+ 3)	(−1;+ 4)	(−1;+ 5)	(−1;+ 1)	(−1;+ 2)	(−1;+ 3)	(−1;+ 4)	(−1;+ 5)	(−1;+ 1)	(−1;+ 2)	(−1;+ 3)	(−1;+ 4)	(−1;+ 5)
$Deregind_{it-1}$	0.046	0.047	0.045	0.023	0.038	0.040	0.042	0.040	0.017	0.033	0.143	0.155	0.153	0.127	0.153
	(3.22)	(3.24)	(2.78)	(1.30)	(1.93)	(2.81)	(2.90)	(2.48)	(1.00)	(1.70)	(8.16)	(8.42)	(7.32)	(5.71)	(6.11)
$BkLev_{it-1}$	−0.165	−0.163	−0.143	−0.125	−0.114	−0.162	−0.161	−0.142	−0.124	−0.114	−0.308	−0.319	−0.299	−0.276	−0.281
	(−26.42)	(−24.45)	(−18.45)	(−14.79)	(−11.86)	(−25.83)	(−24.12)	(−18.34)	(−14.65)	(−11.81)	(−22.52)	(−21.75)	(−18.20)	(−15.87)	(−14.28)
$\Delta BkLev$	0.015	0.019	0.019	0.019	0.017	0.017	0.020	0.020	0.020	0.017	0.008	0.010	0.011	0.012	0.008
	(2.65)	(3.09)	(2.90)	(2.71)	(2.15)	(2.92)	(3.22)	(2.98)	(2.82)	(2.20)	(1.33)	(1.67)	(1.59)	(1.66)	(1.05)
$(BkLev-IndLev)_{it-1}$											0.158	0.171	0.169	0.162	0.180
											(11.67)	(11.72)	(10.34)	(9.31)	(9.32)
$BkLev \times Deregind \times PostReg$	−0.015	−0.004	0.013	0.025	0.040	−0.016	−0.005	0.011	0.023	0.039	−0.050	−0.047	−0.019	−0.014	0.030
	(−0.65)	(−0.14)	(0.59)	(0.90)	(1.70)	(−0.68)	(−0.22)	(0.51)	(0.84)	(1.63)	(−1.99)	(−1.56)	(−0.62)	(−0.44)	(0.95)
$\Delta BkLev \times Deregind \times PostReg$	0.086	0.206	0.158	0.257	0.065	0.082	0.203	0.154	0.252	0.062	0.018	0.121	0.095	0.171	0.067
	(1.97)	(3.12)	(2.10)	(2.28)	(1.24)	(1.88)	(3.07)	(2.04)	(2.26)	(1.18)	(0.35)	(1.97)	(1.64)	(1.69)	(1.14)
$(BkLev-IndLev) \times Deregind \times PostReg$											0.134	0.165	0.099	0.148	−0.028
											(2.04)	(2.01)	(1.29)	(2.18)	(−0.32)
$\Delta Ebitta$						−0.000	0.038	0.053	0.042	0.045	0.003	0.041	0.056	0.044	0.046
						(−0.00)	(1.61)	(2.02)	(1.36)	(1.24)	(0.13)	(1.77)	(2.15)	(1.42)	(1.29)
ΔMtb						0.005	0.010	0.010	0.009	0.010	0.006	0.010	0.010	0.010	0.011
						(3.20)	(4.80)	(3.67)	(3.25)	(3.46)	(3.54)	(5.22)	(4.03)	(3.71)	(3.94)
$\Delta Depta$						0.159	0.035	0.137	0.090	−0.064	0.185	0.081	0.179	0.115	−0.071
						(0.86)	(0.18)	(0.66)	(0.39)	(−0.25)	(1.01)	(0.44)	(0.87)	(0.50)	(−0.28)
$\Delta Ln(Assets)$						0.085	0.057	0.050	0.048	0.037	0.085	0.056	0.049	0.048	0.036
						(8.57)	(6.41)	(5.84)	(5.75)	(4.21)	(8.68)	(6.44)	(5.82)	(5.68)	(4.12)
$\Delta Fata$						−0.130	−0.109	−0.157	−0.147	−0.075	−0.137	−0.120	−0.171	−0.161	−0.091
						(−2.65)	(−2.16)	(−3.03)	(−2.69)	(−1.32)	(−2.79)	(−2.40)	(−3.33)	(−2.96)	(−1.61)
$\Delta R\&D\ Indicator$						0.015	0.009	−0.019	−0.004	0.024	0.013	0.006	−0.022	−0.007	0.020
						(0.78)	(0.49)	(−0.98)	(−0.18)	(1.24)	(0.68)	(0.35)	(−1.15)	(−0.36)	(1.03)
$\Delta R\&D$						0.194	0.281	0.359	0.390	0.355	0.179	0.257	0.329	0.350	0.313
						(2.73)	(4.06)	(4.63)	(4.38)	(3.81)	(2.56)	(3.85)	(4.38)	(4.04)	(3.47)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.022	0.022	0.017	0.014	0.012	0.023	0.022	0.018	0.015	0.013	0.025	0.025	0.021	0.018	0.015
N	80,274	71,813	64,119	57,330	51,295	80,274	71,813	64,119	57,330	51,295	80,274	71,813	64,119	57,330	51,295

