

COMPETITION AND MERGER ACTIVITY IN THE U.S. TELECOMMUNICATIONS INDUSTRY

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Recommended Citation:

Okoeguale, K. and Loveland, R., 2018. Competition and merger activity in the U.S. telecommunications industry. *Journal of Financial Research*, 41(1), pp.33-65.

Abstract

This paper examines the U.S. telecommunications industry during a period of rapid deregulation to determine the effects of a deregulatory shock on industry competition and merger activity. We show that merger activity exhibits a clear wave-like pattern, regardless of the listing status of the participants. Increased competition and IPO activity following deregulation increased cash flow volatility and probability of exit while the introduction of new technology increased dispersion of economic efficiency across the industry. These changes resulted in a significant increase in merger activity. Competition also played an important role in shaping “who buys whom?”

JEL Classification: G34; G38

We thank Stuart Gillan, James Linck, Harold Mulherin, Jeffrey Netter, Annette Poulsen, seminar participants at the University of Georgia and Saint Mary's College of CA and conference participants at the 2012 Southern Finance Association meetings, 2013 Financial Management Association meetings and 2013 Australasian Finance Banking Conference, for helpful comments, suggestions and discussions. We are also grateful for the comments of an anonymous associate editor.

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I. Introduction

The merger literature provides extensive empirical evidence to support the finding that corporate mergers (M&A) cluster by industry and time (Mitchell and Mulherin, 1996; Andrade, Mitchell and Stafford, 2001; Harford, 2005). Neoclassical theory views these merger clusters, or “waves”, as the mechanism through which industries reallocate assets, on a large-scale, to more efficient users in response to an industry-wide economic shock. Behavioral finance theory, on the other hand, argues that relative stock misvaluation is the primary driver of merger waves (Shleifer and Vishny; 2003; Rhodes-Kropf, Robinson and Viswanathan, 2005), while also acknowledging a role for industry shocks in initiating the wave (Rhodes-Kropf, Robinson and Viswanathan, 2005; p. 600).

However, comparatively little work has been devoted to understanding how these forces form concentrated merger waves. Harford (2005) shows that, in addition to the economic shocks that initiate the wave, capital liquidity is needed to provide sufficiently low transaction costs to allow for merger waves to propagate. Maksimovic, Phillips and Yang (2013) find that firms with higher productivity and better access to capital markets participate more in acquisition waves. Other studies suggest that coincident factors such as cash flow volatility (Garfinkel and Hankins, 2011) or heterogeneous industry risk (Loveland and Okoeguale, 2016) are partially responsible for the propagation of merger waves.

To determine how industry change drives M&A, we use data from the U.S. telecommunications (telecom) industry to empirically document the manner in which industry shocks drive merger activity. In particular, we examine the role of competition in driving industry M&A. To do so, we utilize a large sample of public and private mergers, along with industry and firm-level data, to provide a detailed depiction of the industry prior to, and industry dynamics following, a regulatory shock: passage of the 1996 Telecommunications Act (the Act).

The 1996 Act was a sweeping overhaul of the telecom industry, intended to foster increased competition in order to promote the development of new services in broadcasting, cable, telecommunications, information and video services. The Act opened the markets for local and long distance phone services to entry and competition from new communication technologies, removing previous product and geographical boundaries set by law. The passage and implementation of the Act sparked a transformation of the telecom industry, notable for the multitude of new entrants to the marketplace, numerous industry exits through takeover or failure, and rapid expansion of the industry.

The U.S. telecom industry provides an excellent setting to study the effect of industry change and increased competition on M&A because the industry experienced several structural shocks via deregulation and technological change over the sample period (Weston, Mitchell and Mulherin, 2004), while its large, capital-intensive public firms were subject to several bull markets (mid-1980s, 1990s and mid-2000s) that provide fertile ground for possible misvaluation. Moreover, the study of this single industry allows us to focus on the specific channel that alters firm-level characteristics in response to industry-level change.

We find that acquisition activity in the U.S. telecom industry exhibits a clear wave-like pattern in the years following passage of the Act, regardless of the public/private status of the acquirer or target. This evidence is consistent with the extant literature (e.g., Mitchell and Mulherin, 1996; Harford, 2005), however, our finding that private acquirers exhibit more acquisition volatility than public acquirers is inconsistent with recent evidence that demonstrates public acquirers generally exhibit more extreme wave-like clustering than private acquirers (e.g., Netter, Stegemoller and Wintoki, 2011; Maksimovic, Phillips and Yang, 2013). We also find that deals involving public acquirers and targets are representative of the population of telecom M&A deals during the period.

Given this finding, we next examine the competitive dynamics of the telecom industry using a panel data set of public deals.

We find that deregulatory changes to industry structure had several important effects. The changes: i) spurred IPO activity, thus decreasing the concentration of large, publicly-traded firms. The result was a more heterogeneous set of firms industry-wide. ii) Increased firm-level cash flow volatility and simultaneously decreased correlation amongst firm-level cash flows, thus increasing the probability of exit. iii) Increased the dispersion in firm-level economic efficiency across the industry (the result of technological innovations that lowered the cost of providing telecom services for those firms that invested in emerging technologies (Beker, 2001)). These changes are positively associated with increases in the level of merger activity following deregulation of the industry, consistent with predictions of industry shocks theory. Collectively, these findings are also consistent with evidence in the literature that mergers play an expansionary as well as contractionary role (e.g., Andrade and Stafford, 2004). Finally, we find that as merger activity increased following passage of the 1996 Act, stock misvaluation declined; a finding inconsistent with predictions of misvaluation theory.

Analysis of firm-level characteristics shows that pre-deregulation size and profitability/efficiency characteristics are important determinants of who survives versus who exits the industry via merger or bankruptcy. In the more competitive post-deregulatory environment, smaller and less efficient incumbents are not targeted for acquisition but are instead left to face exit via bankruptcy or non-voluntary delisting. However, ex-ante levels of efficiency and leverage are important in determining which firms become acquirers and which become targets in mergers of industry incumbents; the more efficient and less levered incumbents are more likely to be acquirers in intra-industry mergers.

We contribute to the merger literature in several ways. First, we demonstrate that changes to

the competitive structure of the telecom industry following deregulation in 1996 resulted in a significant increase in industry-wide merger activity, regardless of the public/private status of the participants. Second, we show that competition plays an important role in shaping “who buys whom?” Fatter and fitter firms are more likely to survive and become acquirers in intra-industry mergers, while smaller and less efficient incumbents are not targeted for acquisition but, rather, are left to face exit via bankruptcy or non-voluntary delisting. Collectively, the evidence presented in this paper demonstrates that competition is an important channel through which industry change drives an industry merger wave. We show that in the U.S. telecom industry, mergers facilitated the reallocation of resources within the industry to the most efficient users in response to increased competition brought about by deregulation and technological change. This evidence thus affirms the link between deregulation, competition and merger activity.

II. The U.S. Telecommunications Industry

Brief History of the U.S. Telecommunications Industry

The telecommunications industry in the U.S. has historically been subject to heavy regulation. By the very early part of the 20th century, AT&T dominated the industry through ownership of the great majority of telephony exchanges in the country (Economides, 1999). At the time, the telecommunications market was viewed as a natural monopoly in which competition was not possible; thus regulation was used to protect customers from abuse by the monopoly supplier. Regulation was initially instituted at the state level and then later at the federal level with the passage of the 1934 Telecommunications Act which created the Federal Communications Commission.

However, beginning roughly 40 years ago, the industry experienced progressive deregulation. The process began in 1974 when the U.S. Department of Justice brought an antitrust suit against

AT&T alleging that it monopolized the long distance market and that its arrangement to buy equipment only from its subsidiary, Western Electric, was illegally exclusive. The 1982 Modification of Final Judgement (MFJ) settled the case by spinning off from AT&T its 22 local telephone companies and reorganizing them into seven independent regional Bell operating companies (RBOCs). The break-up, by design, created competition in the long-distance telephony, manufacturing and information services markets. The RBOCs were allowed monopoly control over their respective local phone markets but could not engage in manufacturing of equipment. AT&T retained its core long-distance operations as well as its equipment business, Western Electric, and its research and development arm, Bell Labs. MCI and Sprint were the companies permitted to compete with AT&T in the long distance market.

