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Merger waves following industry deregulation☆

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ABSTRACT

Deregulation is endogenous. It is preceded by poor industry performance and is predictable with performance variables. These results imply that merger activity following deregulation should be systematically related to poor pre-deregulation industry performance. Consistent with this hypothesis, I find that post-deregulation mergers serve a contractionary role. Bidders and targets in post-deregulation mergers are poor performers prior to the merger and operate with significant excess capacity. Consistent with the hypothesis that post-deregulation mergers represent a form of exit, the frequency of cash and bankruptcy mergers is significantly higher following deregulation and the offer premium is significantly lower.

1. Introduction

Empirical research on mergers and acquisitions (M&A's) has documented two broad stylized facts. First, mergers involving publicly traded targets come in distinct aggregate waves. Second, aggregate merger waves are caused by the clustering of industry-level merger waves.[1] Under the neoclassical view, merger waves result from technological and/or economic industry shocks that necessitate industry transformation (see Gort (1969), Maksimovic and Phillips (2001) and Jovanovic and Rousseau (2002), for example; Coase (1937) argued earlier that technological changes lead to mergers). The traditional view in the literature is that these industry shocks are unexpected or exogenous. For example, Andrade et al. (2001) in their survey of the merger literature argue that unexpected industry shocks lead to time clustering of industry-level takeover activity. Similarly, Rhodes-Kropf et al. (2005) summarize the Q theory of mergers by stating that exogenous economic shocks may create attractive opportunities for reorganization if some firms are well positioned to take advantage of these shocks while others are not.

It is not difficult to imagine however, that certain industry shocks are not unexpected or exogenous. This view has two implications. First, a non-trivial portion of merger activity following an endogenous shock should be explained by factors that cause the shock in the first place. Second, characteristics of mergers that take place following an endogenous shock should be systematically related to factors that cause that industry shock. This logic is important for our understanding of merger dynamics.

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[1] See Betton et al. (2008), Andrade et al. (2001), and Bruner (2004) for summary information on merger waves. See Mitchell and Mulherin (1996), Mulherin and Boone (2000), Maksimovic and Phillips (2001), Andrade and Stafford (2004), Harford (2005), among others, for evidence of industry clustering in merger waves.

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It also helps move the merger debate forward from analyzing *whether* industry shocks lead to merger activity to analyzing *how* industry shocks lead to merger activity.

There are a number of industry shocks that are endogenous to industry dynamics. In this paper, I focus on industry deregulation, which is one of the most often cited and arguably most significant of them. Andrade et al. (2001), for example, conclude that deregulation of such industries as airlines, telecommunications, railroads, utilities, and financials is the dominant factor in M&A activity since the 1980s. Schoenberg and Reeves (1999) similarly find that exposure to deregulation is the most significant driver of high merger activity in the United Kingdom. Bruner (2004) and Weston et al. (2004) in two widely used M&A textbooks list deregulation as the top driver of M&A activity.

Economic deregulation, defined as deregulation of entry, exit, price, and quantity, has had a significant impact on the U.S. economy. Winston (1993), citing the results from the 1991 Survey of Current Business, reports that the share of regulated industries' output was as high as 17% of GNP in 1977. Over the next decade, that share has declined considerably, so that by 1988, the share of regulated industries output stood at only 6.6% of GNP. In my analysis below, I corroborate these findings and find that regulated industries that become deregulated lose considerable significance for the U.S. economy over the 1960–2008 period. It seems natural to ask whether factors that contributed to the decline of these industries also played a role in the deregulation decision and affected merger activity that followed.

My starting point is to recognize that regulators do not randomly decide to deregulate an industry. Rather, regulators respond to pressure from special interest groups (Becker, 1983; Peltzman, 1976; Stigler, 1971) and to changes in economic conditions in an industry. Deregulation may take place in response to unexpected industry shocks that make industry environment less predictable (Demsetz and Lehn, 1985). For example, Jensen (1993) and Mitchell and Mulherin (1996) argue that the sudden spike and volatility in energy prices from the oil price shocks made the regulatory scheme in the airline industry less viable.

In addition to exogenous price shocks, deregulation may take place in response to technological and/or production shocks in an industry. Consider the development of microwave technology in the 1950s, for example. This technological breakthrough transformed telecommunications from a natural monopoly to a competitive industry, thereby eliminating the need for entry and rate regulation. During the same time period, the development of the interstate highway system significantly increased railroad competition from trucking, which in turn, increased pressure on the Interstate Commerce Commission (ICC) to relax rail rates.

Finally, deregulation may take place in response to more gradual demand/supply changes in the industry that make regulation less desirable. The airline industry again provides a good case study. The Civil Aeronautics Board (CAB) initially set out to regulate airline fares in order to support an air transportation system larger than the private market would support (Keeler, 1984). The intent was to provide service to small communities that would not be supported otherwise. The CAB achieved this objective by setting rates on long-haul high-density routes too high and using abnormal profits to cross-subsidize rates on low-density routes.[2] From the CAB's viewpoint, however, the unintended consequence of such a policy was that airlines began to compete on service quality, which dissipated abnormal profits on high-density routes. Coupled with significant increases in the small community population and the demand for air travel, the need for airfare regulation was significantly reduced. As soon as this became accepted, airline deregulation, further fueled by the oil price shocks, became an eventual certainty. Deregulation, therefore, takes place when regulation no longer works and is no longer politically tolerable, which should be reflected in poor industry performance prior to deregulation.

In the empirical analysis below, I document that deregulation is indeed preceded by poor and deteriorating industry performance. Prior to deregulation, industries under regulatory control are characterized by abnormally low and declining profitability, high leverage, low solvency, negative liquidity, and high but declining capital expenditures. Despite high capital expenditures, however, regulated industries grow no faster than other industries. This suggests that industries overinvest in capital during the period of regulation. Prior industry performance also predicts industry deregulation. Even after controlling for other determinants of regulatory changes, such as industry composition, competition, and lobbying pressure from special interest groups, I find that industry performance and changes in industry performance are strongly related to the deregulation probability. These results suggest that lawmakers respond to changes in industry conditions when initiating regulatory reform and decide to deregulate an industry when regulation fails to achieve its intended objective. Poor and deteriorating industry performance is a symptom of failure of regulation.

Given these results, I next argue that merger activity and merger characteristics are systematically related to poor pre-deregulation performance of deregulated industries. I hypothesize that mergers following industry deregulation represent a form of exit from poorly performing industries. When industries are regulated, exit (including through M&A activity) is less likely. For example, entry regulation suppresses competition and allows inefficient firms, that otherwise would disappear, to survive. Exit regulation explicitly prevents firm exit because the government considers the product produced by regulated firms important for public welfare. Price regulation suppresses cost considerations and often gives preferential treatment to some customers at the expense of others. Deregulation then either directly removes exit barriers or facilitates exit of less efficient firms, by creating a more competitive industry environment. Deregulation may also facilitate the ongoing industry transformation by speeding up technological and other changes that have contributed to deregulation in the first place. Merger clustering, especially involving exit mergers, therefore, is more likely following deregulation.

Under the exit explanation, I expect a disproportionately greater number of cash mergers (Jensen, 1988, 1993) and of bankruptcy mergers during the wave that follows industry deregulation. I label such a wave as the deregulatory merger wave. I also expect bidders and targets in the deregulatory merger wave to be poor performers relative to bidders and targets in other

[2] Averch and Johnson (1962) show that firms are willing to enter low-cost markets as long as they are regulated on the rates of return earned in all markets.

mergers. Finally, I expect target premiums, especially in bankruptcy mergers, to be lower because targets are more likely to be acquired at fire sale prices following industry wide shocks such as deregulation (Shleifer and Vishny, 1992).

I find empirical support for these predictions. The frequency of cash and bankruptcy mergers is significantly greater in deregulated industries. Moreover, in multivariate regressions after controlling for other determinants of cash and bankruptcy mergers, I find that the frequency of cash and bankruptcy mergers is especially high in the deregulatory merger wave. I also find that bidders and targets in the deregulatory wave are poor performers relative to bidders and targets in other mergers. Moreover, targets in the deregulatory wave are poor performers relative to non-merging firms in the same industry. The evidence indicates that even though an entire industry is performing poorly before deregulation, it is the relatively healthy bidders that acquire the relatively poorly performing targets. Finally, I find that the target premium is lower in the deregulatory wave and the lower premium is generated by bankruptcy mergers inside the wave. These results are consistent with the evidence in Hotchkiss and Mooradian (1998) and consistent with the Shleifer and Vishny (1992) hypothesis that targets are acquired at fire sale prices.

Several other merger characteristics suggest that mergers in the deregulatory wave are exit mergers. I find that deregulatory wave mergers take much longer to complete and are less likely to be completed. This is consistent with Hotchkiss and Mooradian (1998) that coordination problems among creditors make acquisitions less likely. In addition, significantly more mergers in the deregulatory wave involve subsidiary targets and subsidiary bidders. Harford (2005) finds that the majority of partial firm acquisitions are for cash, which again indicates that a significant portion of deregulated industries' assets exit the industries in these acquisitions. As regards subsidiary bidders, the results are consistent with Shleifer and Vishny (1992) in that a subsidiary of a conglomerate may be in a better position to acquire a target because it is able to receive a cross-subsidy from the conglomerate's other divisions that are not subject to the same industry shock.

The results in this paper contribute to the growing literature on mergers in deregulated industries.[3] The results imply that mergers in the deregulatory wave serve an important contractionary role. For example, I find that deregulated industries have a significantly lower ratio of sales-to-assets compared to that of unregulated industries. I further find that a low sales-to-assets ratio is associated with a higher deregulation probability. In the merger sample, I find that lower sales-to-assets is associated with higher frequency of cash and bankruptcy mergers. If the sales-to-assets ratio proxies for firm-level capacity utilization, i.e. the intensity of asset use, the results imply that deregulation is more likely in industries with low capacity utilization. Moreover, consistent with the contractionary motive for mergers, the results indicate that cash and bankruptcy mergers are more frequent when capacity utilization is low. The results are consistent with Andrade and Stafford (2004) who find evidence of contractionary as well as expansionary roles of mergers. The Andrade and Stafford (2004) analysis reveals an important time series variation in merger dynamics, with mergers in the 1970s and 1980s serving a contractionary role and mergers in the 1990s serving an expansionary role. The results in this paper imply that there is an important cross-sectional heterogeneity in merger dynamics as well. Moreover, given that mergers cluster in particular industries during particular times, the results in this paper add to our understanding of why contractionary mergers were more likely to take place in the 1970s and 1980s.

The results in this paper also highlight the importance of the market for corporate control. It has long been documented in the M&A literature that firms involved in takeovers are poor performers prior to the acquisition.[4] This result is consistent with the existence of the market for corporate control. What is less clear, however, is why it seems to take substantial time for the market for corporate control to work. For example, Palepu (1986) reports that abnormal returns cumulated over a *four*-year period prior to the acquisition predict takeover probability. Similarly, Morck et al. (1989) find that firms that become targets over the 1981–1985 period have lower Q ratios during the 1978–1980 period. Betton et al. (2008) in reviewing the M&A literature state that the 1980s merger wave took place in part to correct excessive conglomeration at least a *decade* earlier in the 1960s.

Jensen (1991) and Jensen (1993) contend that capital market regulatory constraints played a significant role in restricting the market for corporate control. Jensen argues that the passage of the Glass–Steagal Act and of the 1940 Investment Company Act put significant limitations on equity ownership by commercial banks and investment funds, respectively, which, in turn, limited investor activism and the ability to discipline management. I argue that economic regulation of entry and exit and of price and quantity has also played a key role in the failure of the market for corporate control in regulated industries. Regulatory barriers shield firms from competition and create perverse incentives for operational inefficiencies (see Winston (1993) and Winston (1998) for a review of the relevant literature). The market for corporate control cannot address these inefficiencies until regulatory barriers are removed. This argument helps explain why takeover firms may be poor performers long before being acquired.

The argument in this paper also addresses the debate on merger success. Researchers have long recognized that judging merger success requires understanding of reasons behind merger activity (see Mitchell and Mulherin, 1996, for example). However, the view held by some is that large-sample studies are incapable of providing valuable insights into factors behind merger success given the heterogeneity of reasons for mergers (Healey et al., 1992, for example). I challenge this view in this paper and argue that there may be much more commonality in reasons for mergers than has been previously thought. Industry

[3] See Becher et al. (2012), Becker-Blease et al. (2008), Green and Lehn (1995), Leggio and Lien (2000), Kim and Singal (1993), Kole and Lehn (1997), Kole and Lehn (1999), McLaughlon and Mehran (1995), Singal (1996), Slovin et al. (1991), Stiroh and Strahan (2003), Whinston and Collins (1992).

[4] In one of the earlier studies, Morck et al. (1989) show that targets of hostile and friendly acquisitions have lower Q ratios and earn lower abnormal returns prior to the acquisition compared to firms that are not acquired. Similarly, Hasbrouck (1985) finds that target firms have lower Q ratios compared to size-matched and industry-matched control firms. Palepu (1986) finds that firms are more likely to be acquired if their stock price performance is poor. More recently, Comment and Schwert (1995) find that target firms have below average sales growth and market-to-book ratios. Rhodes-Kropf et al. (2005) find that target firms have significantly lower ROA and ROE ratios. Cremers et al. (2008) find that the takeover probability is negatively associated with the Q and the ROA ratios.

shocks tell a researcher *where* to look for merger activity. The reasons behind those industry shocks may go a long way in telling *what* to look for in merger activity.

The rest of the paper is organized as follows. Section 2 describes the sample of deregulated industries and the sample of merger firms in those industries. I also present evidence that deregulated industries lose significance for the U.S. economy during my sample period. Section 3 tests the hypothesis that deregulation is endogenous to industry performance. I show that deregulation is predictable and takes place following poor and deteriorating industry performance. Section 4 analyzes merger activity following industry deregulation. I find a higher frequency of cash and bankruptcy mergers. I also show that bidders and targets in deregulated industries are inferior performers prior to the merger compared to other bidders and targets. Finally, I show that target premiums are lower following industry deregulation. Section 5 concludes.