dynamic rebalancing increases following deregulation and firms are more likely to respond by adjusting their capital structure to the target.

In columns 6–10, I add the full set of explanatory variables. The coefficients on past leverage and leverage change are little affected by the inclusion of additional controls. Deregulated firms exhibit strong evidence of dynamic rebalancing as evidenced by the coefficient on the interaction term of past leverage change with the post-regulation indicator. The results for other control variables are also consistent with the dynamic tradeoff theory. The equity share in new issues is positively correlated with market-to-book and the R&D-to-assets ratio, which proxy for growth opportunities of firms. The equity share is positively correlated with firm size, which is consistent with the existence of significant economies of scale in the market for new equity issues so that larger firms issue more equity (Dudley, 2008). Finally, the equity share is negatively correlated with the ratio of fixed assets-to-assets, which indicates that firms with more tangible assets issue less equity. Because firms with more tangible assets face lower agency costs of debt and because tangible assets serve as collateral, firms with more tangible assets rely more heavily on debt issues.

The negative coefficient on past leverage in row 2 in Table 5 indicates that firms with higher past leverage issue less equity. If high-leverage firms are more likely to be above their target capital structure, this result is inconsistent with the dynamic tradeoff theory. However, it is not obvious whether high-leverage firms are likely to be above the target or whether high-leverage firms simply have even higher target leverage ratios (Hovakimian, Hovakimian, and Tehranian, 2004). Indeed, if I measure leverage deviation from the target by the difference between actual leverage and industry median leverage, the results strongly support the dynamic tradeoff theory. In row 4 in columns 11–15, firms with leverage above industry leverage issue significantly more equity. The results are more pronounced for newly deregulated firms as evidenced by the coefficient on the interaction of leverage deviation from industry leverage and the post-regulation indicator in row 7. So, deregulated firms issue significantly more equity following the beginning of deregulation if their pre-deregulation leverage is above industry leverage.[17]

Overall, the results in Table 5 are consistent with the dynamic tradeoff theory of capital structure. Those firms that are likely to be above their target capital structure issue significantly more equity in the future. This behavior is especially pronounced among deregulated firms immediately following the beginning of deregulation, which is consistent with my predictions that the change in target capital structure pushes newly deregulated firms to adjust their capital structure sooner following the beginning of deregulation.

[17] This result is sensitive to the industry definition. If industries are defined at the four-digit SIC level, the relation between leverage deviation from industry leverage and equity issues is negative and mostly insignificant.