Change in the industry, however, cannot be viewed only through the lens of government (de)regulation. Rapid technology development also played an outsized role in shaping the industry. Fransman (2001) provides a simple model of the technology and service layers underpinning the industry up to the mid-1980s. Layer 1 of Figure I is the production of equipment such as circuit switches, transmission systems and premises equipment that are used to form the telecommunications networks in Layer 2. Layer 3 holds the services sold to customers in the form of voice, data, fax and 1-800 services. Until the MFJ was put into effect in 1984, AT&T's vertically integrated business model dominated Layers 1 and 2.

< Insert Figure I about here >

In Fransman's pre-deregulation model, research and development was carried out primarily in Layer 2 by the network provider AT&T's Bell Labs. Once a technology was deemed viable it was passed upstream to Layer 1 for the equipment manufacturers to test and make operationally robust. However, from the 1960s onward, new technologies such as microwave transmission, packet-

switching and fiber-optic cable were increasingly developed by manufacturers in Layer 1. Consequently, barriers to entry into Layer 2 were lowered as new entrants were able to rely on technology provided to the market by companies in Layer 1. This opened up the marketplace to new competition and made new entrants more efficient by 1) eliminating the R&D function now taken up by Layer 1 companies and 2) employing new technologies that were oftentimes more cost effective (e.g., packet-switching and digital transmission technology). New entrants in Layer 2 also provided new customers for Layer 1 companies.

In the decade that followed the MFJ, the commercial deployment of these new technologies in the cellular communication market (e.g., McCaw Cellular's use of CCSS7 signaling and introduction of roaming charges to create the first nationwide cellular network named "Cellular One") and local wireline market (e.g., MFS's use of fiber-optic transmission lines) increased the level of entry into, and competition within, the industry. At the same time, the use of microwave and fiber optic transmission technology by MCI and Sprint, respectively, made these firms profitable and viable competitors to AT&T's wire-line long distance network (Weston, Mitchell and Mulherin, 2004).

In response to these market developments, the Federal Communications Commission made several regulatory decisions in 1992 and 1993 that facilitated the entry of competitive local exchange carriers and the expansion of new technologies (fiber optic and wireless services) into the local phone markets. These step-wise changes foreshadowed the type of competitive marketplace ultimately created by the 1996 deregulation. In this way, technological advancements provided the impetus for deregulatory changes and also spurred dramatic changes in the market for communications services – a market that demanded companies offer a complete package of vertically integrated products and services.

The 1996 Telecommunications Act

The Telecommunications Act of 1996 (the Act) was signed into law on February 8, 1996. The Act covers five broad areas of telecom service: radio and television broadcasting, cable television, telephone services, Internet and on-line computer services and telecommunications equipment manufacturing. Under the Act, incumbent telecom network providers must allow new entrants to interconnect with their network at any feasible point, lease unbundled network elements to competitors at cost, and provide to competitors at wholesale discount any service the incumbent provider offers (Economides, 1999). The Act removed the cross-market barriers that had previously prevented firms from operating in more than one telecom industry and, in order to promote competition, explicitly permitted mergers, consolidations, and integration of services across market lines previously disallowed by law. As part of this open market access, the Act also created a process by which the RBOCs would be free to offer long distance service once they made a showing that their local markets had been opened up to competition¹. The stated goal of the new law was to let anyone enter into any communications business and to let any communications firm compete in any market against each other².

As outlined above, the Act was drafted during a period of rapidly emerging new technologies that offered alternatives to the services provided by local telephone companies. Given the emergence of these new technologies that seemed to hold the potential for more robust product market competition, lawmakers structured the Act to promote competition in all telecom markets. The Act was an attempt to create an open and competitive market, free of monopoly control, for every service that comprised the broader telecom network, as well for the final telecom services provided to the consumer. In this regard, the Act aimed to create competition in the monopolized local exchange

¹ U.S.C. section 271

² fcc.gov

markets much like the breakup of AT&T, twelve years earlier, precipitated a competitive long-distance telephony market (Economides, 1999).

Thus, the competitive structure of the telecom industry changed fundamentally after passage of the Act in 1996 (see e.g., Beker, 2001; Hazlett, 1999; Economides, 1999). Deregulation affected not only the level of entry and competition in the telecom industry, but the nature of competition. Because the Act removed boundaries previously set by federal and state regulators, post-1996 telecom firms became less defined by product and geographical boundaries and more aligned into a vertically integrated business model, in step with ongoing technological developments. This change is reflected in a quote made by the CEO of SBC Communications Inc., shortly after the passage of the Act: “all of us at SBC and Southwestern Bell welcome the opportunity to focus completely on our customers and what they want and need, and not just what products we are allowed to sell by law.”

Against this backdrop, the U.S. telecom industry and the Act of 1996 provide an attractive setting to study the dynamics of deregulation, competition and industry change. Although the Act impacted every sector of the broader communications industry, we restrict this study to the telephone communication sector of the industry for two reasons: 1) the telephone communication sector is one of the legacy sectors of the industry most disrupted by the deregulation of the industry, and 2) it allows a focused study of the ways in which deregulation impacted competition and merger activity in the previously fragmented local and long-distance phone markets, uncontaminated by changes in other sectors that were not as heavily restricted in their allowable business practices.

III. Data Sample and Variable Construction

Sample Construction

We follow the methodology employed in Netter, Stegemoller and Wintoki (2011) to assemble,

from Thompson Financial's Securities Data Company U.S. Mergers and Acquisitions Database (SDC), a comprehensive sample of completed telecom M&A deals with an explicit change of control, inclusive of small, private and public acquirers and targets. The sample period includes the years 1979 to 2009. Our initial data sample is assembled using the following criteria:

Step 1: All deals with announcement date from 01/01/1979 to 12/31/2009.

Step 2: Disclosed and Undisclosed [deal value] Mergers and Acquisitions (Deal Type: 1, 2).

Step 3: Deal Status is "Completed."

Step 4: Percentage of Shares Acquired in Transaction: 50 to HI.

Step 5: Percentage of Shares Held by Acquirer Six Months Prior to Announcement: 0 to 49.

From this initial sample we then select deals in which the Acquirer Ultimate Parent Nation is the U.S. Finally, we include deals if the Acquirer or Target Primary SIC Code is 4812 - Radiotelephone Communications or 4813 - Telephone Communications, Except Radiotelephone.³ We eliminate duplicate transactions by matching on announcement date, acquirer CUSIP and target CUSIP. These steps leave us a sample comprised of 3,887 transactions with available deal values totaling over \$1.3 trillion.

We compile the population of domestic public U.S. telecom firms by selecting the firms listed on the CRSP monthly stock file, which consists of publicly traded firms on the NYSE, AMEX and Nasdaq stock exchanges. We include only firms with CRSP Share Code 10 and 11, thus excluding foreign firms (incorporated outside the U.S., and ADRs). Firms that enter and exit the CRSP listing in the same year are excluded.

We assemble the population of all domestic U.S. private telecom firms for the period 1990-2009 from the U.S. Census Bureau's Statistics of U.S. Businesses annual data by establishment

³Both four-digit SIC codes 4812 and 4813 make up the three-digit SIC Industry Group 481: Telephone Communications

industry. This annual data is available beginning in 1990, hence, the test involving total industry size (presented in Table 2) is restricted to the period 1990-2009. While this period is shorter than the full 1979-2009 sample period, it does allow us to examine the impact of deregulation on the full industry for a five year period before deregulation and thirteen years after.

We use data from the CRSP delist file, which provides descriptive delist information, to identify the nature of public firm exits. We gather details about the exits from SDC and news wire articles on LexisNexis. An exit date is identified as the last date a firm appears in the sample. If the exit is via merger, we substitute the merger announcement date for the CRSP delist date. IPOs are identified based on data from the SDC IPO database and information from news wires on LexisNexis.

Construction of Variables

We measure the effect of deregulation on market power using the Herfindahl-Hirschman index (HHI) of industry concentration, firm ROA, and industry turnover. HHI is a measure of concentration employed by the Department of Justice and Federal Trade Commission to evaluate the level of market power of firms within an industry; it is the sum of the squared market share (sales scaled by total industry sales) of firms in an industry in a given year. Following Irvine and Pontiff (2009), we use ROA as an alternate measure of market power; firms with less competition and more market power will generate higher returns, on average, than those firms with more competition and less market power. Firm ROA is defined as the sum of net income and interest income scaled by total assets. We again follow Irvine and Pontiff (2009) in the use of a second alternate measure of market power: turnover. Industry turnover (annual industry entry and exit scaled by industry size) serves as a proxy for the market power of the firms that remain within the industry; the stiffer the competition within an industry, the greater the expected industry turnover.