2. Sample

I begin my analysis in Section 3 with a sample of firms operating in deregulated industries over the period January 1960–December 2008. Deregulated industries include airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. One deregulated industry that I do not consider in this study is the financial services industry. I exclude it because many performance characteristics that I focus on below do not apply directly to financial intermediaries (leverage, for example), which makes any inter-industry comparisons and generalizations impossible. Industry definitions are described in Appendix A. I require that firms have book assets of at least $10 million. I further require that all firm-years have non-missing data for book assets, sales, cash flows, capital expenditures, current assets, and current liabilities. These data requirements reduce the sample to include only publicly traded firms that are covered by CRSP/Compustat. The sample consists of 41,853 observations and 3345 unique firms.

In Section 4, I confine my analysis to a sample of firms in the above industries that have been involved in merger and acquisition (M&A) activity over the period January 1980–December 2008. The sample starting point is dictated by data availability and lines up roughly with the beginning of deregulation in most industries in my sample. The M&A sample is from the

Table 1
Major deregulatory initiatives affecting deregulated industries, 1960–2008.

Year	Initiative
Airlines	
1978	Airline Deregulation Act
1980	International Air Transportation Competition Act
1986	Trading of airport landing rights
Natural gas	
1978	Natural Gas Policy Act
1989	Natural Gas Wellhead Decontrol Act
1992	FERC Order 636
Oil	
1981	Decontrol of crude oil and refined petroleum products (executive order)
Railroads	
1980	Staggers Rail Act
1987	Sale of Conrail
1995	ICC Termination Act
Telecommunications	
1979	Deregulation of satellite earth stations (FCC)
1980	Deregulation of cable and 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
Trucking	
1980	Motor Carrier Reform Act
1993	Negotiated Rates Act
1994	Trucking Industry and Regulatory Reform Act
1995	ICC Termination Act
Utilities	
1988	Proposed rules on natural gas and electricity (FERC)
1992	Energy Policy Act
1996	FERC order 888
1999	FERC order 2000

Source: Viscusi et al. (2005).

Securities Data Company's (SDC) U.S. Mergers and Acquisitions Database. I use a relatively unrestricted sample of mergers, tender offers, and acquisitions of remaining interest with a deal value of at least $1 million. I allow the bidder and the target to be public, private, or a subsidiary firm. This sample consists of 7858 transactions where either the bidder or the target (or both) operate in one of the deregulated industries.[5] Because of data limitations, the number of observations varies across tests. The construction of all variables is described in Appendix A. To mitigate the effects of outliers and other data errors, I winsorize all variables at the upper and lower one-percentiles of the distribution.

Table 1 describes the major federal deregulatory initiatives affecting industries in my sample. Viscusi et al. (2005) provide an excellent description of these regulatory reforms; Ovtchinnikov (2010) provides a good summary.

I begin the analysis by describing the evolution of deregulated industries over my sample period. Winston (1993) reports that deregulated industries undergo a significant transformation during deregulation and lose considerable significance for the U.S. economy. Citing the results from the 1991 Survey of Current Business, he documents that fully regulated industries produced 17% of U.S. GNP in 1977. By 1988, that percentage is reduced to 6.6% of GNP. Table 2 provides detailed evidence on the evolution of deregulated industries from 1960 to 2008. All data except for value added is from Compustat. Value added is from the Bureau of Economic Analysis GDP-by-Industry Data Files. I take four separate snapshots of deregulated industries. I measure industry characteristics in 1960 and 2008, the beginning and end of my sample period, as well as in 1977 and 2000, the years preceding the beginning and following the end of deregulation, respectively.

Consistent with the results in Winston (1993), I find that deregulated industries lose considerable significance for the U.S. economy during my sample period. Deregulated industries account for 16.6% of all firms in 1960. By 1977, that percentage decreases to 10.2% and by 2000, the percentage decreases further to 7.6%. The trend reverses slightly over the later period, so that by 2008, deregulated industries account for 8.5% of all firms. Similarly, the market capitalization of firms in deregulated industries declines from 35.3% in 1960 to 28.3% in 1977 and declines further to 15.6% by 2000 before bouncing back in the later subperiod to 20.1% in 2008. In terms of the labor force employed and value added, again there is consistent evidence of a diminished importance of deregulated industries for the U.S. economy. Deregulated industries employ 6.8% of the total labor force and produce 12.0% of GDP in 1960. By 1977, deregulated industries employ 5.4% of the total labor force and produce 11.6% of GDP. The trend continues through deregulation, so that by 2000, deregulated industries employ only 4.1% of the total labor force and produce only 9.7% of the GDP. There is little change in these statistics over the 2000–2008 period.[6]

It is worth pointing out that the trend first described in Winston (1993) and reported here is not specific to the deregulation period. Deregulated industries are declining prior to deregulation. This is especially evident in Fig. 1, where I "fill in the gaps" in the time-series evolution of deregulated industries. All series with the exception of value added are declining rather dramatically long before the beginning of deregulation. There is no compelling evidence that deregulation speeds up the process. In fact, when I regress each time series on the time trend (measured in years) and on the interaction term between the time trend and an indicator for deregulation years, I find that the coefficient on the interaction is significantly negative only in the fraction of firm regression. The results, reported in panel B of Table 2, indicate that deregulated industries are declining prior to deregulation and continue to decline (although often at a slower rate) through the deregulatory period. This is broadly consistent with Jensen (1993) who argues that a ten-fold increase in oil prices in the 1970s resulted in contraction in the oil and other industries. The oil price increase also generated an increase in productive efficiency in other industries, which in turn, led to significant excess capacity. The resulting need for exit was facilitated in part by mergers because flawed internal governance systems prevented firms from shrinking themselves. This argument suggests, therefore, that mergers that take place in deregulated industries represent, at least in part, a form of exit from these declining industries.

In Table 3, I report detailed characteristics of firms that comprise deregulated industries during the pre-deregulation period defined as the five-year period immediately preceding the year when the first major deregulatory initiative in each industry is adopted. I first compute the median value of each characteristic and then average the medians across the deregulated industries. The results are reported in column 1. For comparison, I repeat the same procedure for all non-regulated industries (defined at the Fama–French 17 industry level) and report the results in column 2.

The results in Table 3 indicate that deregulated firms are different from non-regulated firms on several dimensions just prior to deregulation. First, deregulated firms are much larger. For example, the median deregulated firm has total assets of $1.2 billion prior to deregulation. In comparison, unregulated firms are one-fifth that size. The results for other measures of size (sales, market capitalization, and book equity) are similar. Deregulated firms also appear to be poor performers prior to deregulation. The sales-to-assets, the liquidity, and the ROA ratios are significantly lower for deregulated compared to unregulated firms. In fact, the sales-to-assets ratio for deregulated firms is half the size that of unregulated firms (0.872 vs. 1.619), and deregulated firms' liquidity is negative −0.011. Deregulated firms also have significantly higher book and market leverage and significantly lower solvency ratios compared to unregulated firms. Deregulated firms invest significantly more in CAPEX (but not R&D) compared to unregulated firms and appear to grow faster as evidenced by the sales growth ratio and, to a lesser extent, by the employees growth ratio. It is premature to place too much weight on the growth result because deregulated firms are so much larger than other firms. Deregulated firms also have insignificantly lower market-to-book prior to deregulation, which suggests that investors are skeptical about these firms' growth opportunities. Overall, the initial results indicate that deregulated firms have considerable

[5] My methodology is similar to Harford (2005), who also classifies bids to a specific industry if either the bidder or the target operates in that industry.

[6] I also find that industries become more concentrated following deregulation. Employees are concentrated in fewer firms following deregulation compared to other industries. This result is especially pronounced in airlines, natural gas, railroads, and trucking industries. Weston, et al (2004) similarly report that industries become more focused following deregulation and the subsequent merger and divestiture activity.

Table 2
Evolution of deregulated industries, 1960–2008. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. Panel A reports industry characteristics during four separate snapshot years. Industry characteristics are reported for 1960 and 2008, which represent the beginning and end of my sample period. Industry characteristics are also reported for 1977 and 2000, which represent years preceding and the beginning and following the end of deregulation, respectively. The table reports the number and percentage of firms operating in deregulated industries, the market capitalization and the percentage of total market capitalization of deregulated industries, the number of employees and the percentage of the total labor force employed in deregulated industries, and value added and the percentage of U.S. GDP produced by deregulated industries. All data except for value added is from Compustat. Value added is from the Bureau of Economic Analysis GDP-by-Industry Data Files. Panel B reports time-series regressions of industry characteristics on the time trend and on the interaction term between the time trend and an indicator for deregulation years. The numbers in parentheses are t-statistics under the null hypothesis that the coefficient is zero.

	Time period			
Variable	1960	1977 (pre-deregulation)	2000 (post-deregulation)	2008
Panel A: Industry characteristics				
Number of firms	185	500	621	598
Number of firms/all firms	0.166	0.102	0.076	0.085
Market value ($ millions)	763,361	870,912	3,040,011	4,246,697
Market value/total market cap	0.353	0.283	0.156	0.201
Employees (millions)	4.2	4.8	5.8	5.4
Employees/total labor force	0.068	0.054	0.041	0.037
Value added ($ millions)	446,484	797,241	1,158,857	1,395,077
Value added/GDP	0.120	0.116	0.097	0.101

Panel B: Industry regressions

$$\frac{Firms_{it}}{All\ firms_t} = \underset{(t=10.31)}{3.22} - \underset{(-9.96)}{0.0016} * Year - \underset{(-3.53)}{0.000008} * (Year \times Deregulation) \qquad \left(R^2 = 0.771\right)$$

$$\frac{Market\ value_{it}}{Total\ market\ cap_t} = \underset{(13.77)}{8.99} - \underset{(-13.37)}{0.0044} * Year + \underset{(1.21)}{0.000056} * (Year \times Deregulation) \qquad \left(R^2 = 0.809\right)$$

$$\frac{Employees_{it}}{Total\ labor\ force_t} = \underset{(44.31)}{1.27} - \underset{(-42.46)}{0.0006} * Year + \underset{(0.71)}{0.000001} * (Year \times Deregulation) \qquad \left(R^2 = 0.978\right)$$

$$\frac{Value\ added_{it}}{GDP_t} = \underset{(7.87)}{1.13} - \underset{(-7.11)}{0.0005} * Year + \underset{(4.43)}{0.000004} * (Year \times Deregulation) \qquad \left(R^2 = 0.552\right)$$

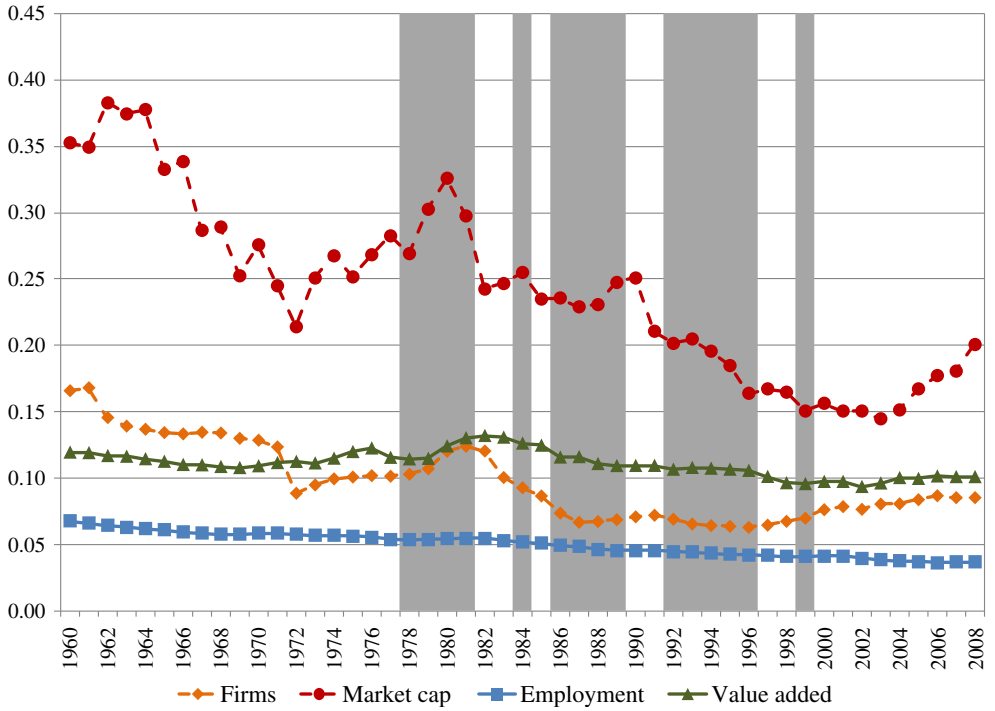

Fig. 1. Time-series evolution of deregulated industries, 1960–2008. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The figure plots the percentage of firms operating in deregulated industries (diamond marker), the percentage market capitalization of deregulated industries (round marker), the percentage of the labor force employed in deregulated industries (square marker), and the percentage of U.S. GDP produced by deregulated industries, i.e. value added (triangular marker). All data except for value added is from Compustat. Value added is from the Bureau of Economic Analysis GDP-by-Industry Data Files. Shaded areas are years when significant deregulatory initiatives in deregulated industries are adopted.

Table 3
Characteristics of firms operating in deregulated industries, 1960–2008. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The table reports firm characteristics for deregulated industries during the pre-deregulation period defined as the five-year period immediately preceding the year when the first major deregulatory initiative in each industry is adopted. I first compute the median value of each variable and then average the medians across the deregulated industries. Column 1 reports the results for firms in deregulated industries. Column 2 reports the results for firms in non-regulated industries defined at the Fama–French 17 industry level. All variables are defined in Appendix A. ***, **, * indicate statistical significant differences between deregulated and other firms at the 1%, 5%, and 10% levels, respectively.

Variable	Deregulated firms	Other firms
Firm size		
Assets ($ millions)	1164	264***
Sales ($ millions)	799	383***
Market equity ($ millions)	769	63***
Book equity ($ millions)	413	116***
Age (years)	11	12
Performance		
MTB	0.713	0.764
ÄSales	0.144	0.115**
ÄEmployees	0.022	0.017
Sales/assets	0.872	1.619***
CF	0.108	0.100*
Liquidity	−0.011	0.038**
ROA	0.050	0.058**
Investment		
CAPEX	0.118	0.061***
R&D	0.001	0.015**
Leverage		
Book leverage	0.375	0.247***
Market leverage	0.534	0.336***
Quick ratio	0.894	1.147***
Current ratio	1.121	2.164***
Interest coverage	4.685	5.740*

Table 4
Pre-deregulation abnormal performance of firms operating in deregulated industries, 1960–2008. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The table reports differences in differences in mean (panel A) and median (panel B) pre-deregulation performance characteristics between deregulated and size-matched benchmark firms immediately prior and 10 years after deregulation. Size-matched firms are firms in the same NYSE quintile as the average deregulated firm in the year immediately preceding the year when the first significant deregulatory initiative is adopted. All variables are defined in Appendix A. ***, **, * indicate statistical significant differences between deregulated and benchmark firms at the 1%, 5%, and 10% levels, respectively.