7. Conclusion

Deregulation provides a unique opportunity to study capital structure decisions of firms. In this paper, I analyze capital structure decisions of firms in five deregulated industries: entertainment, petroleum and natural gas, utilities, telecommunications, and transportation. I find that deregulation has a significant impact on the firms' operating environment, which, in turn, affects firms' financing decisions. Leverage declines considerably following deregulation, and this decline coincides with a decline in newly deregulated firms' profitability, asset tangibility, and an improvement in deregulated firms' growth opportunities. These changes come about because of changes in the existing firms' decision making as well as because of the changing composition of the industry brought by deregulation. In subsequent analyses, I show that firms reduce leverage in response to deregulation by issuing significantly more equity and by retiring debt. Moreover, those firms that are more likely to be above target leverage issue significantly more equity in the future. Overall, the results indicate that (i) capital structure is not static but evolves in response to changes in the operating environment brought forth by exogenous shocks, such as deregulation; (ii) profitability, growth opportunities, and expected bankruptcy costs as measured by firm size and earnings volatility are important factors driving capital structure decisions in a manner consistent with the tradeoff theory of capital structure; and (iii) firms behave consistent with weighing the benefits of leverage adjustment to target leverage against the adjustment cost and adjusting leverage when the benefit exceeds the adjustment cost.

The results in this paper naturally beg the question of whether capital structure adjustments in response to deregulation result in a shareholder wealth increase. It is not obvious whether improvements in operating efficiencies (the elimination of excess capacity, for example) improve shareholder wealth because increased competition brought by deregulation most likely forces these efficiency improvements to be passed on to the consumers. What about improvements in managing capital structure decisions? In the tradeoff theory, any change in capital structure must be value increasing unless it reveals new information about the firm's prospects. Then the effect is ambiguous because it is confounded by the revelation of potentially negative information. Unless firms make capital structure changes an instant after the regulatory change takes place, deregulation provides a cleaner test of the effect of capital structure changes on shareholder wealth. My hope is that future research will analyze this issue in detail.

Appendix A. Variables construction

All variables are constructed from Compustat. All nominal values (i.e., non-ratios) are in December 2006 dollars:

Total assets=Book assets [data6];
Total debt=Long-term debt [data9]+Short-term debt [data34];

Market equity=Shares outstanding [data25] × Stock price [data199];
Market leverage=*MktLev*=Total debt/(Market equity+Total debt);
Book leverage=*BkLev*=Total debt/Total assets;
Profitability=*Ebitta*=Operating income before depreciation [data13]/Total assets;
Market-to-book=*Mtb*=(Market equity+Total debt+Preferred stock liquidating value [data10]−Deferred taxes and investment tax credits [data35])/Total assets;
Depreciation-to-assets=*Depta*=Depreciation and amortization [data14]/Total assets;
Fixed assets-to-assets=*Fata*=Net Property Plant and Equipment (PPE) [data8]/Total assets;
R&D-to-assets=*R&D*=Research and development expense [data46]/Total assets;
Deregulated industry=*Deregind*=indicator variable set to one for firms in entertainment (Fama-French 48-industry 7), petroleum and natural gas (industry 30), utilities (industry 31), telecommunications (industry 32), and transportation (industry 40) industries, and zero otherwise;
Regulation indicator=*Reg*=indicator variable set to one for years 1966–1979 for entertainment, 1966–1977 for petroleum and natural gas, 1966–1987 for utilities, 1966–1978 for telecommunications, and 1966–1975 for transportation firms, and zero otherwise;
Debt issues=(Long-term debt−Lagged long-term debt)/Lagged total assets;
Equity issues=((Shares outstanding × Adjustment factor [data27]−Lagged shares outstanding x Lagged adjustment factor) × ((Lagged stock price/Lagged adjustment factor−Stock price/Adjustment factor))/2)/Lagged total assets.