We follow Zingales (1998) in the use of return on sales (ROS), measured as annual cash flow

scaled by sales, as a proxy for production efficiency. Because ROS captures the relationship between operating revenues and operating costs, it is a convenient measure of the efficiency or quality of a firm’s production technology. We capture the disparate impact of technological change on firm efficiency across the industry with the variable dispersion in economic efficiency, defined as the annual cross-sectional standard deviation of ROS. We compute ROS using annual data from the CRSP/Compustat Merged Fundamentals Annual file. We exclude firm-year observations where ROS is greater than 1 or less than -1, in order to remove the influence of extreme values.

To capture the impact of economic shocks we employ the “economic shock index” used by Harford (2005). Harford’s economic shock index is the first principal component of the median absolute changes in seven performance variables. The variables are: return on sales (ROS), return on assets (ROA), asset turnover, research and development scaled by assets, capital expenditures scaled by assets, employee growth and sales growth. These variables are computed using annual data from the CRSP / Compustat Merged Fundamentals Annual file for the firms belonging to the telecom industry.

Our measure of risk is the cross-sectional standard deviation of shocks to firms’ quarterly cash flows. We follow Irvine and Pontiff (2009) and measure cash flow volatility as the cross-sectional standard deviation of shocks to firms’ quarterly cash flows. The quarterly cash flow data is from the CRSP/Compustat Merged Fundamentals Quarterly file. Firms’ quarterly cash flows are scaled by the number of common shares outstanding, and are then winsorized at the 1st and 99th percentiles. The quarterly cash flow shocks are estimated from pooled cross-sectional and time-series industry-level regressions that control for the seasonal variation and documented persistence in cash flow (see Irvine and Pontiff, 2009):

$$C_{ijt} - C_{ijt-4} = \varphi_1 + \beta_1(C_{ijt-1} - C_{ijt-5}) + \beta_2(C_{ijt-2} - C_{ijt-6}) + \beta_3(C_{ijt-3} - C_{ijt-7}) + \mu_{ijt} \quad (1)$$

C_{ijt} is the quarter t cash flow for firm i belonging to industry j . $C_{ijt} - C_{ijt-4}$ is the difference between current quarter t cash flow and cash flow from four quarters ago (same quarter of the preceding year). The residuals, μ_{ijt} , from equation (1) are the quarterly cash flow shocks. The quarterly cash flow shocks are deflated by end of quarter share price. A higher inter-firm dispersion in quarterly cash flow shocks implies lower correlations between firms' cash flows.

We use the valuation variables from the decomposition of the M/B ratio introduced by Rhodes-Kropf, Robinson and Viswanathan (2005) to examine the effect of potential stock market misvaluation on merger activity. The first variable used from the decomposition is a measure of market price to a theoretical fundamental value (M/V); the second is a measure of the same fundamental value to book value (V/B). As in Rhodes-Kropf, Robinson and Viswanathan (2005), we decompose M/B by running cross-sectional regressions of firm market equity on firm accounting data, each year, for each firm in the industry. We match each firms' fiscal year accounting data from Compustat with CRSP market equity at fiscal year-end and run the following regression of market equity (\mathbf{m}) on book equity (\mathbf{b}), net income (\mathbf{NI}) and leverage (\mathbf{LEV}).⁴

$$\mathbf{m}_{it} = \alpha_{0jt} + \alpha_{1jt}\mathbf{b}_{it} + \alpha_{2jt}\ln(\mathbf{NI})^+_{it} + \alpha_{3jt}\mathbf{I}_{(<0)}\ln(\mathbf{NI})^+_{it} + \alpha_{4jt}\mathbf{LEV}_{it} + \varepsilon_{it} \quad (2)$$

We apply the industry-year multiples and their long-run industry averages from the regression to the firm-level, time-varying accounting information to compute the industry market-to-value (M/V) and long-run value-to-book (V/B) ratios. V/B measures the component of market valuation that reflects growth opportunities based on long-run industry average multiples. M/V measures the

⁴ Market equity (\mathbf{m}_{it}) and book value of equity (\mathbf{b}_{it}) are computed in logs (hence the lowercase) to account for the right skewness in the accounting data. \mathbf{NI}^+ stands for the absolute value of net income and $\mathbf{I}_{(<0)}\ln(\mathbf{NI})^+_{it}$ is an indicator function for negative net income observations. And \mathbf{LEV}_{it} is the leverage ratio. Estimating this cross-sectional regression for each year allows the industry multiples ($\alpha_k, k = 0, \dots, 4$) to vary over time (see Rhodes-Kropf, Robinson and Viswanathan, 2005).

component of market valuation that reflects potential misvaluation based on the deviation of short-run industry multiples from their long-run average values. Rhodes-Kropf, Robinson and Viswanathan (2005) assert that deviations could be interpreted as reflecting that industry valuations may be overheated, given knowledge held by management that was unknown to the market at the time.

IV. Public and Private Mergers in the U.S. Telecommunications Industry

We begin our analysis by documenting the temporal trend of merger activity in the industry. We then analyze characteristics of the merger sample. As recent research highlights, inferences about corporate events rely inherently on the representativeness and completeness of the sample studied. For instance, Netter, Stegemoller and Wintoki (2011) find that the magnitude of merger waves are diminished when private and small deals are considered together with public deals; they also find the link between IPO and merger waves to be considerably weaker when this broader sample is used. Maksimovic, Phillips and Yang (2013) find that public manufacturing firms participate more in acquisition waves than do private firm. To ensure that our analysis and inferences are not biased by firm size or listing status, we analyze samples inclusive of small, private acquirers and targets as well as public acquirers and targets.

Merger Waves in the U.S. Telecommunications Industry

Figure II displays the time series of merger activity for the telecom sector for every month from December 1982 to December 2009. The figure presents the time series trend for U.S. public acquirers, U.S. private acquirers and all U.S. acquirers. Following Netter, Stegemoller and Wintoki's (2011) methodology to identify merger waves, we construct the time series by summing all mergers, by acquirer type, over the previous 24 months and then dividing the sum by the total number of mergers over the entire sample period. The thick (red) section of each acquirer type's time series trend line highlights the 24 month period that has the largest number of mergers, defined as a merger cluster

(the identification of which is discussed thoroughly in subsequent analysis).

< Insert Figure II about here >

Figure II shows a distinct increase in merger activity for all three acquirer types before and after the 1996 Telecom Act. Beginning around 1994, merger activity rises rapidly, plateaus in 1997 and then spikes again, nearly doubling by 2001. Takeover activity drops for all acquirer types during and after the 2001 recession, however, the decrease is much more severe for the public acquirers group and all acquirers group. Merger activity subsequently increases for all acquirer types during the mid-2000s economic boom before decreasing sharply during the financial crisis. For all acquirer types, merger clusters occur almost simultaneously during the turn of the millennium. However, for private acquirers, a second, more intense, merger cluster also occurs during the mid-2000s industry shakeout.

All three acquirer types exhibit a distinct wave-like pattern. The trend line for private acquirers shows the highest peak, lowest trough and greatest slope during the spike of activity in the middle of the time series. The trend lines for public acquirers and all acquirers are virtually identical; both trend lines are flatter than that of private acquirers. Although this pattern is inconsistent with the overall findings of Netter, Stegemoller and Wintoki (2011) and Maksimovic, Phillips and Yang (2013) that private acquirers show a smoother acquisition pattern with less clustering, it is consistent with Netter, Stegemoller and Wintoki's (2011) finding that the volatility of public acquirers acquisition activity is not significantly higher than that of private acquirers in fully one third of the 48 Fama-French industry groups.⁵

Figure III compares the time series of monthly merger activity for U.S. public acquirers and

⁵ For the wider Communications industry, as defined by the Fama-French 48 industry groups, Netter, Stegemoller and Wintoki (2011) find that public U.S. acquirers and all targets and all U.S. acquirers and all targets have greater volatility of acquisition activity than private U.S. acquirers and all targets.

targets to the time series for all the acquirers group displayed in Figure II. The time series patterns are very similar; merger activity increases steadily before and after the 1996 Telecom Act before peaking around 2000. However, merger activity for public acquirers and targets is more volatile than for all acquirers with a larger dip in activity during and after the 2001 recession. The merger clusters occur almost simultaneously for both groups, during the turn of the millennium.