	Years relative to deregulation									
Variable	−10	−9	−8	−7	−6	−5	−4	−3	−2	−1
Panel A: Means										
Sales/assets	−0.122	−0.072	−0.288	−0.128	−0.277	−0.343**	−0.321**	−0.269*	−0.493**	−0.452**
CF	−0.017	−0.004	−0.008	−0.005	−0.001	−0.003	−0.006	−0.007	−0.022**	−0.019*
ROA	−0.018**	−0.005	0.001	−0.004	0.003	0.001	−0.003	−0.003	−0.007*	−0.004
MTB	−0.360*	−0.374*	−0.333*	−0.366*	−0.311**	−0.073	−0.032	0.014	0.129	0.203
CAPEX	0.008	0.001	0.012	0.022	0.005	0.021	0.024	0.012	0.033	0.020
R&D	−0.019	−0.013	−0.002	−0.006	0.012	0.006	0.0112	0.006	0.006	0.008
ÄEmployees	−0.039*	−0.012	−0.045	−0.001	0.371	−0.045	−0.019	−0.040	−0.096**	−0.063*
ÄSales	−0.039	0.009	−0.044	0.023	0.021	−0.032	−0.015	0.008	−0.049	−0.049*
Book leverage	0.045	0.021	0.026	0.028	0.016	0.035	0.048**	0.066***	0.071***	0.065***
Interest coverage	2.467	5.803	−0.588	−1.240	6.181	1.157	−11.280	−16.024	−13.320**	−8.271***
Current ratio	0.011	−0.106	−0.141	−0.111	−0.115	−0.235**	−0.298**	−0.336***	−0.359***	−0.242***
Liquidity	−0.004	0.007	0.0138	0.025	0.028	0.012	−0.000	−0.024***	−0.032***	−0.023***
Panel B: Medians										
Sales/assets	−0.046	−0.006	−0.246	−0.137	−0.259	−0.267*	−0.222*	−0.169*	−0.405**	−0.357*
CF	−0.012	0.002	−0.004	0.003	−0.002	−0.000	0.000	−0.006	−0.016*	−0.015
ROA	−0.015**	−0.004	−0.004	−0.005	−0.003	−0.002	−0.004	−0.007	−0.006	−0.004
MTB	−0.205*	−0.147	−0.144	−0.115	−0.121	0.046*	0.050	0.052	0.163	0.183
CAPEX	0.016	0.001	0.003	0.029	0.027	0.013	0.007	0.019*	0.014	0.000
R&D	−0.025*	−0.011	−0.005	−0.001	0.002	0.000	0.002	0.009	0.005	0.006
ÄEmployees	−0.005	0.005	−0.033	−0.023	−0.002	−0.003	−0.014	0.006	−0.029	−0.016
ÄSales	−0.005	0.016	−0.015	0.020	−0.004	−0.006	−0.035	−0.039	−0.025	−0.013
Book leverage	0.031	0.004	0.017	0.032	0.030	0.054**	0.054***	0.072***	0.061***	0.058***
Interest coverage	−2.469**	−1.323	−1.606	−1.725	−1.641	−1.128	−1.131	−1.749**	−2.352***	−1.766***
Current ratio	−0.135	−0.151	−0.145	−0.146	−0.093	−0.207***	−0.262***	−0.319***	−0.351***	−0.278***
Liquidity	−0.005	−0.001	0.002	0.004	0.018	−0.007*	−0.015	−0.020**	−0.019	−0.010

shortage of resources prior to deregulation. Despite that, deregulated firms invest significantly more in CAPEX. Palepu (1986) finds that firms with a significant mismatch between growth and resources are more likely to be acquired.

3. Timing of industry deregulation

In this section, I analyze the predictability of industry deregulation based on industry performance. I hypothesize that deregulation is not a random or an exogenous event but rather is an outcome of industry performance and lobbying pressure by special interest groups. In Section 3.1, I present univariate evidence of poor industry performance prior to deregulation. In Section 3.2, I estimate logistic regressions where the probability of deregulation is modeled as a function of prior industry performance and of lobbying variables that may impact deregulation likelihood.

3.1. Univariate analysis

Table 4 reports several measures of pre-deregulation operating performance. I focus on the ten-year period immediately preceding the year when the first significant deregulatory initiative is adopted in each industry and report abnormal performance characteristics for deregulated firms. I measure abnormal performance as the difference in differences in performance between deregulated and benchmark firms immediately prior and ten years after deregulation:

$$\left(X_t^{Treat} - X_t^{Cntrl}\right) - \left(X_{t+10}^{Treat} - X_{t+10}^{Cntrl}\right) \tag{1}$$

where X_t^{Treat} and X_t^{Cntrl} are the average performance characteristics of deregulated and benchmark firms in year t (and $t+10$), respectively. To be clear, I measure the differences in firm performance between deregulated and benchmark firms during two event windows and then take the difference in those differences in Eq. (1). The first event window spans the decade that immediately *precedes* the beginning of deregulation, while the second window spans the *following* already unregulated decade. Note that the difference in firm performance during the second event window, $X_{t+10}^{Treat} - X_{t+10}^{Cntrl}$, measures any natural differences in firm performance across deregulated and benchmark firms unrelated to regulation.[7] Thus, by subtracting the difference in post-deregulation performance of newly deregulated and benchmark firms from the difference in pre-deregulation performance of these firms, I attempt to isolate the effect of regulation on the pre-deregulation performance of deregulated firms.

The benchmark firms are screened on size as follows. I first compute the average market capitalization of 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 NYSE size quintiles and compute quintile breakpoints. Firms with the smallest market capitalization are placed in quintile one and firms with the largest market capitalization are placed in quintile five. Third, I select all non-regulated firms in the same size quintile as the average deregulated firm in the year prior to the beginning of deregulation. I match benchmark firms on size because the results in Table 3 indicate that deregulated firms are much larger than a typical unregulated firm. It is important, therefore, to control for any differences in performance characteristics that stem from differences in firm size rather than from differences in the firms' regulation status. I first compute mean and median abnormal performance characteristics for each industry and then average these statistics across the deregulated industries.

The results in Table 4 indicate that deregulated firms are inferior performers prior to deregulation. In row 1, the abnormal difference (i.e. the difference in firm performance prior to deregulation compared to the difference in performance 10 years later) in the sales-to-assets ratio between deregulated and benchmark firms is negative and declining in all years prior to deregulation. The ratio ranges from −0.122 in year $t-10$ to −0.452 in year $t-1$ and becomes statistically significant during the last five years before the beginning of deregulation. To put these results in perspective, deregulated firms have a pre-deregulation sales-to-assets ratio of 0.872 in Table 3, so the abnormal differences in row 1 are economically large. The results for medians in panel B are similar. The sales-to-assets ratio may be interpreted as a firm-level capacity utilization measure, i.e. a measure of intensity of asset use (Andrade and Stafford, 2004). Under this interpretation, the results indicate that deregulated firms operate with significant excess capacity prior to deregulation. This result indicates that the need for exit may be especially high in deregulated industries (Jensen, 1993).

The slower rate of asset turnover spills into lower profitability for deregulated firms. The abnormal difference in cash flows and ROA is negative and declining as industries approach deregulation. The results in the last 2 years prior to deregulation are particularly economically significant and indicate that deregulated firms underperform their benchmark firms by as much as 2% on the cash flow basis and by 0.7% on the ROA basis prior to deregulation compared to 10 years later. Deregulated firms also have abnormally high leverage and are less solvent. Specifically, abnormal leverage of deregulated firms is 6%–7% higher than that of benchmark firms 3 years prior to deregulation compared to 10 years later. Similarly, the abnormal interest coverage, current, and liquidity ratios are all negative and significant just prior to deregulation compared to 10 years later. This evidence indicates that deregulated firms have poor resources prior to deregulation.

Finally, there is some evidence that deregulated firms spend substantially more on capital expenditures relative to benchmark firms. The abnormal difference in the CAPEX ratio is positive (although insignificantly) and indicates that deregulated firms

[7] Such differences may come from differences in industry structure (monopoly status, for example) or the industry sensitivity to technological and other shocks.

overinvest by as much as 3.3% per year prior to deregulation relative to the benchmark firms. It is noteworthy that despite a higher level of capital expenditures, deregulated firms are not growing any faster than their counterparts. On the contrary, deregulated firms' abnormal sales and employee growth ratios are negative and deteriorate considerably prior to deregulation. So, compared to the results in Table 3, there is less evidence of a mismatch between growth and resources.[8] Deregulated firms do have low resources, but their growth is questionable at best. Thus, the CAPEX evidence in Table 4 points in the direction of the agency cost of free cash flows hypothesis (Jensen, 1986).

Fig. 2 expands the analysis in Table 4 in two ways. First, I break the analysis separately by industry to analyze whether the results in Table 4 are industry specific. Second, I expand the analysis to the 1965–2008 time period to further analyze whether the poor relative industry performance in Table 4 is simply a characteristic of deregulated industries or whether it is a result of deteriorating industry performance long prior to deregulation.[9] The shaded areas in each panel are years when deregulatory legislation initiatives in a given industry are adopted. Solid lines track median characteristics of deregulated firms; dashed lines track median characteristics of size-matched benchmark firms. Because the performance of size-matched benchmark firms may not be an ideal measure of normal performance, I include a second benchmark that consists of all firms in deregulated industries in my sample (lines with a triangular marker). To be clear, this benchmark includes all firms operating in industries that are initially regulated but become deregulated over the sample period. Because industries are deregulated at different points in time, I compare the performance of an industry that is about to be deregulated with the performance of other deregulated industries.

Corroborating Table 4 results, deregulated firms are less efficient prior to deregulation. In all industries except trucking, the deregulated firms' sales-to-assets ratio in panel A is lower than that of size-matched benchmark firms during all pre-deregulation years, and the differences appear substantial. For example, in the year immediately preceding the first year of deregulation, the median sales-to-assets ratio is 1.317 in airlines, 0.903 in natural gas, 0.845 in oil, 0.678 in railroads, 0.439 in telecommunications, and 0.408 in utilities. Compared to their counterparts, these ratios are 26.2% [(1.784 − 1.317) / 1.784 = 0.262], 45.3%, 41.1%, 59.1%, 69.8%, and 71.7% below the respective median capital expenditure ratios of the benchmark firms. Interestingly, prior to deregulation, telecommunications and utilities are the only two industries in which the sales-to-assets ratio is below that of other deregulated industries. Airlines do experience a significant drop in sales-to-assets from 1.25 in 1965 to 0.81 in 1969 but the ratio still remains well above that of other deregulated industries. So, even though deregulated industries as a group are characterized by lower sales-to-assets, there is no robust evidence in the time series that the ratio drops further prior to deregulation. This result is in contrast to the results in Table 4, where I document a significant drop in the average abnormal sales-to-assets ratio 5 years prior to deregulation.

The ROA results indicate that, compared to the size-matched benchmark, deregulated industries perform poorly and in the time series the performance tends to decline prior to deregulation. All industries except for oil and trucking have ROA ratios that are substantially lower than ROA ratios of size-matched benchmark firms. The ROA "discount" in the year prior to deregulation is 42.5% in airlines, 47.0% in natural gas, 49.1% in railroads, 34.7% in telecommunications, and 38.6% in utilities. Moreover, compared to both benchmarks, airlines, oil, trucking, and (to a lesser extent) railroads experience a significant decline in ROA in the years prior to or in the year of deregulation. The decline in ROA in airlines is especially pronounced, where it drops from 8.7% in 1966 to 0.1% in 1969. It does recover back to the level of deregulated benchmark's ROA but still remains significantly lower than size-matched firms' ROA prior to deregulation. Similarly, in trucking, the ROA drops significantly from 9.2% in 1965 to 2.4% before zigzagging randomly around the deregulated benchmark's ROA of just over 4%.

Also consistent with Table 4 results, the evidence in panels E and F indicates that deregulated firms are significantly less solvent than size-matched benchmark firms. Both the current ratio in panel E and the liquidity ratio in panel F are significantly lower for deregulated relative to size-matched benchmark firms.[10] Moreover, liquidity declines significantly prior to deregulation and is negative in airlines, natural gas, telecommunications, and utilities. This indicates that a typical firm operating in one of these industries is not able to cover its current liabilities with cash on hand prior to deregulation.

Finally, the results in panel D indicate that deregulated firms tend to undertake capital expenditures at a rate substantially above that of size-matched benchmark firms. This result is especially evident in airlines, oil, telecommunications, and trucking industries, where, in the year prior to deregulation, the capital expenditures ratio is 6.5%, 13.1%, 4.7%, and 12.6% higher than that of benchmark firms, respectively. In the time-series, deregulated industries generally experience a decline in capital expenditures. Airlines experience a particularly sharp drop in capital expenditures prior to deregulation, while in trucking, the decline is more gradual. Railroads have below normal capital expenditures for all years prior to deregulation, while in natural gas and utilities, capital expenditures fall below the benchmark level in the 5 years prior to deregulation. The only industry for which the time-series pattern is significantly different is oil where the rise in capital expenditures prior to deregulation is especially striking and consistent with the agency cost of free cash flow (Jensen, 1986, 1988). I also plotted the sales and employees growth ratios for each industry. Similar to Table 4 results, there are no significant and consistent differences in these ratios for deregulated industries prior to deregulation. In the interest of space, the results are not reported but are available upon request.

Overall, the evidence in Table 4 and Fig. 2 indicates that deregulated firms are less efficient prior to deregulation than unregulated size-matched benchmark firms. Deregulated firms operate with significant excess capacity, and become less

[8] The differences in the employee and sales growth results in Tables 3 and 4 do indeed come from differences in benchmark samples used. If the benchmark sample in Table 4 includes all unregulated firms instead of the size matched subsample, deregulated firms' sales and employee growth ratios are significantly higher than benchmark firm sales and employee growth ratios. The results are available upon request.