Appendix B. Summary of the regulatory reform in entertainment, petroleum and natural gas, utilities, telecommunications, and transportation industries

The following discussion summarizes the regulatory reform in entertainment, petroleum and natural gas, utilities, telecommunications, and transportation industries. The discussion is condensed from Viscusi, Harrington, and Vernon (2005).

Entertainment: Regulation of entertainment can be traced back to the Communications Act of 1934, which created the Federal Communications Commission (FCC) and empowered it to regulate wire and radio communication. The original justification for imposing regulations under the Act was that because broadcasters were permitted to use the limited spectrum space on public airwaves, they should be required to serve "the public interest, convenience and necessity". By the late 1970s, the growth of such technologies as cable and subscription television led to the Congress' belief that the public interest could best be served by the competition in the marketplace. Cable deregulation began with the federally mandated elimination of price controls over pay channels in 1979 and ended with the deregulation of basic cable service rates with the passage of the Cable Communications Policy Act of 1984. The Act prohibited all regulation (federal, state, and local) of basic cable service rates in areas where cable companies faced effective competition. The FCC originally defined effective competition as the presence of three or more over-the-air television stations. Rubinovitz (1993) cites a study by the General Accounting Office that indicates that at the end of 1989, 96% of all cable systems and 99% of all cable subscribers were no longer subject to local rate regulation.

In the area of radio, the deregulatory policy pursued by the FCC concentrated on deregulation of content and entry. The FCC chairman, Mark S. Fowler, pushed for the elimination of regulations that originally limited one company to own no more than seven AM radio stations, seven FM stations, five VHF television stations, and two UHF television stations. The FCC chairman also opposed rules prohibiting networks from owning cable systems. These rules were originally instituted to prevent large communications businesses from the concentrated ownership, which could potentially reduce the diversity of voices and opinions broadcasted across airwaves. Deregulation of radio by the FCC in 1981, in addition to easing entry, also substantially reduced the burdens on broadcasters by eliminating non-entertainment program guidelines, formal documentation of "community needs", and program logs, as well as by abolishing the FCC guidelines on the maximum commercial time allowed on radio stations.

Petroleum and natural gas: Petroleum has a long and rich history of regulation. Early regulation focused on quantity. Oklahoma was the first state to regulate quantity in 1909 by limiting the production of wells. Texas was the second state to regulate quantity beginning in 1919. However, regulation of quantity was not heavily enforced until 1928. The discovery of new reserves and, in particular, the East Texas oil field in 1930, coupled with a reduction in demand caused by the Great Depression, increased the supply of oil and resulted in significant oil price declines. Following Oklahoma, Texas began limiting the production of oil in 1930 and Kansas followed in 1931. In addition to restricting the domestic production, oil imports became regulated in 1959 with the Mandatory Oil Import Program (MOIP) instituted by President Eisenhower in the wake of rising oil imports. By the early 1970s, however, the regulation of quantity had become extinct. States had stopped restricting domestic oil production and the MOIP was ended in 1973. In the wake of rising inflation, regulation shifted from quantity to price. In November 1973, the Emergency Petroleum Allocation Act was passed that instituted oil price ceilings. Control over oil prices shifted from the Cost of Living Council to the Federal Energy Administration in May 1974. Under President Ford, the Energy Policy Conservation Act went into effect in December 1975. The Act rolled back some oil prices, but called for gradual decontrol starting in early 1976. President Carter put forth a new plan for gradual decontrol of oil prices from June 1979 to September 1981; however, concerned with the possible wealth transfer from consumers to oil producers under decontrol, the President instituted the Crude Oil Windfall Profits Tax of 1980. President Reagan lifted all remaining oil price controls in January 1981, ahead of the schedule outlined by President Carter.