< Insert Figure III about here >

The visual evidence that merger activity for all four acquirer types clusters within the five-year period following passage of the Act in 1996, and during a period of intense technological innovation, is consistent with evidence in the literature that exogenous events like regulatory or technology shocks spur merger activity (Mitchell and Mulherin, 1996; Harford, 2005; Ovtchinnikov, 2013). We analyze this finding in more detail in subsequent analysis.

Statistical Analysis of Volatility and Clustering of Merger Activity in the U.S. Telecommunications Industry

Table 1 reports the volatility of the time series of merger activity and descriptive statistics about the merger clusters that are displayed in the figures above. We measure volatility as the standard deviation of the time series of acquisition activity reported in Figures II and III. Table 1 reports that the volatility of acquisitions is highest for private acquirers, followed by public acquirers and public targets and all mergers; public acquirers have the lowest acquisition volatility of the acquirer types. The difference in volatility between private acquirers and all mergers is significant at the 5% level.

< Insert Table 1 about here >

The table also reports, for each acquirer type, the 24 month period with the largest number of mergers. We identify a collection of mergers as a cluster only if it was not likely to have occurred by chance. Following Harford (2005), we simulate 1,000 distributions of the number of mergers for each

acquirer type over the period Jan-1981 to Dec-2009 (348 months) by randomly assigning each merger occurrence to a month where the probability of assignment is 1/348 for each month. From this procedure we build a distribution of the largest 24 month cluster of mergers. If the number of actual mergers in the largest 24 month period exceeds the 95th percentile of the simulated distribution we designate that period as a merger cluster.

We find that all four acquirer types have statistically identifiable clusters (marked in red in Figures II and III). The 24 month window for the all mergers group contains 17.3% of all mergers between 1981 and 2009. When we restrict the sample to include only private acquirers we find that 17.8% of mergers occur in a 24 month window. Restricting the sample to public acquirers and public targets increases the prominence of the cluster; 20.1% occur with the 24 month window. Public acquirers have the least prominent cluster; 16.9% of mergers between 1981 and 2009 occur in a 24 month window.

This analysis also reveals that deals involving public acquirers – the public acquirers group and the public acquirers/public targets group – cluster at virtually the same time as the all mergers sample, at the end of the 1990s/start of the 2000s. As noted previously, deals involving private acquirers also cluster at virtually the same point during the end of the 1990s/start of the 2000s, in addition to a second, more statistically significant cluster at the tail end of the bull market in the mid-2000s. Thus, the finding that all deal types cluster at the end of the 1990s, beginning roughly three years after deregulation, confirms the initial visual evidence that merger activity clustered in response to the passage of the 1996 Act and the introduction of disruptive new technologies during the time period. The cluster of private acquirer M&A during the mid-2000s is reflective of buying opportunities during a period of mass bankruptcies in the industry shakeout that resulted from overcapacity and strong product market competition.

The evidence presented in Table 1 also demonstrates that the acquirer types with greater merger volatility generally have larger clusters, while the acquirer types with less merger volatility have less prominent merger clusters. Merger activity involving public acquirers is the least volatile and exhibits the lowest amount of clustering, while merger activity involving private acquirers is the most volatile with the second largest cluster. Public acquirers and targets have the most prominent cluster with the second greatest merger volatility.

The positive relation between clustering and volatility of the mergers in our sample is consistent with the findings in Netter, Stegemoller and Wintoki (2011). Netter, Stegemoller and Wintoki (2011) argue that the difference in merger clustering between public and private acquirers is a function of the costs of restructuring for these firms. Factors such as firm/deal size, management entrenchment and regulatory hurdles may make organizational change comparatively harder and more expensive for large publicly traded firms than for smaller private firms who likely would find it easier to execute small mergers/asset purchases. If this is true of the firms in our sample, then the private firms in the telecom industry would have been much better positioned to invest in positive NPV projects via M&A during periods of opportunity found during the post-1996 period, as well as during the wave of industry-wide bankruptcies in the mid-2000s. Combined with private acquirers' relatively low level of M&A at the beginning and end of the sample period, the high rate of M&A during these two events in the middle of the sample period should produce a comparatively high level of merger volatility and distinct merger clusters over the sample period. Our findings are consistent with this theory⁶.

To examine the sensitivity of these preliminary findings to the measure of merger activity used,

⁶ The relatively high level of volatility and clustering of the public acquirers/targets group is likely a product of the comparatively small sample size. The relation between public and private acquirers follows the above pattern.

we also examine merger activity along another dimension: deal value. We measure deal value as the annual sum of transaction values, by acquirer type. We use the SDC field “value of transaction” to measure deal value. Figure IV displays the time series of annual merger deal value for U.S. public acquirers, U.S. private acquirers and all U.S. acquirers in the telecom sector for every year from 1981 to 2009. Immediately apparent is the fact that public acquirers make up the great majority of merger activity in the industry when measured by deal value. Aggregate deal value for private acquirers barely registers on the scale. In untabulated results we find that the pattern and magnitude of deal values for public acquirers and public targets closely resembles that of public acquirers.⁷

< Insert Figure IV about here >

In this section, we analyze the time series pattern of merger activity in the telecom industry, both visually and numerically, and find that acquisition activity in the telecom industry exhibits a clear wave-like pattern regardless of the public/private status of the acquirer or target. Merger activity for the four groups increases steadily during the 1990s, especially around the 1996 Telecom Act, before clustering at a high level in the late 1990s/early 2000s, less than five years after industry deregulation. We find that private acquirers exhibit more acquisition volatility than public acquirers, a finding inconsistent with recent evidence in the literature (e.g., Netter, Stegemoller and Wintoki, 2011; Maksimovic, Phillips and Yang, 2013). We also find a positive relation between acquisition volatility and deal clustering. We explore the determinants of these findings in the following sections.

⁷ We note that of the 3,883 transactions for the all mergers category, 51% of the deal values are missing. 46% of the 2,543 transactions for the public acquirers category and 71% of the 658 transactions for the private acquirers category have no deal values. These percentages are consistent with Netter, Stegemoller and Wintoki’s (2011) finding that 58% of the deals across all transaction types in their 1992-2009 sample period have missing deal values. The median reported deal value for private acquirers in our sample is \$12.6 million - if we assume each missing private deal value takes on that value, we still come to the same conclusion: deals involving public acquirers account for the vast majority of merger activity, as measured by value.

V. Impact of Deregulation and Competition on M&A Activity

In this section, we examine more closely the dynamics of the telecom industry and the impact of competition on M&A activity in the industry before and after passage of the Telecommunications Act in January of 1996. Because the Act explicitly permitted mergers, acquisitions, and integration of services across market lines previously disallowed by law, we expect to find an increase in competition and M&A activity following its passage.

We begin by examining the relationship between M&A activity and competition using a straightforward measure of competition: industry size, as measured by the annual count of firms in the industry. Table 2 reports industry size and M&A activity for the five year period prior to (1991 to 1995), and following (1996 to 2000), passage of the Act in January of 1996. The table shows that competition and M&A activity increases significantly for the population of firms in the industry and for the sample of public acquirers/targets following deregulation. Average annual total industry firm count increases an average of 3,515 firms per year following deregulation, significant at the 1% level. At the same time, average M&A increases by 128 deals per year, significant at the 1% level.

<Insert Table 2 about here>

Average annual public firm count increases an average of 31 firms per year following deregulation, significant at the 1% level while average M&A increases by 7 deals per year, significant at the 1% level. Thus, this initial evidence is consistent with the notion that increased competition leads to increased M&A. The finding that there is a significant increase in merger activity after industry deregulation in 1996 confirms our earlier findings and is consistent with evidence in the literature that industry deregulation spurs merger activity (see, e.g. Mitchell and Mulherin, 1996; Harford, 2005).