[9] I do not go back to 1960 because deregulated industries often have very few observations during the pre-1965 time period.

[10] The unreported results for the quick ratio are similar.

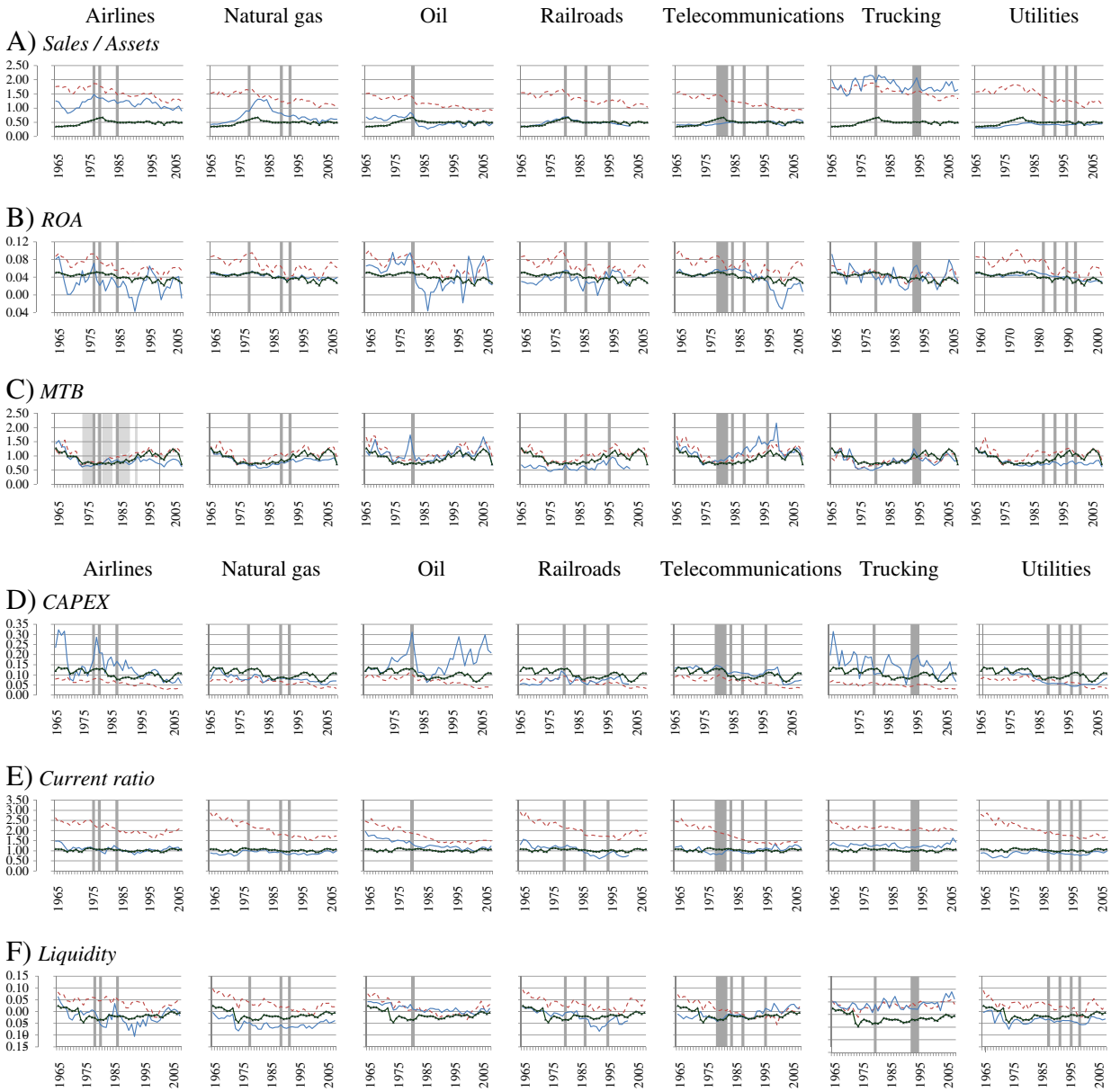

Fig. 2. Performance characteristics of firms operating in deregulated industries, 1960–2008. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The figure plots various firm performance characteristics for firms in each deregulated industry (solid lines), non-regulated size-matched benchmark firms (dashed lines), and all deregulated industries (triangular marker) over the sample period. Size-matched firms are firms in the same NYSE quintile 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 the sales-to-assets ratio. Panel B presents the results for the ROA ratio. Panel C presents the results for the market-to-book ratio. Panel D presents the results for the CAPEX ratio. Panel E presents the results for the current ratio. Panel F presents the results for the liquidity ratio. All variables are defined in Appendix A.

profitable and less solvent prior to deregulation. There is also evidence that deregulated firms spend significantly more on capital expenditures compared to unregulated benchmark firms but in the time series capital expenditures tend to fall prior to deregulation. Despite the high but falling level of capital expenditures, there is no evidence that deregulated firms grow faster prior to deregulation.

The results in this section are consistent with prior literature. Numerous studies report that firms in deregulated industries operate inefficiently prior to deregulation. Keeler (1984) in reviewing the literature on theories of regulation argues that industries such as railroads, airlines, and telecommunications are characterized by inefficient cross-subsidization, where a multiproduct firm prices some products below average cost and compensates for the loss by pricing other products above average cost. Deregulation takes place when regulation fails to protect profitable businesses from competition. In railroads, for example,

competition from water and especially from trucking transportation ate away lucrative business from high-value commodities where rail profits were the greatest. In airlines, competition among airlines themselves for the quality of service reduced profits from high-density routes intended for cross-subsidization (Keeler, 1978). In telecommunications, competition from independent long-distance companies ate into AT&T's long-distance profits (Viscusi et al., 2005, pp. 541–542). The outcome in each of these cases is the same—declining profitability of deregulated industries prior to deregulation. For example, Boyer (1987) finds evidence of declining revenues per ton-mile in the railroads industry prior to deregulation. He also finds that railroads lose considerable share of the intercity market prior to deregulation. Similarly, Peltzman (1989) finds that the ratio of cash flows to revenues declines considerably among airlines prior to deregulation.

The evidence of productive inefficiency is not confined to railroads, airlines, and telecommunications. Meyer and Leland (1980) find that regulated prices in the utilities industry were set significantly below unregulated profit-maximizing level. In the oil industry, oil price controls, set below world prices, resulted in insufficient oil production by domestic suppliers. Similarly, prices in the natural gas industry were set below market-clearing levels, which resulted in significant excess demand. One piece of evidence of this comes from a congressional report 94-732 (cited in Hubbard and Weiner, 1986; Viscusi et al., 2005) that finds that interstate prices for natural gas increased by 158% from 1969 to 1975, but intrastate prices (unregulated by regulators) increased by a much larger 650% over the same time period.

In addition to the effect on firm profitability, regulation also has a significant impact on firm investment. First, industries subject to the rate-of-return regulation, may suffer from the Averch–Johnson effect. Averch and Johnson (1962) argue that the rate of return regulation may encourage firms to overinvest in capital. If the "fair" rate of return is computed relative to the amount of capital employed (rate base), a regulated firm always has an incentive to overinvest in capital. Rungsuriyawiboon and Stefanou (2007) report evidence consistent with this hypothesis for a sample of U.S. utilities firms. Peles and Whittred (1996) provide evidence of the Averch–Johnson effect on a (small) sample of Hong Kong firms. Second, multitier price controls, such as those imposed on firms in oil and natural gas industries, where the prices for "new" oil and gas are set at higher levels than prices for "old" oil and gas, may produce perverse incentives for excessive drilling. A firm that drills a "new" well even over the existing reservoir is able to reclassify the product as "new" and obtain a higher price. Thus, firms may have an incentive to overinvest in capital (Viscusi et al., 2005). Third, in imperfect capital markets the cost of internal capital diverges from the cost of external capital so that the availability of internal capital matters for investment (Fazzari et al. (1988), Hubbard (1998) provides an excellent review). Regulation may increase the availability of internal capital if firm profits are shielded from competition. Thus, regulation may have a positive effect on investment through this cost of capital channel (Alesina et al., 2005). Note that under this view, regulated firms are not necessarily overinvesting but rather are investing closer to the first-best level relative to unregulated firms.[11]

3.2. Logistic analysis

Given the results in Table 4 and Fig. 2 as well as the results in other studies, it is natural to ask whether deregulation is predictable. In Table 5, I estimate the following logistic model:

$$D_{it}^{*} = \beta' Y_{it-2} + \gamma' X_{it-1} + \varepsilon_{it}, \tag{2}$$

where D_{it} is equal to one if a deregulatory initiative affecting industry i is passed in year t and zero otherwise, Y_{it-2} is a vector of performance variables discussed in Section 4.1, X_{it-1} is a set of control variables that may affect the passage of industry deregulatory initiatives, and ε_{it} is a random error term assumed to be possibly heteroskedastic and correlated within industries (Petersen, 2009).

Regulators are more likely to deregulate an industry following an extended period of poor and/or deteriorating performance. The results in Table 4 and Fig. 2 are consistent with this hypothesis. Moreover, there is likely to be a non-trivial lag between the time when deregulatory legislation is introduced and the time when it is passed by regulators. To capture the long-run performance of deregulated industries, I calculate a 5-year average and a 5-year change in each performance variable. To capture the lag between the introduction and the passage of deregulatory initiatives, I lag performance variables by 2 years. So, in the levels' regression, Y_{it-2} is a vector of average performance variables computed from year $t-6$ to year $t-2$ relative to the year when a deregulatory initiative is passed. In the change regression, Y_{it-2} is a vector of changes in performance variables computed from year $t-6$ to year $t-2$ relative to the year when a deregulatory initiative is passed. All control variables are lagged by one year, i.e. computed in year $t-1$ relative to the year when a deregulatory initiative is passed. Because of the need to lag the data, I begin the analysis in 1966. Because an industry cannot be deregulated again once it is fully deregulated, I only include industry-years up to and including the last year of deregulation in my analysis.

Control variables come from prior literature. Under the economic theory of regulation (Becker, 1983; Peltzman, 1976; Stigler, 1971), regulatory changes are more likely to take place for the benefit of interest groups that are better organized and that stand

[11] The relation between regulation and investment is complex and depends on many factors, including the industries affected, the type of regulation pursued by regulators, etc. A large literature has emerged that analyzes the effects of regulation on investment (see Guthrie, 2006 for a review). In many instances, regulation may depress investment. For example, Alesina et al. (2005) report that deregulation of entry and privatization of public enterprises spurred investment in a panel of 21 OECD countries during the period 1975–1998. The R&D results discussed in this section are consistent with this hypothesis.

Table 5
Logistic regressions predicting deregulation, 1966–1999. The sample contains all firms that operate in deregulated industries. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The table reports parameter estimates from logistic regressions where the dependent variable is equal to one if a deregulatory initiative affecting a given industry is passed in a given year and zero otherwise. The standard errors in parentheses are robust to clustering at the industry level and heteroskedasticity. The marginal effects (ME) measure the instantaneous changes in the dependent variable at sample means. All performance variables are defined in Appendix A. All control variables are defined in Section 3.2. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Level regression		Change regression	
Variable	Coefficient	ME	Coefficient	ME
Sales/assets	6.320	0.005	−9.278***	−0.293
	(4.706)		(2.113)	
ROA	−66.468	−0.051	−94.476***	−2.983
	(54.524)		(34.167)	
MTB	−22.800***	−0.018	−4.730**	−0.149
	(8.031)		(1.909)	
CAPEX	−99.568***	−0.078	−5.095	−0.161
	(15.859)		(5.067)	
ÄSales	28.370	0.022	−6.309*	−0.199
	(17.658)		(3.267)	
Book leverage	8.613	0.007	−40.421***	−1.276
	(16.895)		(15.362)	
Liquidity	22.394	0.018	−27.006*	−0.853
	(19.070)		(16.377)	
Interest coverage	−3.985***	−0.003	0.002	0.000
	(0.808)		(0.111)	
Sales	−152.784	−0.119	8.197	0.259
	(107.714)		(34.551)	
Unionized	−68.730***	−0.054	−19.472***	−0.615
	(19.876)		(4.019)	
Firms	0.018	0.000	−0.002	−0.000
	(0.026)		(0.008)	
Active firms	−0.387**	−0.000	−0.095	−0.003
	(0.153)		(0.117)	
Herfindahl	67.103***	0.053	−10.375	−0.328
	(18.291)		(11.741)	
ÄFirms	0.073**	0.001	0.029	0.001
	(0.032)		(0.027)	
Election year	1.282*	0.001	0.699*	0.023
	(0.664)		(0.400)	
Republican control	−2.228**	−0.002	−1.309	−0.041
	(1.018)		(1.343)	
Industry FE	Yes		Yes	
N	196		196	
Log likelihood	−41.049		−49.048	
Correlation of prediction with deregulation	0.645		0.539	

to gain more from favorable legislation. Thus, industries with fewer firms are more likely to observe regulatory changes. I proxy for industry size with total industry sales (Sales) and the number of firms operating in each industry (Firms). Moreover, those industries that stand to gain more from favorable legislation should have more politically active firms. I proxy for the degree of political activism in the industry with the number of industry firms with an established Political Action Committee (Active firms). The data on firms with Political Action Committees is from Cooper et al. (2010). Zardkoohi (1985) argues that the transaction cost of organizing and delivering political lobbying is smaller in highly concentrated industries. Thus, if legislation responds to lobbying, regulatory changes are more likely in highly concentrated industries.[12] I proxy for industry concentration with the Herfindahl index of sales concentration (Herfindahl). Masters and Keim (1985) argue that the extent of industry unionization positively affects the probability of industry lobbying either because unionization may be correlated with the extent to which government is involved in the industry or because firms may be forced to establish their own lobbying presence to counteract labor unions' influence among legislators. Thus, legislative initiatives may be more likely in heavily unionized industries. I proxy for the degree of industry labor unionization with the ratio of industry employees who are union members to total industry labor force (Unionized). The labor union data is from Hirsch and Macpherson (2003). Keeler (1984) argues that deregulation is more likely when regulation can no longer protect profitable businesses from competition. Thus, deregulation is more likely when the level of industry competition increases. In addition, technological changes in an industry may affect industry competition, which in turn affects the deregulation probability. I proxy for industry competition by the level of net entry of new firms in the industry (ΔFirms).[13]

[12] Regulatory changes may be less likely in industries with fewer firms and highly concentrated industries if firms are expected to lose from these changes.
[13] Note that industry competition is a reasonable but certainly an imperfect proxy for technological change, so the results must be interpreted with some caution.