Natural gas has been regulated since 1938 when Congress passed the Natural Gas Act, which gave the Federal Power Commission (FPC) control over the interstate transportation and sale for resale of natural gas in interstate commerce. In addition, a landmark Supreme Court ruling in Phillips Petroleum Co. vs. State of Wisconsin specified that the FPC also had a task of regulating wellhead rates for natural gas under the

Natural Gas Act of 1938. From that point on, the FPC was very active in regulating gas prices. Empirical evidence suggests that prices were regulated below their competitive levels, so by the late 1960s, shortages began to emerge in natural gas markets in the Midwest and the Northeast. In addition, the oil price shocks of 1973–1974 hit, which resulted in significant disequilibrium in the natural gas market. The government responded with the passage of the Natural Gas Policy Act of 1978. The Act called for the gradual decontrol of prices for new gas, defined as gas produced by wells discovered after 1977. Old gas prices remained controlled under the Act. In addition, price control was extended to the intrastate market for the first time. Government jurisdiction over the natural gas market moved from the FPC to the Federal Energy Regulatory Commission (FERC). According to the plan, prices for gas produced from deep wells were fully decontrolled in November 1979 and new gas prices were decontrolled in January 1985. Old gas prices were effectively decontrolled in 1986 when the FERC issued Order 451. In July 1989, President Bush signed the Natural Gas Wellhead Decontrol Act of 1989, which fully deregulated gas prices.

Utilities: The federal government has played a somewhat lesser role in regulation of utilities than in regulation of other industries. The main regulatory body for utilities has traditionally been the state public utility commissions, which controlled rates and evaluated proposed investments in generation, transmission, and distribution of power. The federal government, represented by the Federal Energy Regulatory Commission (FERC), has traditionally had responsibilities over wholesale power transactions (which historically meant the sale of power between utilities) and interstate transmission of power. The first change in federal regulatory policy can be traced to the Public Utilities Regulatory Policy Act of 1978. The Act gave qualifying facilities the right to sell power to vertically integrated utilities, which led to a significant increase in the number of non-utility power generators. The limitations of the Act included not allowing non-utility power generators to directly contract with customers and not allowing non-utility power generators to sell outside the service territory of their host utility. The Energy Policy Act of 1992 repealed the second limitation. In 1996, the FERC took further deregulatory steps with their Order 888, which required that owners of regional transmission networks act as common carriers of electric power. This meant providing interconnection service between power plants and wholesale buyers on the same terms with which it provided services to itself. This led to further deregulatory restructuring at the state level. The common element of these state restructuring regimes has been vertical unbundling. Instead of having one provider that is vertically integrated to generate, transmit, distribute, and market electricity to customers, the four functions are unbundled so that different services can be provided by different firms. A retail customer has a choice to access the wholesale power market and purchase unbundled distribution and transmission services from their local utility to deliver power.