IPO and Merger Waves in the U.S. Telecommunications Industry

Next, we analyze telecom merger activity through the lens of another, recently uncovered,

finding that suggests IPO waves and merger waves are strongly correlated. Studies by Celikyurt, Sevilir and Shivdasani (2010) and Hovakimian and Hutton (2010) find support for a hypothesized link between IPO activity and subsequent merger waves, confirming Hsieh, Lyandres and Zhdanov (2011) who find that IPO waves precede merger waves. Since the telecom industry experienced a surge of IPO activity around the 1996 Act, we preliminarily examine its impact on merger activity here.

Table 3 presents the correlation of monthly merger activity and monthly IPO listings in the telecom industry for the same four acquirer types examined previously. We measure the correlation of monthly merger count and contemporary IPO listing (first column) as well as of monthly merger count and IPO listings lagged 12 months (second column). The correlations of public acquirers', public acquirers' and public targets' and all U.S. acquirers' merger activity and contemporary IPO listings range between roughly .50 and .60 and are statistically significant. The correlation for private acquirers is much lower (roughly .20) and insignificant. The correlations for merger activity and IPO listings lagged one year are essentially unchanged for public acquirers, but higher for the rest of the acquirers. All lagged correlations are significant.

< Insert Table 3 about here >

Results reported in Table 3 show that the level of correlation between IPO activity and the merger activity of the all acquirers group, public acquirers group and public acquirers/targets group is similar, between roughly .50 and .60, and highly statistically significant. The correlation for private acquirers is much smaller and much less significant. Hence, these initial results generally confirm findings in literature and demonstrate that IPO financing appears to boost contemporary and subsequent M&A in the telecom industry.

Univariate Tests of Industry Investment, Competition and Firm Performance

We next examine how deregulation affects competition, firm performance, firm risk and firm

valuation in the telecom industry. As Peltzman (1976, page 230) notes: “Regulation should reduce conventional measures of owner risk. By buffering the firm against demand and cost changes, the variability of profits (and stock prices) should be lower than otherwise”. Recent literature confirms this effect. Irvine and Pontiff (2009) examine deregulated industries and find that these industries experience increases in idiosyncratic risk after deregulation. Loveland and Okoeguale (2016) confirm this relationship in the banking industry. Irvine and Pontiff (2009) link increases in the idiosyncratic volatility of firm-level cash flows (and stock returns) to increases in industry competition. They test the cross-section of Fama French 49 industries and find that proxies for competition are significantly related to increases in idiosyncratic volatility over the period 1964–2003, consistent with the notion that increases in competition increase firm risk.

We lean on the findings of Irvine and Pontiff (2009) to support our prediction that increases in competition following deregulation should produce increases in firm risk (as proxied by cash flow volatility) and decreases in the correlation of firm risk industry-wide. Both should increase the rate of industry exit. In addition, the introduction of new, more efficient technology during this period should also increase the dispersion of economic efficiency across the industry as firms deploy new technologies at different rates. As a result of these changes, increasing heterogeneity in financial performance industry-wide should increase the rate of industry exit through merger and bankruptcy.

We note at this point that analysis in the preceding section reveals that the merger activity of the public acquirers/targets group is very similar to that of all merger activity in the telecom industry. The close similarity of the two groups permits us to use mergers of public acquirers and public targets as an accurate proxy for the merger activity of the telecom industry as a whole. We make this choice because the availability of detailed information about financial, industry and deal characteristics enables a comprehensive study of changing industry dynamics that a study of private firms would not

permit.

Table 4 presents univariate tests of competition, performance, risk and valuation measures for public firms for the five years preceding, and five years following, the 1996 industry deregulation. IPOs serve as a proxy for the level of financing, investment and competition in the industry. Mergers and bankruptcies serve as proxies for consolidation, capacity reduction and decreases in competition in the industry.

<Insert Table 4 about here>

Table 4 reports that the average annual number of IPOs increases from roughly 8 to 16, resulting in a 105% increase that is highly statistically significant. Total industry exit also increases significantly over the same period, from an average of 6.4 to 15.6 exits per year, an increase of roughly 145%. M&A makes up the bulk of industry exits, increasing a highly significant 145%, from 4.4 to 10.8 per year. These results support the initial finding that IPO financing appears to boost M&A in the telecom industry.

The increasing rate of investment in, and exit from, the public markets during the event period translates into statistically significant increases in industry turnover (defined as the sum (of count or value) of IPOs, spin-offs and exit scaled by annual public market size (count or value)). Average annual turnover by count increases 57% while average annual turnover by market value increases 400%. Table 4 also reports that the average annual industry HHI score decreases by 21% and that firm ROA decreases by 45% per year, on average; changes in both measures are highly statistically significant. The erosion of market power, as measured by industry HHI and average firm ROA, for the average telecom firm following passage of the 1996 Act is again evidence of increased competition in the industry post-deregulation.

Table 4 also reports on firm performance, risk and valuation variables. Reported results show

that the value of the economic shock index variable increases over 60% while the dispersion in ROS increases over 20%; both differences are significant. Dispersion in shocks to firm cash flow increases fivefold; the difference is again significant. The M/B ratio stays roughly constant, while the valuation error decreases from overvalued to undervalued; significant at the 10% level. The V/B ratio increases from .96 to 1.12 although the difference is not significant.

Test results in this section again reflect the impact of a changing industry landscape after passage of the 1996 Act - economic disruption, greater heterogeneity in industry cash flow and returns and decreasing valuations. Overall, the results paint a picture of increasing industry investment, competition and exit. The concurrent increases in the economic shock index and merger count is again broadly consistent with evidence in Mitchell and Mulherin (1996) and Harford (2005) that economic shocks drive industry merger activity.

Firm Characteristics Before and After Deregulation

In this section we take a more detailed look at the characteristics of public firms in the telecom industry before and after deregulation. Table 5 presents average financial and operating characteristics of public telecom firms for the pre-1996 period (1979 to 1995) and the post-1996 period (1996 to 2009). The size measures reveal that post-1996 telecom firms are larger than their pre-1996 counterparts, on average, as measured by most of the size proxies. Total assets, equity, sales and cash flow are all significantly greater for post-1996 firms, on average.

<Insert Table 5 about here>

Notably, however, average net income, R&D and number of employees drops after deregulation. Efficiency and profitability measures presented in the second half of the table also show a reduction in average firm profitability over the period. Income/sales, income/assets, cash

flow/sales, and cash flow/assets all drop significantly after deregulation. Thus, the average firm post-deregulation is larger and less profitable than their pre-1996 counterpart.

Collectively, these initial results begin to explain how radical industry change drives firms to merge. In the case of the U.S. telecom industry, increased competition and the introduction of new technologies increased the variability of cash flows and decreased the level of profitability and liquidity, even as firms raised fresh capital to invest in new capital projects in order to compete in a changing product marketplace. These changes increased the rate of M&A and bankruptcy. We explore the last finding, and examine the characteristics of surviving, acquiring and target firms, in more detail in the next section.

Robustness Analysis

Before exploring the previous findings, however, we first perform a robustness check on tests performed in this section. Evidence presented in Table 4 establishes that industry investment, exit, and turnover is significantly higher in the 5-year period following deregulation than the 5-year period preceding it. Moreover, firm market power decreases significantly, while the economic shock index and dispersion in ROS increase significantly during the same period. We next perform the same univariate tests using a longer twenty year period (1986 to 2005); we examine the periods 10 years prior, and 10 years after passage. We examine this twenty year period to explore Winston's (1998) finding that substantial merger activity generally occurs within the decade after industry deregulation.

However, when we expand the event window to twenty years and compare the ten year periods pre- and post-1996, we find largely similar results. Appendix B1 reports that IPO activity increases post-1996 although the change is not significant. Consistent with prior tests, mergers and total public market exits increase significantly post-1996, as does turnover. Decreases in market power (HHI and firm ROA) are highly significant. Appendix B1 also reports that the economic shock index for the

average firm during the period increases significantly, as does the dispersion in cash flow shocks across the industry. However, the dispersion in ROS increases at an insignificant rate. The valuation measure M/B declines significantly; changes to Industry Error and V/B are insignificant.