Finally, I control for political factors. Kroszner and Strahan (1999) suggest that Republicans are more likely to favor deregulation, so I calculate the percentage of power concentrated among Republicans as in their study (Republican control). Because legislators may be less likely to undertake significant (especially unpopular) regulatory reforms during election years, I also include an indicator variable for all election years in the sample (Election year). Lastly, to control for any remaining unobservable time-invariant industry characteristics related to the deregulation probability, I include industry fixed effects in all regressions.

The results indicate that deregulation is predictable and more likely following a period of poor industry performance. In the level regression in column 1, the deregulation probability is negatively and significantly related to market-to-book, CAPEX and interest coverage ratios, and negatively but insignificantly related to ROA. The marginal effects, reported in column 2, indicate that the results are economically significant. The standard deviations of 5-year averages of market-to-book, CAPEX, and the interest coverage ratios are 0.211, 0.057, and 4.827 in my sample, so a one standard deviation decrease in each variable increases the deregulation probability by 0.38% ($-0.018\times-0.211=0.0038$), 0.44%, and 1.45% respectively. Sales-to-assets is positively but insignificantly related to the deregulation probability. This result appears in contrast with the results in Table 4 and Fig. 2, where I find that deregulated industries have a much lower sales-to-assets ratio prior to deregulation than their benchmark firms. However, when I replicate the analysis in Table 5 by replacing the sales-to-assets ratio with an indicator variable set to one if an industry is in the bottom two deciles of the sales-to-assets distribution in a given year, I find a significantly positive relation between the indicator and the deregulation probability. So, industries that are performing poorly relative to other industries in a given year and industries with excess capacity are more likely to be deregulated.

In the change regression in column 3, the deregulation probability is negatively and significantly related to changes in sales-to-assets, ROA, market-to-book, and leverage ratios, and negatively and marginally related to changes in sales growth and liquidity ratios. These results again imply that deteriorating industry performance (as measured by these variables) is associated with higher deregulation probability. The marginal effects, reported in column 4, indicate that the results are economically even more significant than in the level regression. The standard deviations of 5-year changes in sales-to-assets, ROA, sales growth, leverage, market-to-book, and liquidity ratios are 0.193, 0.021, 0.131, 0.044, 0.247, and 0.026 in my sample, so a one standard deviation decrease in each variable increases the deregulation probability by 5.65%, 6.26%, 2.61%, 5.61%, 3.68%, and 2.22% respectively.

Turning to control variables, there is evidence that industries characterized by the heavier presence of labor unions are less likely to be deregulated. This is consistent with evidence in Rose (1987) who reports that labor in the trucking industry was able to extract significant rents under regulation.[14] There is also evidence in the level regression that more concentrated industries with more competition but fewer politically active firms are more likely to be deregulated. These results are consistent with prior literature. Finally, deregulation appears less likely when the Republican control is greater.

I perform a number of robustness checks. First, as stated above, I proxy for poor industry performance with an indicator variable set to one if an industry is in the bottom two deciles of the performance distribution of all industries in a given five-year period and zero otherwise.[15] It is possible that regulators push for regulatory changes when an industry is performing especially poorly relative to other industries. This approach also controls for general business cycles because it identifies time periods when industry relative performance is poor. I find that poor relative performance, as measured by the sales-to-assets and market-to-book indicators, is consistently associated with a higher deregulation probability.

Second, I expand my analysis of performance variables to include a different set of lags. It is not clear how long regulators are willing to tolerate poor industry performance before deciding to act. I calculate 3-year, 7-year, and 10-year averages of the performance variables and 3-, 7-, and 10-year changes in the performance variables and repeat my analysis with these variables. All control variables are still lagged by one period, i.e. calculated in year $t-1$ relative to the deregulation year. The results in the level regression indicate that lagged ROA, market-to-book, and capital expenditures are consistently negatively associated with the deregulation probability, while in the change regression, lagged changes in sales-to-assets, market-to-book, and leverage are consistently negatively associated with the deregulation probability. I also assume different lags between the introduction and the passage of deregulatory initiatives. The sign on most performance variables remains unchanged, although the statistical significance varies between specifications. Overall, the results in Table 5 are consistent with the results in Table 4 and the hypothesis that deregulated industries perform poorly prior to deregulation. Deregulated industries also appear to use resources inefficiently. Finally, I experiment with a variable similar to the one computed in Baker and Wurgler (2002):

$$\text{Performance}_{it}=\sum_{s=0}^{s-z}\text{Performance}_{is}\times I_{is} \tag{3}$$

where Performance_{it} is one of the performance variables in Table 5 and I_{is} is defined

$$I_{is}\begin{cases}1, \text{if industry } i \text{ is } a \text{ poor relative performer}\\ 0, otherwise\end{cases}. \tag{4}$$

[14] See Peltzman (1989) for similar evidence.

[15] For CAPEX, the indicator variable is set to one if an industry is in the top two deciles of the CAPEX distribution. This variable captures relative industry overinvestment.

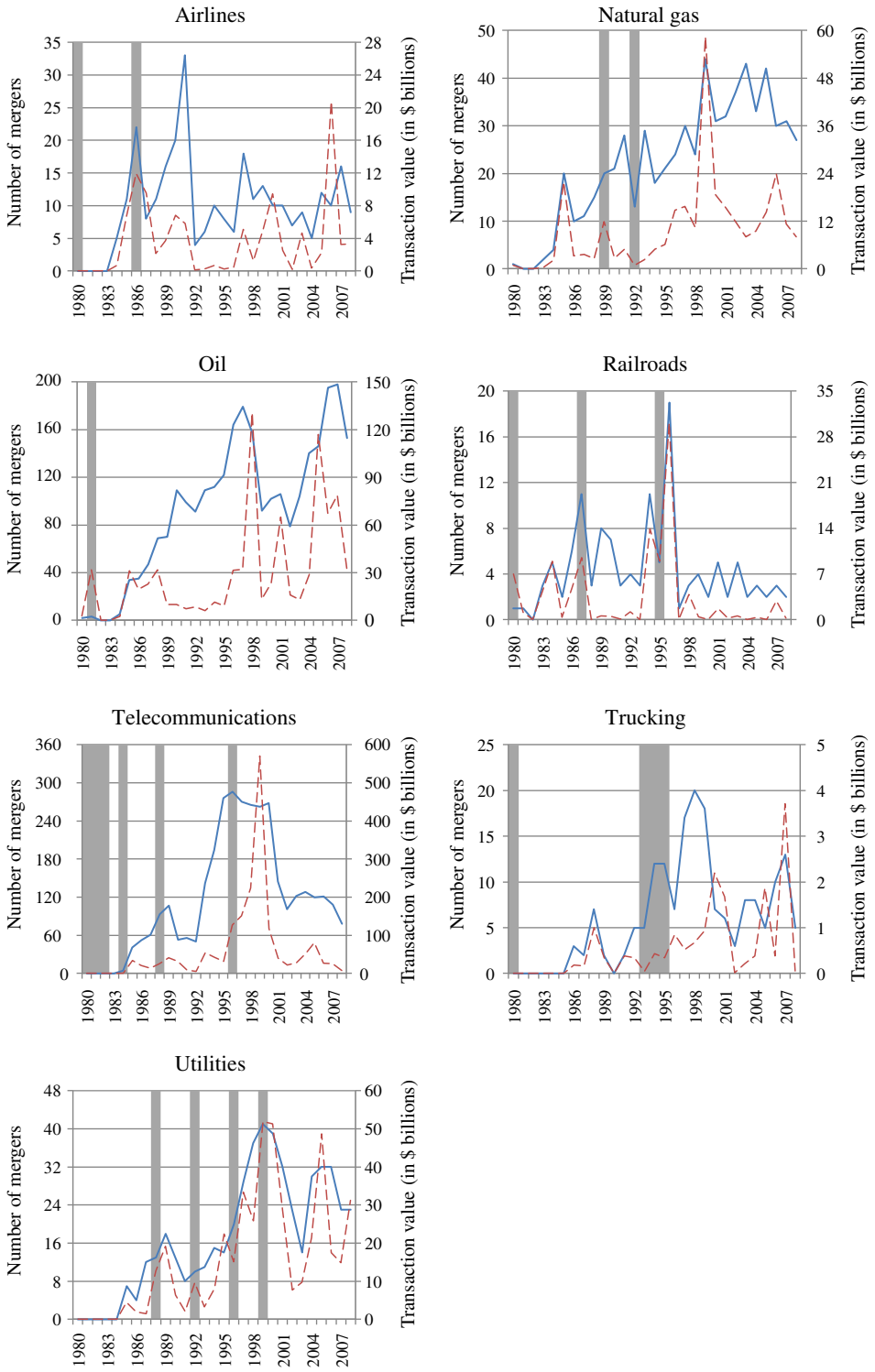

Fig. 3. Annual number and value of mergers in deregulated industries, 1980–2008. The sample contains all firms that operate in deregulated industries and that have been involved in M&A activity over the sample period. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The M&A sample is from SDC. The figure plots the annual number of mergers (solid) and the total transaction value (dashed) for each deregulated industry. Shaded areas are years when significant deregulatory initiatives are adopted.

An industry is defined as a poor relative performer if it is in the bottom two deciles of the performance distribution of all industries in year *s*. The advantage of using this variable instead of an (arbitrary) number of lags is that it identifies which lags are important for predicting the year of deregulation, which is likely to be industry specific. I find that market-to-book is consistently

negatively associated with the deregulation probability. Industries that are performing poorly and, therefore, are consistently in the bottom of the industry performance distribution are more likely to be deregulated.

In the last set of robustness tests, I add other performance and solvency measures from Table 3. In the level regression, the cash flow and the quick ratios enter with a negative sign, although only the coefficient on the quick ratio is statistically significant. In the change regression, the change in the cash flow ratio enters with a positive sign and is significant. This result is inconsistent with the hypothesis that declining industry performance predicts deregulation. The result is consistent with the agency cost of free cash flow (Jensen, 1986) and suggests that industries that operate inefficiently are more likely to be deregulated.

4. Mergers following industry deregulation

The results in the previous section show that deregulated industries perform poorly prior to deregulation and this poor performance helps predict industry deregulation. In this section, I hypothesize that merger waves following deregulation represent a form of exit from these industries. Under this exit hypothesis, I expect that, on average, bidders and targets in the merger wave following deregulation are poor performers with significant excess capacity relative to bidders and targets in other mergers. I also expect a disproportionately greater number of cash mergers (Jensen, 1988, 1993) and mergers with bidders and targets near or in financial distress. Finally, I expect target premiums to be lower because these firms are more likely to be acquired at fire sale prices (Shleifer and Vishny, 1992).

4.1. Merger characteristics

I begin by identifying merger waves following industry deregulation. Fig. 3 presents the time-series of the number (solid line) and the aggregate value (dashed line) of mergers in each deregulated industry in my sample.[16] The spikes in merger activity following industry deregulation are especially evident in the airlines, railroads, telecommunications, and trucking industries, while in the utilities industry, the peak of merger activity seems to occur during the last year of deregulation. In the rest of the industries, the spikes following industry deregulation are less evident. The methodology for identifying merger waves is as follows. I begin by classifying mergers that take place in the last year of deregulation and during the two-year period immediately following industry deregulation as deregulatory wave mergers. Based on prior studies (Harford, 2005; Mitchell and Mulherin, 1996), I allow the merger wave to last at least 2 years following the completion of deregulation. However, in industries with a pronounced wave longer than 2 years, I allow the merger wave to continue past the two-year cutoff until there is a significant drop in the number of industry mergers. For example, in airlines, there is a pronounced merger wave that begins in 1986 and ends in 1991. Similarly, in telecommunications and trucking, there are pronounced merger waves that begin in 1996 and 1995 and end in 2000 and 1999, respectively. Therefore, in the airlines, telecommunications, and trucking industries, the deregulatory merger waves are defined as those mergers that take place during the 1986–1991, the 1996–2000, and the 1995–1999 periods, respectively. In the natural gas, oil, railroads, and utilities industries, the deregulatory merger waves are defined as those mergers that take place during the 1992–1994, the 1981–1983, the 1995–1997, and the 1999–2001 periods, respectively.[17] Based on this methodology, 37.9% of all mergers in airlines, 9.4% in natural gas, 0.11% in oil, 19.8% in railroads, 39.7% in telecommunications, 41.8% in trucking, and 22.4% in utilities industries occur during each industry's deregulatory merger wave. In unreported results, I find that mergers following deregulation become more focused. Prior to deregulation, 53.7% of all deals in my sample involve bidders and targets from the same industry, compared to 62.4% of such deals following deregulation. When I further split the post-deregulation period into the period inside and outside the deregulatory wave, I find no significant differences in the frequency of same-industry mergers in the two sub-periods. These results are consistent with Becher et al. (2012) who similarly find that the frequency of same-industry mergers increases following deregulation of the utilities industry.

Before proceeding, it is important to consider why merger waves in natural gas and oil are significantly smaller than waves in other deregulated industries. The unique regulatory feature in the two industries is that both were regulated on price but not on quantity. Regulators established price ceilings that constrained prices but allowed companies to supply quantities well below the demand. Thus, these industries are characterized less by excess capacity (unlike railroads, for example, where the Interstate Commerce Commission required companies to meet all demand at regulator-established prices) and more by capacity shortages prior to deregulation. The need for exit, therefore, is likely to be much smaller in the natural gas and oil industries, which may help explain why significantly fewer mergers take place in these industries following deregulation.

Table 6 analyzes characteristics of mergers in the deregulatory merger wave. For comparison, I also present the results for mergers that take place in deregulated industries but outside the wave and for mergers in other unregulated industries (defined at the Fama–French 17 industry level) with available data in SDC. As in Table 3, I first compute the median value of each variable

[16] Netter, Stegemoller, and Wintoki (2011) show that merger waves are much less evident when private and subsidiary bidders and target firms are considered. To make sure that my results are not driven by the sample selection procedure, I similarly use an unrestrictive sample of mergers that includes public, private, and subsidiary firms but I do require that the deal value is known and equals at least $1 million.