Telecommunications: Regulation of the intercity telecommunications market (ITM) is rooted in the Mann-Elkins Act of 1910, which gave the Interstate Commerce Commission (ICC) the power to regulate interstate telephone service. The Communications Act of 1934 transferred power over ITM to the newly created Federal Communications Commission (FCC). The FCC had control over most aspects of competition through its control of price, entry, and interconnection. Until the late 1950s, the ITM was a classic example of a regulated monopolist. The logic behind regulation of the ITM was the belief that it represented a natural monopoly. With the advancement in microwave technology, many firms and government organizations began petitioning the FCC in the early 1950s to allow them to build and operate their own point-to-point communication networks. In 1959, the FCC made a decision to allow private users to share frequencies above 890 megacycles with American Telephone & Telegraph (AT&T) (the common carrier). In 1963, Microwave Communications Incorporated (MCI) petitioned the FCC to enter the St. Louis-Chicago private-line service market to compete with AT&T. The application was approved in 1969, which led to a significant increase in the number of similar requests made to the FCC from other firms desiring to enter the industry. In response to this demand, the FCC reached the Specialized Common Carrier decision in 1971, which allowed free entry into the private-line service market. Entry was further extended to the message toll service market with MCI's introduction of Execunet in 1975. However, FCC still regulated rates. Entry initially took place in the high-density markets, where several firms could operate simultaneously. In January 1982, AT&T agreed to sever its connections with its 22 telephone operating companies, a result of a seven-year antitrust case against AT&T brought by the U.S. Justice Department. In exchange for spinning off its telephone operating companies, AT&T was allowed to retain Western Electric (its manufacturing division), Bell Labs (its R&D division), and Long Lines (its suppliers of intercity telecommunication services). Also, the 1956 consent decree that prevented AT&T from entering any unregulated market was erased. The breakup of AT&T took place on January 1, 1984. Despite the increased competition brought by the breakup of AT&T and the inflow of new firms, regulation persisted. The FCC continued regulating AT&T on price and in March 1989 approved the use of price caps. The Telecommunications Act of 1996, enacted by Congress and signed by President Clinton, took a significant step toward deregulating the industry. The Act preempted all state laws that limited competition in the market for local and long-distance telephone services. It obviated the 1982 consent decrees prohibiting the regional Bell operating companies (RBOCs) and General Telephone & Electronics Corporation (GTE) from supplying long-distance telephone service, and required RBOCs to provide equal access to their systems by long-distance telephone systems, and permitted them to offer on their own long-distance telephone service to their local customers. RBOCs entered the long-distance telephone markets soon thereafter, but failed to enter other markets. Even though in the 1990s the RBOCs appeared ready to upgrade their systems to fiber-optics to enter the cable television market and the cable companies appeared to be getting ready to offer

local residential telephone service, these intentions failed to materialize. Cable television companies continued to enjoy a near monopoly, with the only source of competition being satellite TV.

Transportation: The history of transportation regulation goes back to the second half of the 19th century when railroads were the predominant form of long-range transportation. During that time period, aggressive price competition led to a significant increase in volatility of rail rates. The Joint Executive Committee (JEC) was formed in 1879 in order to coordinate pricing decisions and stabilize prices at profitable levels. In 1887, the JEC was replaced by the Interstate Commerce Commission (ICC) with the passage of the Interstate Commerce Act. The ICC was given the power to set rail rates and that power was further refined and expended with the Hepburn Act of 1906 (which gave the ICC the power to set maximum rates) and with the Transportation Act of 1920 (which gave the ICC the power to set minimum rates and to control entry and exit of firms from rail routes). The next wave of regulation came in the 1930s and 40s. In response to increased competition from other transportation industries, railroads applied significant lobbying pressure that led to the passage of the Motor Carrier Act of 1935 (which brought motor carriers under the ICC control) and of the Transportation Act of 1940 (which placed certain water barge transportation under the ICC control). The development of the interstate highway system in the 1950s and the presence of an unregulated trucking sector comprising owner-operators, and manufacturers and wholesalers providing their own freight transportation, made it increasingly difficult for railroads to compete from alternative modes of transportation. Railroads found ICC regulations too restrictive and began lobbying for less ICC control. Spurred by lobbying pressure and the bankruptcy of Penn Central, the Railroad Revitalization and Regulatory Reform Act of 1976 (the 4R Act) was passed. The 4R Act set up a ''zone of reasonableness'' within which railroads could adjust rates with the exception of those routes where railroads had ''market dominance''. For those routes, the ICC maintained strict price control. Another important provision of the Act was to give railroads increased freedom to abandon unprofitable routes. At the same time, the ICC began deregulating the trucking industry. The major deregulatory initiatives affecting railroads and trucking companies came in 1980. The Staggers Act of 1980 overturned much of the Interstate Commerce Act of 1887 and gave railroads considerable freedom in setting rates as well as relaxed restrictions on entry and exit. The Motor Carrier Act of 1980 codified much of the deregulation that the ICC had pursued in the trucking industry since the late 1970s. Subsequent deregulatory initiatives further deregulated the surface transportation industry.