VI. Incumbents' Pre-Deregulation Performance and Merger Characteristics: "Who Buys Whom?"

Impact of Pre-1996 Deregulation Performance on Incumbents' Survival and Merger Rates

Evidence from the previous section indicates that increases in M&A after passage of the Act in 1996 were part of a broad restructuring response to the deregulation of the industry and the increase in competition that followed; removal of barriers to entry and rapid technological change facilitated a rapid increase in product market competition. If competition is, in fact, the mechanism through which deregulation and technological change drive merger activity, then we should find a relationship between firm efficiency and the characteristics of merging firms in the industry. We expect acquiring firms, on average, to be more efficient and have more resources (or "fitter" and "fatter" according to Zingales, 1998) than targets firms. To test this theory, and determine "who buys whom?", we examine the effect of industry incumbent's pre-1996 firm and efficiency characteristics on their rate of survival or exit via takeover.

Table 6 presents the measures of size, efficiency and leverage for the 90 firms incumbent to the public markets at the beginning of 1996. The table also classifies these incumbents as survivors or exits over the subsequent five year period (1996 to 2001) and ten year period (1996 to 2006) and reports the firms' ex-ante (as of year-end 1995) size, efficiency and leverage data. For this purpose, we define incumbent firms as those firms listed on CRSP just prior to the January 3, 1996 approval of the Telecommunications Act by Congress. Reported results reveal that incumbent survivors are more

profitable and efficient, ex-ante, than exits by several measures. Income/assets and cash flow/assets are greater for incumbent survivors over the 1996 to 2001 period, while capital expenditures/assets is lower for incumbent survivors over the same period, indicating that survivors are likely more efficient in adapting and implementing new technology.

<Insert Table 6 about here>

The table reports no significant difference in size, on average, between incumbent firms that survive the 1996 to 2001 time period and incumbent firms that exit over the same period. Further, we find no significant differences in the ex-ante leverage measures of incumbent survivors and incumbent exits over the 1996 to 2001 period.

A comparison of the ex-ante efficiency measures for the 1996 to 2006 groups again reveals that survivors are generally more profitable and efficient than exits; the profitability measures income/sales, income/assets, cash flow/sales and cash flow/assets are significantly greater for incumbents that survive through 2006 than for incumbents that exit during the period 2001 to 2006. A comparison of the ex-ante size and leverage measures again reveals no significant differences between the two groups. Similar to the 1996 to 2001 groups, ex-ante capital expenditures/assets is lower for incumbent survivors over the same period, as is the market/book ratio. The remaining efficiency measures reveal no statistically significant differences.

Thus, test results indicate that an incumbent firm's ex-ante profitability and efficiency are important determinants of its probability of survival or exit after industry deregulation in 1996. The more profitable and efficient incumbent firms exhibit greater survivability in an industry that is more competitive post-deregulation.

Next, we examine the above finding more closely by testing whether firm characteristics are determinants of a specific type of industry exit – exit via merger. We focus on the period 1996 to

2001 in the following analyses in order to minimize the potential effects of confounding factors. Table 7 presents the ex-ante size, efficiency and leverage characteristics of the incumbent survivors and merger exits over the 1996 to 2001 period. Reported results indicate almost no statistically significant differences in the size, efficiency, and leverage characteristics of survivors and merger exits, on average. The exception is capital expenditures which is significantly lower for survivors than for merger exits.

<Insert Table 7 about here>

In untabulated tests, we also compare the ex-ante size, efficiency and leverage characteristics of the same set of incumbent survivors against non-merger exits (bankruptcy and non-voluntary exits) over the 1996 to 2001 period. We find that incumbent survivors are significantly larger in size and possess significantly higher ex-ante profitability and efficiency than incumbent non-merger exits, on average; almost all size and efficiency difference measures are statistically significant. Thus, test results demonstrate that smaller and less efficient incumbent firms are not targeted for acquisition but, instead, left to face exit from the public markets via bankruptcy or non-voluntary delisting.

Collectively, tests in this section produce two important findings: 1) incumbents that become targets in a merger following industry deregulation are not systematically different from the incumbents that survive, based on ex-ante size, efficiency and leverage characteristics, and 2) industry deregulation forces smaller and less efficient firms to exit the public markets via bankruptcy or non-voluntary delisting. The second finding is consistent with the disciplinary and efficiency-improving role of competition, as shown in Zingales (1998). Zingales (1998) suggests that size may be a proxy for efficiency because only efficient firms survive to become large, and once large, these firms have more bargaining power in a competitive environment. In the case of the telecom industry after the 1996 deregulation, size may also proxy for unobserved heterogeneity in the quality of firms'

production technology. Larger incumbents may have been better positioned to adopt new communication technologies in response to consumers' demand for a vertically integrated product package – an industry trend that had begun prior to the draft of the Telecommunications Act (see e.g., Maloney and McCormick, 1995). In the next section, we explore the implications of the first finding regarding survivors and merger targets as we seek to answer the question “who buys whom”?

Who Buys Whom?

In this section, we test for systematic differences between industry incumbents that become acquirers, and those that become targets, in mergers in which both are incumbents. We again focus on the period 1996 – 2001. Of the 34 mergers during this period in which the target is an incumbent, roughly half (18) involve an acquirer that is also an incumbent. Table 8 presents the size, efficiency and leverage characteristics of the incumbent acquirers and targets involved in these 18 merger transactions. Reported results reveal no significant difference in size, on average, between incumbent acquirers and incumbent targets. However, a comparison of the efficiency measures reveals that incumbent acquirers are significantly more profitable and efficient than incumbent targets by several measures: income/sales and income/assets. Moreover, incumbent acquirers are significantly less levered than incumbent targets (by market value).

<Insert Table 8 about here>

The test results are consistent with Ovtchinnikov's (2013) finding that relatively healthy industry participants tend to acquire poor performing participants after the industry is deregulated. The effect of leverage is consistent with Zingales' (1998) assertion that in a more competitive post-deregulation environment, lower leverage may strengthen a firm's relative competitive position and enable it to successfully finance new investments, including acquisitions.

Likelihood of Exit, Takeover or Acquisition

This section further examines the impact of firm characteristics on a firm's subsequent survival and merger participation. We explore how firm characteristics affect the probability of surviving, merging or exiting the industry. Given the evidence in preceding sections that firm characteristics are systematically related to survival and merger participation, we test the probability that the following outcomes are a function of a firm's financial characteristics: a firm 1) survives the industry and acquires another industry firm, 2) survives the industry but does not acquire another firm, 3) exits the industry via merger, or 4) exits the industry via bankruptcy/delisting.

Table 9, Models I and II, present logit regressions in which the dependent variable takes on the value of one if a firm survives the industry and acquires another industry firm, or zero if a firm survives but does not acquire, or exits the industry via merger, bankruptcy or delisting, as described above.⁸ Model I shows that a one unit increase in the size measure assets (log of book value) produces a .55 increase in the log odds of a firm being an acquirer. The estimate of log odds is statistically significant. Neither industry error nor V/B significantly influence the log odds of a firm becoming an acquirer. Model II shows that a one unit increase in the size measure equity (log of market value) also produces a significant .423 increase in the log odds of a firm becoming an acquirer. Again, neither industry error nor V/B significantly influence the log odds of a firm becoming an acquirer.

<Insert Table 9 about here>

To examine the sensitivity of our findings to the definition of the dependent variable, and more directly test the likelihood of acquisition vs. exit, we next run the same set of tests with the outcome "survives the industry but does not acquire another firm" eliminated from the Outcome

⁸ We test all characteristics analyzed in previous sections but, for reasons of exposition, present only the most notable results.

measure. Models III and IV report the same test specifications employed in Models I and II, but uses the revised Outcome measure as the dependent variable. Model III shows that a one unit increase in the size measure assets (log of book value) again produces a significant increase in the log odds of a firm becoming an acquirer. However, in this specification, the efficiency measure ROA also produces a significant 21.753 increase in the log odds of a firm becoming an acquirer. Again, neither Industry error nor V/B significantly influence the dependent variable Outcome. Model IV reports no significant results for the valuation measures, nor for the alternate measures of size or efficiency.

Test results reported in Table 9 demonstrate that firm size and, to a lesser extent, firm efficiency are important determinants of an individual firm's competitive position within an industry. Fatter and fitter firms are more likely to survive and become acquirers in intra-industry mergers, consistent with the findings of Zingales (1998). Firms that are less fat and less fit are more likely to exit the industry as a merger target, or via bankruptcy or delisting. The level of stock price misvaluation and long-term growth options do not significantly affect firm outcome.