[17] Andrade and Stafford (2004) report that an average industry has approximately half of its mergers take place within a 5-year subperiod. In my sample, 1735 mergers take place during the deregulatory merger waves, which represents 22% of all mergers in deregulated industries. If mergers were randomly spread through time, I would expect 1403 mergers during any 5-year period and 842 mergers during any 3-year period. Thus, mergers following industry deregulation are more frequent that what would be expected by chance.

Table 6
Characteristics of mergers in deregulated industries, 1980–2008. The sample contains all firms that operate in deregulated industries and that have been involved in M&A activity over the sample period. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The M&A sample is from SDC. The table presents a number of merger characteristics for mergers in deregulated and other industries. I first compute the median value of each variable and then average the medians across the subsamples of mergers. Panel A presents the number of cash, stock, and mixed consideration transactions. Panel B presents the bidder and target announcement period CARs and the target premium. Panel C presents deal characteristics. Panel D presents industry-adjusted characteristics of bidders. Panel E presents industry-adjusted characteristics of targets. Industry-adjusted characteristics are calculated as the difference between bidder or target characteristics and the industry average characteristic. All variables are defined in Appendix A. ***, **, * indicate statistical significant differences between mergers in the deregulatory merger wave and other mergers in deregulated industries and between mergers in the deregulatory merger wave and mergers in other unregulated industries at the 1%, 5%, and 10% levels, respectively.

Variable	Deregulated wave	Other deregulated	Other industries
Panel A: Number of mergers			
Cash	1155	4252	19,884
Stock	194	610	5548
Mixed	386	1261	9280
Panel B: Announcement period CARs			
Bidder			
Cash	0.47	0.63	0.65
Stock	−0.13	0.36	0.34
Mixed	0.78	0.51	1.01
Target			
Cash	19.01	15.96	20.56
Stock	10.98	8.44	13.11
Mixed	12.34	11.66	17.99***
Target premium			
Cash	29.90	23.91**	34.87
Stock	11.82	11.91	23.54**
Mixed	15.14	18.78	29.61***
Panel C: Deal characteristics			
Transaction value ($ millions)	414	407	344
TV/assets	0.102	0.285	0.163*
Relative size	0.256	0.507*	0.501*
Days to completion	105	106	69***
Cash in payment (%)	65.91	66.39	74.74*
Equity in payment (%)	30.33	30.14	22.05
Completed (%)	76.07	76.80	82.61**
Hostile (%)	1.80	4.26	3.68
Competed (%)	6.49	4.66**	3.14***
Public targets (%)	35.04	35.39	35.62
Private targets (%)	21.31	22.46	30.53**
Subsidiary targets (%)	43.64	42.15	33.84**
Public bidders (%)	85.37	91.02	92.84***
Private bidders (%)	7.57	3.32*	4.41
Subsidiary bidders (%)	7.06	5.56	2.73***
Panel D: Industry-adjusted bidder characteristics			
Assets ($ millions)	3571	455**	1538*
MTB	−0.088	0.047**	0.139***
ÄSales	0.031	−0.260	0.132
Sales/assets	0.064	0.041*	0.040*
CF	0.007	0.006	0.038**
Liquidity	0.011	0.025*	0.016
ROA	0.010	0.007	0.036**
CAPEX	−0.010	0.025**	−0.002
Book leverage	−0.020	−0.007	−0.006
Current ratio	−0.061	−0.091	−0.300
Panel E: Industry-adjusted target characteristics			
Assets ($ millions)	−943	−3672**	−2261**
MTB	−0.210	0.036**	−0.017
ÄSales	−0.118	−0.368	0.077
Sales/assets	0.113	0.069	0.117
CF	−0.027	−0.020	−0.005
Liquidity	−0.091	−0.023*	−0.032
ROA	−0.024	−0.028	−0.008
CAPEX	−0.065	−0.006***	0.001***
Book leverage	0.032	0.002	0.005
Current ratio	−0.424	−0.083*	−0.690

and then average the medians across the subsamples of mergers. Consistent with the exit hypothesis, the frequency of cash mergers is greater in the deregulatory merger wave than in other industry mergers. There are 1155 cash mergers during the deregulatory wave in my sample, which represents 67% (1155/1735 = 0.67) of all mergers in the deregulatory wave. In comparison, there are 19,884 cash mergers in unregulated industries over the sample period, which represents 57% (19,884/34,712 = 0.57) of all mergers in unregulated industries.[18] At first sight, the higher frequency of cash mergers during the deregulatory merger wave appears more of an industry phenomenon, as mergers that take place in deregulated industries but outside the wave are also more likely for cash (4252 cash mergers out of 6123 total mergers or 69% occurring outside the wave). I experimented with other definitions of the deregulatory wave (especially in the oil industry where the merger activity does not pick up until late 1980s), but the results are not sensitive to the definition of the wave. I find in Table 7 below, however, that after controlling for other determinants of cash mergers, the relative frequency of cash mergers in deregulated industries outside the wave is lower than the frequency of cash mergers inside the wave and the frequency of cash mergers in unregulated industries.

I next attempt to isolate whether bankruptcy mergers are more likely to be for cash and whether this relation holds stronger for mergers in deregulated industries and during the deregulatory wave. In unreported results, I focus on those mergers in the deregulatory wave in which the bidder or the target has the Altman's Z-score below 2.7 (which I refer to as bankruptcy mergers) and where the bidder or the target is in the bottom market-to-book quintile of all merging and non-merging firms in the year prior to the year of the merger announcement (which I refer to as bottom quintile mergers). I find that the frequency of cash bankruptcy and bottom quintile mergers is significantly greater in deregulated industries than in other industries. For example, 373 bankruptcy mergers are for cash in the deregulatory wave, which represents 62% of all bankruptcy mergers in the wave. Similarly, 118 bottom quintile mergers are for cash in the deregulatory wave, which represents 63% of all bottom quintile mergers in the wave. This is similar to other mergers in deregulated industries outside the wave where 63% and 61% of bankruptcy and bottom quintile mergers are for cash and significantly higher than the frequency of bankruptcy and bottom quintile mergers in unregulated industries where 56% of bankruptcy and 57% of bottom quintile mergers are for cash, respectively. The percentages are similar if bankruptcy or bottom quintile mergers are defined based on the status of the bidder.

Overall the results indicate that cash mergers are significantly more likely in deregulated industries and this result is evident inside and outside of the deregulatory wave as well as among bankrupt and poorly performing merging firms. The results for the deregulatory wave are especially compelling given the evidence in Section 3 that deregulated industries are performing poorly and have negative liquidity prior to deregulation. Chang and Mais (2000) and Heron and Lie (2002) find that the method of payment in mergers is significantly related to the availability of funds. Firms with higher levels of cash relative to the transaction value finance a greater portion of the deal with cash. The evidence in Table 6 indicates that despite poor performance and a shortage of capital, deregulatory wave mergers are more likely to be for cash. This is consistent with the exit hypothesis.

Panel B presents bidder and target announcement period cumulative abnormal returns (CARs) cumulated from 1 day before to1 day after the merger announcement. CARs are calculated relative to CRSP value-weighted market model benchmark returns. The parameters for the market model are estimated over the (−205, −6) interval. I also present the target offer premium computed as a cumulative abnormal return over the (−63, 126) interval with market model parameters estimated over the (−316, −64) interval (Schwert, 2000). Bidder CARs are positive and insignificantly lower in mergers in the deregulatory wave than in mergers in unregulated industries. I find the well-documented pattern that bidder CARs are positive in cash acquisitions and negative (or positive but significantly lower) in stock acquisitions (Heron and Lie, 2002; Servaes, 1991; Travlos, 1987, for example). There are no consistent differences in bidder CARs during the deregulatory wave and in other mergers in deregulated industries. Similarly, there are no meaningful differences in target CARs between mergers in the deregulatory wave, other mergers in deregulated industries, and mergers in unregulated industries. I find that cash acquisitions are associated with higher target CARs than stock acquisitions (Servaes (1991) and Heron and Lie (2002) among others report similar evidence). Finally, I find that the target premium is lower in mergers in the deregulatory wave compared to the premium in mergers in unregulated industries. The results for stock and mixed consideration deals are statistically significant.[19] Shleifer and Vishny (1992) argue that liquidation values of assets are lower if both the bidder and the target are hit with the same industry-wide shock. Consistent with this, Hotchkiss and Mooradian (1998) find that bankrupt targets are purchased at a significant discount relative to non-bankrupt targets in the same industry. If deregulation lowers liquidation values of industry assets because these assets cannot be easily redeployed to other uses, the lower target premium in the deregulatory merger wave is consistent with the exit hypothesis.

[18] The frequency of cash mergers reported in Table 6 is higher than cash frequencies reported in other papers. Moeller et al. (2004) report that 40% of mergers in their sample are cash mergers. Similarly, Andrade et al. (2001) report that 35% of mergers in their sample are cash mergers. My numbers are closer to those reported in Schwert (2000), who reports that 58% of all mergers in his sample are cash mergers (1363 cash out of 2346 total mergers). Bruner (2004) also reports high percentages of cash mergers.

[19] It is possible that mergers in the deregulatory wave are anticipated, which may explain the lower announcement period CARs and the lower target premium. I recompute the CARs and the premium for each event year following the last year of deregulation and do not find that those mergers closest to the end of deregulation have particularly low CARs and target premiums.

Panel C presents deal characteristics. Mergers in the deregulatory wave are slightly larger in absolute terms (row 1) but smaller as a fraction of bidder's assets and market capitalization (rows 2 and 3, respectively). Moeller et al. (2004) find that large bidders earn significantly lower announcement period CARs compared to small bidders and make acquisitions that are larger in absolute terms but smaller relative to bidders' assets and market capitalization. The results in panel B, therefore, may simply reflect the size effect. It may simply be the case that large firms are more likely to initiate takeover bids following industry deregulation (perhaps because they have relatively more resources at their disposal) and this may explain the lower announcement period CARs during the deregulatory merger wave. I control for this and other possibilities in my multivariate CAR analysis in Section 4.3 below. Also in panel C, mergers in the deregulatory wave take nearly twice as long to complete as mergers in unregulated industries (row 4) and are less likely to be completed (row 7). This is consistent with Hotchkiss and Mooradian (1998) who argue that coordination problems among creditors deter acquisitions. Perhaps because targets are trading at depressed valuations, mergers in the deregulatory wave are more likely to result in competing bids (row 9). This is consistent with Shleifer and Vishny (1992).

The bottom six rows of panel C provide a useful analysis of the target and bidder composition. Close to half of all mergers in the deregulatory wave involve subsidiary targets compared to just over one-third mergers in unregulated industries (row 12). Harford (2005) finds that the majority of partial-firm acquisitions are for cash. This again is consistent with the exit hypothesis because a substantial portion of deregulated industries' assets exit the industries in these acquisitions. Subsidiary bidders are also more frequent in mergers in the deregulatory wave (row 15). This is consistent with Shleifer and Vishny (1992) in that a subsidiary of a large conglomerate may be in a better position to acquire another target because it can receive a cross-subsidy from conglomerate's other divisions that are not affected by the same industry-wide shock. Finally, bidders in the deregulatory wave are less likely to be public (row 13), which may help explain the lower probability of merger success during the deregulatory merger wave. Betton et al. (2009) find that the takeover success probability is higher for public bidders.

Panels D and E present bidder and target characteristics. Because firms in deregulated industries may be fundamentally different from firms in other industries, I report industry-adjusted characteristics calculated as the difference between bidder or target characteristics and the respective industry average. Both bidders and targets in the deregulatory wave are significantly larger than those outside the wave and those in unregulated industries (row 1). Consistent with the exit hypothesis, bidders and targets in the deregulatory wave have lower market-to-book than bidders and targets outside the wave as well as bidders and targets in unregulated industries (row 2). In addition, bidders in the deregulatory wave are worse performers than bidders in unregulated industries (rows 5 and 7). It is also noteworthy that targets in the deregulatory wave underinvest relative to targets outside the wave as well as targets in unregulated industries, while bidders underinvest relative only to bidders outside the wave (row 8). Finally, targets in the deregulatory wave have lower liquidity and are less solvent compared to targets outside the wave. These results suggest that merger firms, especially targets, are poorly managed prior to the merger. This is particularly true for those mergers that take place inside the deregulatory wave.

The comparison of bidders and targets across panels D and E offers additional insights into the motivation behind mergers in the deregulatory wave. While it is the case that bidders are generally relatively healthier than targets across the three groups of mergers, the conventional wisdom that high market-to-book bidders purchase low market-to-book targets does not hold for deregulatory wave mergers. Both bidders and targets in the deregulatory wave have negative and comparable industry-adjusted market-to-book ratios (the unreported t-statistic for the difference is 0.12), which is in contrast to previously reported evidence that bidders' market-to-book is higher than targets' market-to-book (Andrade et al., 2001; Rhodes-Kropf et al., 2005, for example). This result lines up poorly with behavioral explanations for mergers because these explanations rely on the dispersion in bidder and target valuation to generate the motivation for a merger (Rhoders-Kropf and Viswanathan, 2004; Shleifer and Vishny, 2003). The result is consistent with Okoeguale (2012) who finds that the exit of firms through mergers and bankruptcies following the 1996 deregulation of telecommunications does not significantly change industry stock valuations.

The final test that I perform is the comparison of merging and non-merging firms in deregulated industries inside and outside the deregulatory merger wave. In unreported results, I examine the pre-deregulation characteristics (Zingales, 1998) of bidders and targets inside and outside the deregulatory wave and find that firms that become bidders inside the wave are little different from non-merging firms, except that bidders have higher liquidity. Outside the wave, however, I find that eventual bidders are smaller, have a higher sales growth ratio, but are less profitable. Firms that become targets inside the wave are poor performers compared to non-merging firms. Targets operate with significant excess capacity and are more levered, have lower cash flow, ROA, and sales growth ratios inside the wave. Outside the wave, eventual targets have higher market-to-book, sales growth, and liquidity ratios. These results are consistent with the exit hypothesis, whereby the poorly managed targets are acquired by relatively healthy bidders inside the wave. The results are also consistent with Okoeguale (2012) who finds that firms that become bidders following the 1996 deregulation of telecommunications are larger, more efficient and less leveraged before deregulation compared to firms that become targets.