Airlines have been regulated since 1934 when the Airmail Act of 1934 was passed that brought mail rates under the control of the ICC. The passage of the Civil Aeronautics Act of 1938 brought the airline industry under federal regulation. The Act created the Civil Aeronautics Authority (CAA), which two years later became the Civil Aeronautics Board (CAB). The Board was given authority over setting of maximum and minimum rates as well as over entry and exit. Finally, the CAB (and subsequently the Federal Aviation Administration (FAA)) was responsible for airline safety. Deregulation in the industry began in 1977 with John Robson, the CAB chairman, taking the first steps in relaxing entry restrictions into currently served markets and relaxing controls over fares. Fares actually decreased and industry profits rose in 1978. Given such positive results from competition, Congress passed the Airline Deregulation Act of 1978, which called for the gradual deregulation of the airline industry. According to the Act, the CAB's authority over routes would terminate at the end of 1981, its authority over fares would terminate at the end of 1982, and its existence would terminate at the end of 1984. The actual pace of deregulation was much faster—within a year of the Act's enactment, airlines were free to serve any route; by May 1980 the CAB significantly relaxed fare restrictions. Even prior to January 1, 1983, airlines became completely unregulated.

References

Averch, H., Johnson, L., 1962. Behavior of the firm under regulatory constraint. American Economic Review 52, 1052–1069.

Baker, M., Wurgler, J., 2002. The market timing theory of capital structure. Journal of Finance 57, 11–30.

Barclay, M., Smith, C., Morellec, E., 2006. On the debt capacity of growth options. Journal of Business 79, 37–60.

Barclay, M., Smith, C., Watts, R., 1995. The determinants of corporate leverage and dividend policies. Journal of Applied Corporate Finance 7, 4–19.

Bradley, M., Jarrell, G., Kim, E., 1984. On the existence of an optimal capital structure: theory and evidence. Journal of Finance 39, 857–878.

Bris, A., Welch, I., Zhu, N., 2006. The costs of bankruptcy: chapter 7 liquidation versus chapter 11 reorganization. Journal of Finance 61, 1253–1303.

Chang, X., Dasgupta, S., 2009. Target behavior and financing: how conclusive is the evidence?. Journal of Finance 64, 1767–1796.

DeAngelo, H., Masulis, R., 1980. Optimal capital structure under corporate and personal taxation. Journal of Financial Economics 8, 3–29.

Dudley, E., 2008. Capital structure and large investment projects. Unpublished Working Paper, University of Florida.

Fama, E., French, K., 2001. Disappearing dividends: changing firm characteristics or lower propensity to pay?. Journal of Financial Economics 60, 3–43.

Fama, E., French, K., 2002. Testing trade-off and pecking order predictions about dividends and debt. Review of Financial Studies 15, 1–33.

Fama, E., French, K., 2005. Financing decisions: who issues stock?. Journal of Financial Economics 76, 549–582.

Fischer, E., Heinkel, R., Zechner, J., 1989. Optimal dynamic capital structure choice: theory and tests. Journal of Finance 44, 19–40.

Flannery, M., Rangan, K., 2006. Partial adjustment toward target capital structures. Journal of Financial Economics 79, 469–506.

Frank, M., Goyal, V., 2003. Testing the pecking order theory of capital structure. Journal of Financial Economics 67, 217–248.

Frank, M., Goyal, V., 2008. Trade-off and pecking order theories of debt. In: Eckbo, B.E. (Ed.), Handbook of Corporate Finance: Empirical Corporate Finance, vol. 2. North-Holland, Amsterdam (Chapter 12).

Gomez-Ibanez, J., Oster, C., Pickrell, D., 1983. Airline deregulation: what's behind the recent losses?. Journal of Policy Analysis and Management 3, 74–89.

Graham, J., 2000. How big are the tax benefits of debt?. Journal of Finance 55, 1901–1941.

Gruber, J., Poterba, J., 1994. Tax incentives and the decision to purchase health insurance: evidence from the self-employed. Quarterly Journal of Economics 109, 701–733.

Harris, M., Raviv, A., 1991. The theory of capital structure. Journal of Finance 46, 297–356.