VII. Tests of Industry Shock and Misvaluation Merger Theories

The data we have compiled for this study also provide an excellent opportunity to revisit the question of whether industry shocks or stock misvaluation drives aggregate industry merger activity. Misvaluation theory ties merger activity not to industry shocks but to relative stock valuations; acquiring managers use overvalued stock to buy undervalued, or less overvalued, firms (e.g., Shleifer and Vishny, 2003; Rhodes-Kropf and Viswanathan, 2004). The U.S. telecom industry provides an attractive setting to examine these two questions because the industry experienced several structural shocks via deregulation and technological change over the sample period (Weston, Mitchell and

Mulherin, 2004), while its large, capital-intensive public firms were subject to several bull markets (mid-1980s, 1990s and mid-2000s) that provide fertile ground for possible misvaluation.

Table 10 reports the results of OLS regression analysis of the effect of structural and industry misvaluation variables on annual industry merger count. Model I reports that increases in the variable economic shock index has a positive and significant effect on industry M&A activity (proxied by the dependent variable annual merger count) while the estimated coefficients for the valuation variables industry error and V/B are insignificant and weakly significant, respectively. Model II substitutes annual IPO count (a proxy for industry investment) and cash flow dispersion in place of the economic shock index; increases in both variables significantly increase merger activity while the estimated coefficients for the two valuation variables are insignificant. The estimated coefficient for dispersion in ROS is positive and significant in Model III while the coefficients for the two valuation variables remain insignificant.

<Insert Table 10 about here>

When we include all variables in the Model IV specification, annual IPO count subsumes the power of the structural variables economic shock index, cash flow dispersion and dispersion in ROS to explain merger activity, although cash flow dispersion remains weakly significant.⁹ The two valuation variables remain insignificant. The effect of the IPO variable is economically significant; a one standard deviation increase in IPO activity increases annual merger count by 2.7 or 60%. Furthermore, a one standard deviation increase in inter-firm dispersion of cash flow shocks increases annual merger count by .98, or over 20%.

⁹ Although unreported analysis indicates some correlation in the structural change variables, no significant collinearity is present in the regression specifications. The regression analysis was executed in SAS using the Variance Inflation (VIF) option; all VIF levels are less than, or equal to, roughly 3.

As a (untableted) robustness check, we also examine the sensitivity of test results to the measure of takeover activity employed. We substitute annual market value of target firms in place of annual merger count and rerun the same tests. We obtain similar results; IPO count, dispersion in ROS, and cash flow dispersion again have a positive and significant effect on industry M&A activity. However, in this set of tests, cash flow dispersion loads more significantly than does the IPO variable, the opposite of the effect when merger count is the dependent variable. The effect of the valuation variables are again largely insignificant, with the exception of the V/B variable in Model 1 only, which loads significantly as it does in Model 1 in Table 10.

Thus, test results in this section show that industry shocks and industry investment drive aggregate merger activity in the U.S. telecom industry after deregulation in 1996. Stock misvaluation shows little power to influence aggregate industry merger activity. These results are consistent with findings in the merger literature that industry shocks drive merger activity (see, e.g. Mitchell and Mulherin, 1996; Andrade, Mitchell and Stafford, 2001; Harford, 2005), but inconsistent with Rhodes-Kropf, Robinson and Viswanathan (2005) who find stock misvaluation a significant driver of merger waves. This finding also contributes to emerging evidence that industry shocks subsume the power of misvaluation to explain industry merger activity (Loveland and Okoeguale, 2016).

VIII. Summary and Conclusion

This paper examines the U.S. telecommunications industry during a period of rapid deregulation to determine the effects of a deregulatory shock on industry competition and M&A activity. We utilize a large sample of public and private mergers, along with industry and firm-level data, to empirically document the manner in which a radical industry change affected IPOs, industry competition and M&A activity. We show that acquisition activity in the telecom industry exhibits a

clear wave-like pattern, regardless of the public/private status of the acquirer or target.

When we examine the competitive dynamics of the industry we find that deregulation of the industry via the 1996 Telecommunications Act increased IPO activity, thus decreasing the concentration of publicly traded U.S. telecom firms. Deregulation also increased industry competition and reduced the correlation of firm cash flows, thus increasing cash flow volatility and probability of exit. Moreover, deregulation helped speed the adoption of new technology within the industry and increased the dispersion in firm-level economic efficiency across the industry as firms invested in emerging technologies at different rates. We show that these changes to the competitive structure of the telecom industry results in a significant increase in merger activity following deregulation in 1996.

Collectively, the evidence presented in this paper demonstrates that competition is an important channel through which industry change drives an industry merger wave. We show that in the U.S. telecom industry, mergers facilitated the reallocation of resources within the industry to the most efficient users in response to increased competition brought about by deregulation and technological change. This evidence thus affirms the link between deregulation, competition and merger activity.

We also show that competition plays an important role in shaping “who buys whom?” Fatter and fitter firms are more likely to survive and become acquirers in intra-industry mergers, while smaller and less efficient incumbents are not targeted for acquisition but are instead left to face exit via bankruptcy or non-voluntary delisting.

Appendix A

This table defines the variables used in this study.

Variable	Definition	Source
<i>Assets (book value)</i>	Total assets	CRSP/Compustat Merged
<i>Assets (market value)</i>	Equity (market value) + book assets – book equity – deferred taxes	CRSP/Compustat Merged
<i>Equity (market value)</i>	Share price x shares outstanding	CRSP
<i>Equity (book value)</i>	Total common equity = Common stock outstanding + Capital surplus + Retained earnings - Treasury stock adjustments	CRSP/Compustat Merged
<i>Sales</i>	Gross sales - cash discounts - trade discounts - returned sales / allowances	CRSP/Compustat Merged
<i>Net income</i>	Net income (loss)	CRSP/Compustat Merged
<i>Cash flow</i>	Operating income before depreciation – taxes	CRSP/Compustat Merged
<i>Capital expenditures</i>	Expenditures used for additions to property, plant, and equipment (excludes amounts arising from acquisitions)	CRSP/Compustat Merged
<i>R&D</i>	Research and development expense	CRSP/Compustat Merged
<i>Employees</i>	Number of people employed by the company	CRSP/Compustat Merged
<i>Market/book (M/B)</i>	Market equity/book equity	Calculated
<i>Sales/assets</i>	Sales/total assets	Calculated

Variable	Definition	Source
<i>Income/sales</i>	Net income/sales	Calculated
<i>Cash flow/sales (ROS)</i>	Cash flow/sales	Calculated
<i>Cash flow/assets</i>	Cash flow/ total assets	Calculated
<i>Capital expenditures/assets</i>	Capital expenditures/ total assets	Calculated
<i>R&D/assets</i>	Research and development expense / total assets	Calculated
<i>Leverage (market)</i>	1 – equity (market value)/ assets (market value)	Calculated
<i>Leverage (book)</i>	1 – equity (book value)/total assets	Calculated
<i>Turnover</i>	Sum (count or value) of annual entry and exit divided by the sum (count or value) of firms in the industry each year	Calculated
<i>Herfindahl-Hirschman index</i>	Sum of the squared market shares (sales scaled by total industry sales) of firms in the industry each year	Calculated
<i>Return on assets</i>	(net income + interest)/total assets	Calculated
<i>Cash flow shock</i>	The residual from a pooled cross-sectional time-series regression of quarterly firm cash flow differences on past quarterly cash flow differences (as described in detail in Section III of the text)	Calculated
<i>Economic shock index</i>	First principal component of the median absolute change in: sales/assets, net income/sales, capital expenditures/assets, R&D/assets, ROA, sales growth, and employee growth	Calculated

Variable	Definition	Source
<i>Inter-firm dispersion in cash flow shocks</i>	Cross-sectional standard deviation of firms' quarterly cash flow shocks	Calculated
<i>Inter-firm dispersion in ROS</i>	Cross-sectional standard deviation of firms' return on sales (cash flow/sales)	Calculated
<i>Industry error</i>	Proxy for industry misvaluation. Computed using the Rhodes-Kropf, Robinson and Viswanathan (2005) M/B decomposition (as described in detail in Section III of the text)	Calculated
<i>V/B</i>	Proxy for level of firm growth options. Computed using the Rhodes-Kropf, Robinson and Viswanathan (2005) M/B decomposition (as described in detail in Section III of the text)	Calculated

Appendix B1: Competition, Performance and Valuation Before and After Industry Deregulation.