4.2. Frequency of cash and bankruptcy mergers

The results in Table 6 indicate that cash mergers are more likely in deregulated industries. In this section, I analyze the frequency of cash mergers in multivariate regressions controlling for prior performance. A number of studies show that prior firm performance affects the method of payment in mergers, so it is important to understand whether the results in Table 6 are

Table 7
Poisson regressions for mergers in deregulated industries, 1980–2008. The sample contains all firms that operate in deregulated industries and that have been involved in M&A activity over the sample period. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The M&A sample is from SDC. The table presents the results from Poisson regressions of the frequency of cash (Panel A) and of bankruptcy mergers (Panel B). Cash mergers are mergers with cash as a method of payment. Bankruptcy mergers are mergers where either the bidder or the target has the Altman's Z-score below 2.7. The table presents the incidence rate ratios. The standard errors are in parentheses. The marginal effects are in square brackets. All variables are defined in Appendix A. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	1	2	3	4	5	6	7	8
Panel A: Cash mergers								
Deregulated industry	0.792***	0.945***	0.718***	0.728***	1.042**	1.267***	1.218***	1.219***
	(0.014)	(0.021)	(0.018)	(0.018)	(0.019)	(0.029)	(0.034)	(0.035)
	[−2.44]	[−0.61]	[−3.39]	[−3.28]	[0.89]	[5.31]	[4.39]	[4.38]
Deregulatory wave	1.432***	1.382***	1.345***	1.268***	1.135***	1.222***	1.217***	1.276***
	(0.048)	(0.048)	(0.047)	(0.044)	(0.038)	(0.043)	(0.043)	(0.045)
	[4.61]	[4.07]	[3.63]	[2.84]	[2.92]	[4.77]	[4.65]	[5.22]
Liquidity		0.979***	0.970***	0.967***		0.983***	0.982***	0.985***
		(0.002)	(0.002)	(0.002)		(0.002)	(0.002)	(0.002)
		[−1.18]	[−1.62]	[−1.82]		[−1.89]	[−2.01]	[−1.65]
CAPEX		0.993**	1.032***	1.034***		0.967***	0.971***	0.965***
		(0.003)	(0.004)	(0.004)		(0.003)	(0.004)	(0.004)
		[−0.28]	[1.23]	[1.30]		[−2.69]	[−2.36]	[−2.78]
Book leverage		0.963***	0.962***	0.954***		0.991***	0.989***	0.998
		(0.001)	(0.001)	(0.002)		(0.001)	(0.002)	(0.002)
		[−2.79]	[−2.89]	[−3.49]		[−1.41]	[−1.56]	[−0.36]
MTB		1.323***	1.399***	1.643***		1.242***	1.246***	1.109***
		(0.023)	(0.024)	(0.035)		(0.024)	(0.024)	(0.025)
		[1.29]	[1.52]	[2.27]		[1.99]	[2.03]	[0.95]
ÄSales		1.010***	1.009***	1.015***		1.011***	1.011***	1.007***
		(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)
		[0.95]	[0.88]	[1.31]		[1.98]	[2.01]	[1.27]
Sales/assets			0.593***	0.583***			0.940**	0.954*
			(0.013)	(0.013)			(0.024)	(0.025)
			[−2.63]	[−2.74]			[−0.63]	[−0.48]
ROA				0.950***				1.043***
				(0.004)				(0.005)
				[−1.59]				[2.63]
N (industry)					1.001***	1.001***	1.001***	1.001***
					(0.000)	(0.000)	(0.000)	(0.000)
					[12.49]	[11.21]	[11.59]	[11.51]
N (year)					1.000***	1.000***	1.000***	1.000***
					(0.000)	(0.000)	(0.000)	(0.000)
					[11.79]	[11.90]	[12.36]	[12.23]
Year dummies	Yes	Yes	Yes	Yes	No	No	No	No
N	551	551	551	551	551	551	551	551
Pseudo R^2	0.329	0.395	0.419	0.426	0.640	0.655	0.655	0.662
Panel B: Bankruptcies								
Deregulated industry	1.989***	2.434***	1.303***	1.356***	2.742***	2.832***	2.297***	2.302***
	(0.065)	(0.105)	(0.063)	(0.066)	(0.093)	(0.128)	(0.132)	(0.132)
	[2.01]	[2.71]	[0.69]	[0.78]	[5.43]	[5.88]	[4.48]	[4.49]
Wave	1.415***	1.379***	1.247***	1.241***	1.390***	1.429***	1.398***	1.388***
	(0.071)	(0.073)	(0.065)	(0.066)	(0.068)	(0.078)	(0.077)	(0.076)
	[1.06]	[0.97]	[0.61]	[0.41]	[1.70]	[1.97]	[1.83]	[1.78]
Liquidity		0.982***	0.977***	0.976***		0.983***	0.978***	0.977***
		(0.004)	(0.004)	(0.004)		(0.004)	(0.004)	(0.004)
		[−0.24]	[−0.30]	[−0.30]		[−0.41]	[−0.51]	[−0.54]
CAPEX		0.994	1.086***	1.082***		0.991	1.012***	1.014*
		(0.006)	(0.007)	(0.007)		(0.006)	(0.007)	(0.007)
		[−0.05]	[0.76]	[0.70]		[−0.15]	[0.21]	[0.23]
Book leverage		0.979***	0.971***	0.963***		1.006**	1.000	0.997
		(0.003)	(0.003)	(0.003)		(0.003)	(0.003)	(0.004)
		[−0.39]	[−0.50]	[−0.64]		[0.21]	[0.01]	[−0.09]
MTB		1.586***	1.687***	2.017***		1.175***	1.195***	1.245***
		(0.057)	(0.059)	(0.083)		(0.058)	(0.057)	(0.066)
		[0.51]	[0.56]	[0.73]		[0.32]	[0.35]	[0.44]
ÄSales		1.008***	1.009***	1.015***		0.995**	0.996*	0.998
		(0.002)	(0.002)	(0.002)		(0.002)	(0.002)	(0.002)
		[0.18]	[0.21]	[0.31]		[−0.19]	[−0.14]	[−0.09]
Sales/assets			0.332***	0.325***			0.729***	0.723***
			(0.016)	(0.016)			(0.041)	(0.040)
			[−1.32]	[−1.30]			[−0.70]	[−0.71]

(continued on next page)

Table 7 (*continued*)

Variable	1	2	3	4	5	6	7	8
ROA				0.939***				0.985*
				(0.008)				(0.008)
				[−0.45]				[−0.21]
N (industry)					1.001***	1.001***	1.001***	1.001***
					(0.000)	(0.000)	(0.000)	(0.000)
					[2.91]	[2.56]	[2.52]	[2.48]
N (year)					1.000***	1.000***	1.000***	1.000***
					(0.000)	(0.000)	(0.000)	(0.000)
					[2.99]	[3.08]	[2.92]	[2.88]
Year dummies	Yes	Yes	Yes	Yes	No	No	No	No
N	551	551	551	551	551	551	551	551
Pseudo R^2	0.307	0.339	0.400	0.407	0.543	0.548	0.551	0.552

spurious.[20] In addition to analyzing the frequency of cash mergers, I also analyze the frequency of bankruptcy mergers in the deregulatory wave. Bankruptcy mergers are those mergers in which the bidder or the target has the Altman's Z-score below 2.7.[21] Under the exit hypothesis, I expect a greater number of bankruptcy mergers where either the bidder or the target is near or in financial distress. In Table 7, I run Poisson regressions of the number of cash and bankruptcy mergers:

$$P(Y_{it} = y_{it}|X_{it-1}) = \frac{e^{-\lambda_{it}}\lambda_{it}^{y_{it}}}{y_{it}!} \tag{5}$$

where $y_{it} = 0, 1, 2, \ldots$ is the number of cash or bankruptcy mergers in industry i in year t, and λ_{it} is formulated with the loglinear model:

$$\ln(\lambda_{it}) = \beta' X_{it-1}. \tag{6}$$

The vector X_{it-1} includes (i) an indicator variable set to one for all deregulated industries in my sample and zero otherwise, (ii) an indicator variable set to one in the deregulatory wave years and zero otherwise, and (iii) industry performance characteristics that may explain the frequency of cash and bankruptcy mergers. Table 7 reports the incidence rate ratios, which measure the change in the rate ratio for a one unit increase in each independent variable while holding all other independent variables constant. The coefficients on the deregulated industry and the deregulatory wave dummies measure the relative frequency of mergers in the deregulated industries and during the wave relative to the frequency of mergers in unregulated industries and outside of the wave. Under the exit hypothesis, I expect the coefficient on the wave indicator to be significantly greater than one.

The results are strongly consistent with the exit hypothesis. In models 1–4, the relative incidence rate of cash mergers is significantly greater than one and indicates that 27% to 43% more cash mergers take place during the deregulatory wave. The number in square brackets is the marginal effect, which measures the number of additional cash mergers per year that take place in the deregulated wave. This number ranges from 2.8 additional cash mergers per year in model 4 to 4.6 additional cash mergers. The results appear economically significant. Interestingly, the relative frequency of cash mergers outside of the deregulatory wave is actually lower than that of other industries. The coefficient on the deregulated industry indicator is significantly less than one and the marginal effect in square brackets indicates that there are 0.6 to 3.4 fewer cash mergers in deregulated industries outside the wave compared to unregulated industry mergers. Thus, controlling for other determinants of cash mergers, the number of cash mergers is lower in deregulated industries compared to other industries.

The results for other control variables are also consistent with the exit hypothesis. The relative frequency of cash mergers is higher in years when the industry performance is poor as measured by low liquidity (row 3), and low profitability (rows 8 and 9). The relative frequency of cash mergers is also higher when industry leverage is low (row 5), which may reflect the fact that firms have higher debt capacity to undertake cash acquisitions and finance them with leverage. The results also indicate that the relative frequency of cash mergers is high when industry market-to-book and sales growth are high (rows 6 and 7), but this result most likely reflects the fact that the number of all mergers is higher when industry growth opportunities and industry valuations are high.

[20] For example, Martin (1996) shows that firms with higher growth opportunities and firms with a stock price runup prior to the acquisition are more likely to pay with stock. See also Rhodes-Kropf et al. (2005), and Dong et al. (2006), among others. Martin (1996) also finds that the availability of cash is an important predictor of cash mergers. Heron and Lie (2002) among others report similar evidence.

[21] My results are similar if bankruptcy mergers are defined as those mergers in which either the bidder or the target is in the bottom market-to-book quintile of all merging and non-merging firms (bottom quintile mergers).

Table 8
Bidder CARs, Target CARs, and Target Premium, for Regulated and Unregulated Firms, 1980−2008. The sample contains all firms that operate in deregulated industries and that have been involved in M&A activity over the sample period. Deregulated industries are airlines, natural gas, oil, railroads, telecommunications, trucking, and utilities. The M&A sample is from SDC. The table presents the results from OLS regressions of bidder and targets CARs and the target premium on a deregulated industry indicator, a deregulatory merger wave indicator, a bankruptcy indicator, and other controls. All regressions include year dummies. The standard errors in parentheses are robust to heteroskedasticity. All variables are defined in Appendix A. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Bidder CAR		Target CAR		Target premium	
	1	2	3	4	5	6
Intercept	0.0395***	0.0392***	0.0464	0.0487	0.1823	0.1884
	(0.0135)	(0.0135)	(0.0839)	(0.0840)	(0.1378)	(0.1370)
Deregulated industry	−0.0121**		−0.0526		−0.1120	
	(0.0060)		(0.1119)		(0.1361)	
Bankrupt		0.0016		−0.0148		−0.0311
		(0.0021)		(0.0133)		(0.0224)
Wave	−0.0092**	0.0001	−0.0360	0.0090	−0.0985**	−0.0124
	(0.0041)	(0.0070)	(0.0291)	(0.0460)	(0.0485)	(0.0607)
Bankrupt × Wave		−0.0129*		−0.0554		−0.1061*
		(0.0074)		(0.0439)		(0.0632)
Competed	−0.0032	−0.0031	−0.0336**	−0.0329**	0.0322	0.0338
	(0.0047)	(0.0047)	(0.0148)	(0.0147)	(0.0268)	(0.0268)
Private	−0.0010	−0.0009	0.1508*	0.1482*	0.1716	0.1653
	(0.0018)	(0.0018)	(0.0906)	(0.0910)	(0.1758)	(0.1756)
Public	−0.0187***	−0.0189***	0.0332	0.0325	0.1061	0.1041
	(0.0022)	(0.0022)	(0.0388)	(0.0390)	(0.0837)	(0.0834)
Completed	0.0033	0.0033	0.0434***	0.0437***	0.0892***	0.0897***
	(0.0026)	(0.0026)	(0.0134)	(0.0134)	(0.0217)	(0.0217)
Hostile	−0.0108**	−0.0110**	0.1026***	0.1024***	0.0825***	0.0824***
	(0.0050)	(0.0050)	(0.0172)	(0.0172)	(0.0267)	(0.0268)
All stock	−0.0029	−0.0029				
	(0.0027)	(0.0027)				
All cash	0.0027*	0.0027*	0.0445***	0.0448***	0.0818***	0.0825***
	(0.0016)	(0.0016)	(0.0127)	(0.0127)	(0.0201)	(0.0201)
Ln(Assets)	−0.0049***	−0.0049***	0.0220***	0.0217***	0.0257***	0.0250***
	(0.0005)	(0.0005)	(0.0044)	(0.0044)	(0.0073)	(0.0073)
Ln(Target assets)			−0.0233***	−0.0229***	−0.0368***	−0.0361***
			(0.0044)	(0.0044)	(0.0076)	(0.0076)
Relative size	0.0044***	0.0044***				
	(0.0009)	(0.0009)				
MTB	−0.0001	−0.0001	0.0088**	0.0082**	−0.0003	−0.0018
	(0.0005)	(0.0005)	(0.0036)	(0.0036)	(0.0084)	(0.0083)
Target MTB			−0.0194***	−0.0199***	−0.0392***	−0.0404***
			(0.0045)	(0.0045)	(0.0091)	(0.0091)
Book leverage	−0.0011	−0.0015				
	(0.0054)	(0.0059)				
ROA	−0.0172*	−0.0168*				
	(0.0087)	(0.0088)				
Liquidity	−0.0058*	−0.0055*				
	(0.0030)	(0.0030)				
N	9501	9501	1465	1465	1465	1465
R^2	0.058	0.058	0.149	0.151	0.144	0.147
p-Value (Bankrupt + Bankrupt × Wave = 0)		0.116		0.096		0.022
p-Value (Wave + Bankrupt × Wave = 0)		0.004		0.124		0.031

In models 5–8, I follow Rhodes-Kropf et al. (2005) and include as control variables the number of all mergers in each industry and the number of all mergers in each year. These variables capture the fact that some industries experience a high level of takeover activity in general and some years witness a large number of takeovers in general. The inclusion of these variables lowers the coefficient on the deregulated wave indicator, although the results are still statistically and economically significant.