Hovakimian, A., Hovakimian, G., Tehranian, H., 2004. Determinants of target capital structure: the case of dual debt and equity issues. Journal of Financial Economics 71, 517–540.
Hovakimian, A., Opler, T., Titman, S., 2001. The debt–equity choice. Journal of Financial and Quantitative Analysis 36, 1–24.
Hubbard, G., Weiner, R., 1986. Petroleum regulation and public policy. In: Weiss, L., Klass, M. (Eds.), Regulatory Reform: What Actually Happened. Little, Brown, and Company, Boston, MA, pp. 105–136.
Jensen, M., 1986. Agency costs of free cash flow, corporate finance, and takeovers. American Economic Review 76, 323–360.
Jensen, M., Meckling, W., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3, 305–360.
Korajczyk, R., Levy, A., 2003. Capital structure choice: macroeconomic conditions and financial constraints. Journal of Financial Economics 68, 75–109.
Leary, M., Roberts, M., 2005. Do firms rebalance their capital structures?. Journal of Finance 60, 2575–2619.
Lemmon, M., Roberts, M., 2009. The response of corporate financing and investment to changes in the supply of credit. Journal of Financial and Quantitative Analysis, forthcoming.
Lemmon, M., Roberts, M., Zender, J., 2008. Back to the beginning: persistence and the cross-section of corporate capital structure. Journal of Finance 63, 1575–1608.
McMullen, B., Stanley, L., 1988. The impact of deregulation on the production structure of the motor carrier industry. Economic Inquiry 26, 299–316.
Miller, M., 1977. Debt and taxes. Journal of Finance 23, 261–275.
Moore, T., 1991. Unfinished business in motor carrier deregulation. Regulation 14, 49–57.
Myers, S., 1977. Determinants of corporate borrowing. Journal of Financial Economics 5, 147–175.
Myers, S., 1984. The capital structure puzzle. Journal of Finance 39, 575–592.
Petersen, M., 2009. Estimating standard errors in finance panel data sets: comparing approaches. Review of Financial Studies 22, 435–480.
Rajan, R., Zingales, L., 1995. What do we know about capital structure? Some evidence from international data. Journal of Finance 50, 1421–1460.
Ross, S., 1977. The determination of financial structure: the incentive-signaling approach. Bell Journal of Economics 8, 23–40.
Rubinovitz, R., 1993. Market power and price increases for basic cable service since deregulation. RAND Journal of Economics 24, 1–18.
Smith, C., Watts, R., 1992. The investment opportunity set and corporate financing, dividend, and compensation policies. Journal of Financial Economics 32, 263–292.
Strebulaev, I., 2007. Do tests of capital structure theory mean what they say?. Journal of Finance 62, 1747–1787.
Titman, S., Wessels, R., 1988. The determinants of capital structure choice. Journal of Finance 43, 1–21.
Viscusi, W., HarringtonJr., W., Vernon, J., 2005. Economics of Regulation and Antitrust, fourth ed MIT Press, Cambridge, MA.
Welch, I., 2004. Capital structure and stock returns. Journal of Political Economy 112, 106–131.
White, M., 1989. The corporate bankruptcy decision. Journal of Economic Perspectives 3, 129–151.
Willig, R., Baumol, W., 1987. Using competition as a guide. Regulation 1, 28–35.
Winston, C., 1993. Economic deregulation: days of reckoning for microeconomists. Journal of Economic Literature 31, 1263–1289.
Winston, C., 1998. U.S. industry adjustment to economic deregulation. Journal of Economic Perspectives 12, 89–110.
Winston, C., Corsi, T., Grimm, C., Evans, C., 1990. The Economic Effects of Surface Freight Deregulation. Brookings Institution, Washington, DC.
Zingales, L., 1998. Survival of the fittest of the fattest? Exit and financing in the trucking industry. Journal of Finance 53, 905–938.