One potential criticism of Table 7 results is that cash is a dominant form of payment in smaller acquisitions. Hence, even if the number of cash acquisitions is greater in the deregulatory merger wave, the economic significance of the results may be questionable. So, in another robustness test, I analyze whether the dollar value of cash acquisitions is greater in the deregulatory merger wave. I calculate the annual total dollar value of all cash mergers in each industry and regress that dollar value on the control variables in Table 7. Because the value of mergers is left-censored at zero, I estimate Tobit regressions (Greene, 2003, p. 764). In unreported results, I find that, depending on the specification used, the dollar value of cash acquisitions is $5–$6 billion greater in the deregulatory merger wave compared to other periods. Overall, $186.6 billion in assets are acquired in cash

acquisitions during the deregulatory wave. To put this number in perspective, the results in Table 2 indicate that deregulated industries had a total market cap of $871 billion prior to deregulation in 1977. This implies that 21.4% of deregulated industries' 1977 total market cap was acquired during the deregulatory wave. Of course industries evolve from 1977 to the beginning of the merger wave, so I also compute the ratio of the acquired market cap to the industry market cap in the year prior to the beginning of the deregulatory wave. I find that 8.8% of total pre-wave industry market cap is acquired in the deregulatory wave. By either measure, the results appear economically significant.

Panel B presents the results for the relative frequency of bankruptcy mergers. Also consistent with the exit hypothesis, the relative frequency of bankruptcy mergers is significantly greater during the deregulatory wave. Across all models, the number of bankruptcy mergers is 24% to 43% higher during the deregulatory wave than during other time periods. This translates into 0.4 to 2 more bankruptcy mergers per year in the deregulatory wave than in other time periods. This is especially relevant because deregulated industries are already more likely to see bankruptcy mergers. The coefficient on the deregulated industry indicator is significantly above one and the marginal effect indicates that deregulated industries have 0.69 to 5.90 more bankruptcy mergers per year than unregulated industries.

The results for other control variables indicate that, not surprisingly, better performing industries as measured by higher liquidity (row 3), higher sales-to-assets ratio (row 8), and higher ROA (row 9) have fewer bankruptcy mergers. Finally, higher market-to-book (row 6) is associated with more bankruptcy mergers but this again may simply reflect the fact that more mergers take place when industry valuation is high. These results are also consistent with the exit hypothesis.

If deregulatory wave mergers serve an important contractionary role, we should expect the decline in deregulated industries reported in Table 2 and Fig. 1 to be more significant during the wave. I find evidence consistent with this hypothesis. During the deregulatory wave, deregulated industries' market cap, value added and the number of firms as percentages of total economy figures decrease by 0.381%, 0.018%, and 2.693%, respectively. When compared to changes in these statistics during non-wave years (0.003% increase in market cap, 0.005% decrease in value added, and 2.23% decrease in the number of firms), these results indicate that deregulated industries decline more rapidly during the deregulatory merger wave. Deregulated industries' employment is the only statistic that increases slightly during the wave. However, the increase is a small 0.006%. Overall, the results indicate that deregulatory wave mergers facilitate the decline in deregulated industries.

4.3. Announcement period CARs

The results in Table 6 indicate that announcement period CARs differ to some extent between deregulatory wave mergers and other mergers. The premium received by the target is lower especially in stock and mixed consideration deals. As noted above, however, these results could, at least in part, be affected by differences in deal and firm characteristics across the merger subsamples. In this section, I analyze in detail whether deregulatory wave mergers are valued differently by the market than other mergers in my sample. As before, announcement period CARs are computed from 1 day before to 1 day after the merger announcement. The target premium is computed as in Schwert (2000). I regress bidder and target CARs and the target premium on (i) a deregulated industry indicator set to one for all deregulated industries in my sample and zero otherwise, (ii) a deregulatory wave indicator set to one in the deregulatory wave years and zero otherwise, (iii) a bankruptcy indicator set to one for all bankruptcy mergers, and (iv) control variables used in prior literature (Moeller et al., 2004; Officer, 2003, for example). Finally, I interact the bankruptcy and the deregulatory wave indicators to gain further insight into whether bankruptcy mergers in the deregulatory wave are valued differently by the market.

The results in Table 8 are generally consistent with the exit hypothesis. In target premium regressions, the coefficient on the deregulatory wave indicator is negative and significant. The results indicate that, holding everything else constant, targets in the deregulatory wave command on average a 10% lower premium than other targets. Moreover, when I interact the deregulatory wave indicator with the bankruptcy indicator, I find that the interaction is negative and marginally significant, which indicates that it is bankruptcy mergers in the deregulatory wave that command the lower premium. The sum of the bankruptcy indicator and the bankruptcy–wave interaction indicates that bankruptcy mergers in the wave command a 13.72% lower premium than other non-bankrupt mergers. With a p-value of 0.022 (reported in the second to last row), the result is statistically significant. Similarly, the sum of the wave indicator and the bankruptcy–wave interaction indicates that bankruptcy mergers in the deregulatory wave command an 11.85% lower premium than other non-wave mergers. This result is also statistically significant (p-value = 0.031).

In the bidder and target CAR regressions, there appears some evidence that deregulatory wave mergers generate lower value for bidders. There is no evidence that, despite the lower premium, target shareholders are worse off in the deregulatory wave mergers relative to mergers outside the wave. When I further interact the wave indicator with the bankruptcy indicator, I find that the interaction is negative and marginally significant in the bidder CAR regressions. This again points out that it is bankruptcy mergers in the wave that generate lower bidder CARs. There is no evidence that target CARs are lower in bankruptcy mergers in the wave.

As regards coefficients on control variables, my results are mostly consistent with prior studies. In target premium regressions, target premium is positively (negatively) correlated with the bidder (target) size as measured by ln(Assets), negatively correlated with target market-to-book, and is more positive in hostile and completed deals, as in Officer (2003) and Moeller et al. (2004). I also find that target premium is higher for all cash deals, which is similar to Officer (2003) but inconsistent with findings in Moeller et al. (2004). In the CAR regressions, target CARs are lower in competed deals, and are decreasing in target size and

market-to-book. Target CARs are higher in completed and hostile deals, in cash deals, and are increasing in bidder size and market-to-book. Finally, bidder CARs are lower in public and hostile deals, and are decreasing in bidder size. Bidder CARs are marginally higher in all cash deals and are increasing in the size of the deal. These results are generally consistent with prior studies.

5. Conclusion

It has long been noted in the M&A literature that mergers involving publicly traded targets occur in waves and that industry waves are preceded by significant industry shocks. The traditional view has been that industry shocks are unexpected or exogenous. The results in this paper challenge this view. I focus on economic deregulation and argue that regulators do not randomly decide to deregulate an industry but rather respond to pressures from special interest groups and to changes that are already taking place in the industry. Consistent with this view, I find that deregulation is preceded by poor industry performance and is predictable with industry performance variables. Specifically, I find that regulated industries have low profitability, high leverage, low solvency, negative liquidity, and high capital expenditures prior to deregulation. In addition, low profitability, low market-to-book, low solvency, and high capital expenditures are associated with higher deregulation probability. The results indicate that deregulation is endogenous.

These results are important for our understanding of merger dynamics. If deregulation is endogenous, then factors that bring about deregulation should also play a role in shaping merger activity that follows. Based on pre-deregulation industry performance results, I argue that mergers that follow deregulation represent a form of exit from poorly performing industries. Consistent with this argument, I find that the frequency of cash and bankruptcy mergers is significantly higher following industry deregulation. I also find that bidders and targets in these mergers are poor performers compared to bidders and targets in other mergers. Targets are also poor performers relative to non-merging firms in the same industry. Finally, consistent with the view that targets in financial distress are acquired at fire sale prices, I find that the target premium paid in mergers following deregulation is significantly lower than the target premium in other mergers. Overall, the results in this paper indicate that mergers in deregulated industries serve an important contractionary role.

The results in this paper are important to our understanding of merger success. Researchers have long recognized that it is difficult to judge merger success without firm understanding of the reasons behind mergers. I argue in this paper that the analysis of common drivers of endogenous shocks that, in turn, propagate merger activity is important for our understanding of merger success. Of course, this paper is only the first step in the analysis of the impact of regulatory changes on industry merger dynamics. A logical next step is to focus on each deregulated industry separately to develop a richer set of testable hypotheses of the impact of unique deregulatory events on future industry-specific merger dynamics.

Appendix A. Industry definitions and variable construction

The following table summarizes definitions of deregulated industries used in the paper:

SIC	Industry
Airlines	
4512	Air transportation, scheduled
4513	Air courier services
4522	Air transportation, nonscheduled
4581	Airports & terminal services
Natural gas	
1321	Natural gas liquids
4922	Natural gas transmission
4923	Natural gas transmission & distribution
4924	Natural gas distribution
4932	Gas & other services combined
Oil	
1311	Crude petroleum & natural gas
1381	Drilling oil & gas wells
1382	Oil & gas field exploration services
1389	Oil & gas field services, nec
2911	Petroleum refining
2951	Asphalt paving, blocks
2952	Asphalt felts & coatings

(continued on next page)

Appendix A. (*continued*)

Oil	
2992	Lubricating oils & greases
2999	Products of petroleum & coal, nec
4612	Crude petroleum pipelines
4613	Refined petroleum pipelines
4619	Pipelines, nec
Railroads	
4011	Railroads, line-haul operating
4013	Railroad switching & terminal establishments
Telecommunications	
4812	Radiotelephone communications
4813	Telephone communications, except radiotelephone
4822	Telegraph & other message communications
4899	Communications services, nec
4832	Radio broadcasting stations
4833	Television broadcasting stations
4841	Cable & other pay television services
Trucking	
4212	Local trucking
4213	Trucking, except local
4214	Local trucking with storage
4215	Courier services, except by air
4231	Trucking terminal maintenance facilities
Utilities	
4911	Electric services
4931	Electric & other services combined
4939	Combination utilities, nec

All nominal values (i.e. non-ratios) are in December 2008 dollars. Ratios are computed using contemporaneous values of the numerator and the denominator unless a time subscript indicates otherwise. Industry level ratios used in Tables 5 and 7 are computed by first summing the numerator and the denominator across all industry firms and then dividing the former by the latter.

Assets = Total assets [AT];

Sales = Total sales [SALE];

Market equity = Shares outstanding [CSHO] × Stock price [PRCC_F];

Book equity = Total common/ordinary equity [CEQ];

Age = number of years on Compustat starting with the first year of non-missing book equity;

Market-to-book = MTB = (Market equity + Total debt [DLTT + DLC] + Preferred stock liquidating value [PSTKL] − Deferred taxes and investment tax credit [TXDITC])/Assets;

Sales growth ratio = ΔSales = $(\text{Sales}_t - \text{Sales}_{t-1})/\text{Sales}_{t-1}$;

Employee growth ratio = ΔEmployees = $(\text{Employees}_t\ [\text{EMP}] - \text{Employees}_{t-1})/\text{Employees}_{t-1}$;

Sales-to-assets ratio = $\text{Sales}_t/\text{Assets}_{t-1}$;

Cash flow ratio = CF = (Income before extraordinary items_t [IB] + Depreciation and amortization_t [DP])/Assets_{t-1};

Liquidity ratio = Liquidity = (Total current assets_t [ACT] − Total inventories_t [INVT] − Total current liabilities_t [LCT])/Assets_{t-1};

Return on assets = ROA = Income before extraordinary $\text{items}_t/\text{Assets}_{t-1}$;

Capital expenditures = CAPEX = Capital expenditures_t [CAPEX]/Assets_{t-1};

R&D expenditures = R&D = Research and development expense_t [XRD]/Assets_{t-1};

Book leverage = Total debt/Assets;

Market leverage = Total debt/(Market equity + Total debt);

Quick ratio = (Total current assets − Total inventories)/Total current liabilities;

Current ratio = Total current assets/Total current liabilities;

Interest coverage ratio = Operating income before depreciation [OIBDP]/Total interest and related expense [XINT];

Transaction value = Total value of consideration paid by the bidder excluding fees and expenses from SDC;

Announcement period cumulative abnormal return (CAR) is calculated relative to CRSP value-weighted market model benchmark returns over the (−1, 1) interval. The parameters for the market model are estimated over the (−205, −6) interval;

Target premium is the cumulative abnormal return relative to CRSP value-weighted market model benchmark returns over the (−63, 126) interval. The parameters for the market model are estimated over the (−316, −64) interval;

Transaction value-to-assets = TV/Assets = Transaction value/Bidder assets;

Relative size = Transaction value/Bidder market equity;

Days to completion = Number of calendar days between the announcement and the completion dates of the merger;

Cash in payment = Percent cash payment of the transaction value;
Equity in payment = Percent equity payment of the transaction value;
Completed = An indicator variable set to one if SDC's deal status states "Completed" and zero otherwise;
Hostile = An indicator variable set to one if SDC's attitude flag states "Hostile" and zero otherwise;
Competed = An indicator variable set to one if SDC's competing deal code is greater than zero and zero otherwise;
Public targets (bidders) = An indicator variable set to one if SDC's target (bidder) status is set to "Public" and zero otherwise;
Private targets (bidders) = An indicator variable set to one if SDC's target (bidder) status is set to "Priv." and zero otherwise;
Subsidiary targets (bidders) = An indicator variable set to one if SDC's target (bidder) status is set to "Sub." and zero otherwise.

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