	10 Year Averages			
	Before Deregulation	After Deregulation	% Change	<i>t</i> (diff)
	1986 to 1995	1996 to 2005		
Competition				
<i>Industry investment (count)</i>				
IPOs	6.20	9.00	45%	0.81
<i>Exit activity (count)</i>				
Total exit	5.70	15.00	163%	3.05***
M&A	3.50	7.40	111%	2.04**
Bankruptcy	0.10	4.50	4400%	2.12**
<i>Industry turnover</i>				
Turnover (count)	0.20	0.29	45%	1.95*
Turnover (value)	0.02	0.12	500%	3.53***
<i>Market power</i>				
Herfindahl-Hirschman index	0.14	0.12	-14%	-5.85***
Return on assets	0.10	0.07	-30%	-5.49***
Performance & valuation				
<i>Performance</i>				
Economic shock index	0.19	0.29	53%	3.49***
Inter-firm dispersion in cash flow shocks	0.13	0.60	362%	2.02**
Inter-firm dispersion in ROS	0.27	0.29	7%	1.46
<i>Valuation</i>				
M/B	1.03	0.79	-23%	-1.95*
Industry error	0.08	-0.05	-163%	-1.21
V/B	0.95	0.84	-12%	-0.70

This table presents averages of competition, performance and valuation measures of public firms in the U.S. telecommunications industry for the ten year period preceding, and ten year period following, industry deregulation in 1996. IPOs is the annual count of initial public offerings in the industry. Total exit is the sum of the annual count of mergers, bankruptcies and delistings in the industry. M&A is the annual count of mergers in the industry. Bankruptcy is the annual count of bankruptcy filings by firms in the industry. Turnover is the sum (count or value) of annual industry entry and exit divided by the annual sum (count or value) of firms in the industry. Herfindahl-Hirschman index is the sum of the squared market shares (sales scaled by total industry sales) of firms in the industry each year. Return on assets is the sum of firm net income and interest income scaled by total assets. Economic shock index (Harford, 2005) is the first principal component of the median absolute changes in annual: sales/assets, net income/sales, capital expenditures/assets, R&D/assets, ROA, sales growth, and employee growth for firms in the industry. Inter-firm dispersion in cash flow shocks is the cross-sectional standard deviation of firms' quarterly cash flow shocks. Inter-firm dispersion in ROS is the cross-sectional standard deviation of firms' return on sales (cash flow/sales). M/B, or market/book, is the log of firm market value equity/book value equity. Industry error is a proxy for industry-level stock misvaluation. V/B, or value/book, is a proxy for the level of firm growth options. Industry error and V/B are estimated using the Rhodes-Kropf et al. (2005) M/B decomposition. All measures are expressed in means. *t*(diff) is the t-statistic of the difference in means.

*** Significant at the 1% level.

** Significant at the 5% level.
* Significant at the 10% level.

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Layer 3: Services layer (voice, data, fax, 800 services)
Layer 2: Network layer (circuit-switched network)
Layer 1: Equipment layer (switches, transmission systems, customer premises equipment)

Figure I: Model of Pre-Deregulation Telecommunications Industry. This figure presents Fransman's (2001) model of the organization of the telecommunications industry from the 1880s through the mid-1980s.

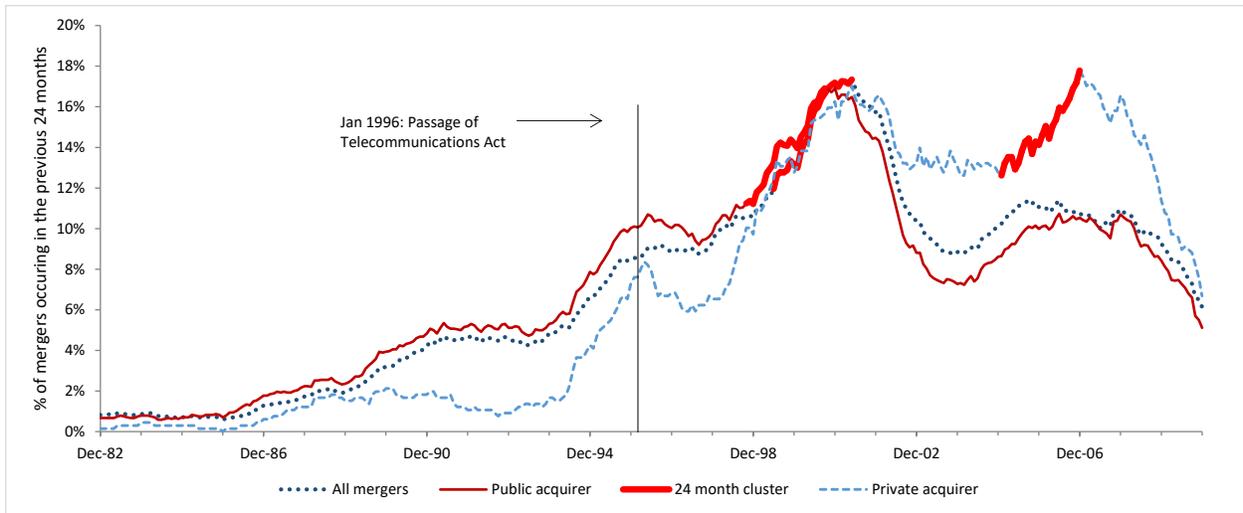


Figure II: Monthly Time Series Comparison of Telecommunications Industry Merger Activity by Acquirer Status. This figure presents a time series plot of the percentage, for each month between December 1982 and December 2009, of the total number of mergers between 1979 and 2009 that occurred in the previous 24 months for public acquirers, private acquirers and all mergers. 24 month cluster is the 24 month period with the highest acquisition activity.

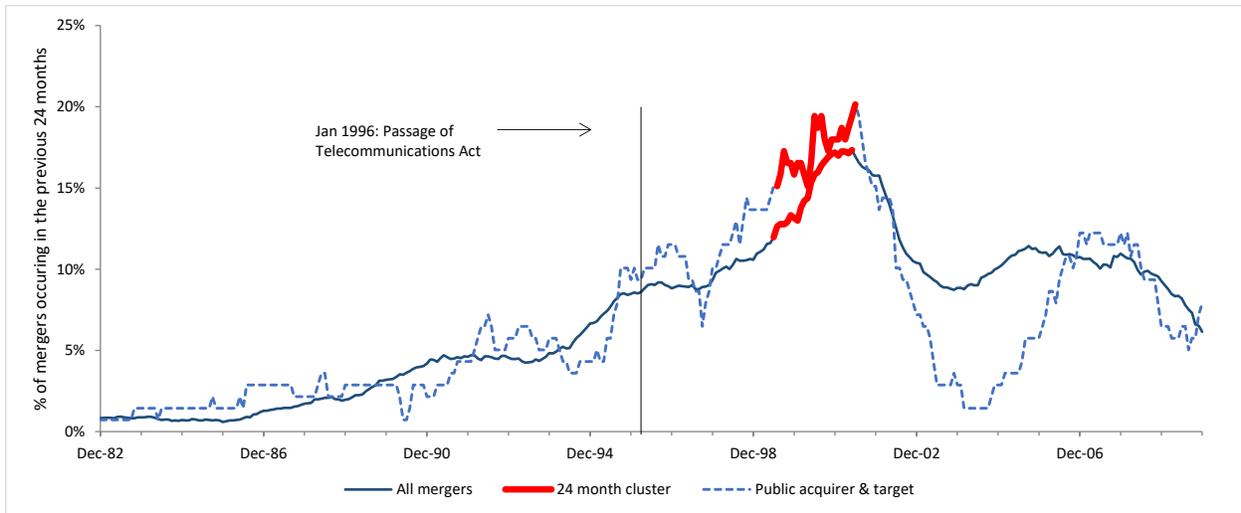


Figure III: Monthly Time Series Comparison of Telecommunications Industry Merger Activity by Acquirer Status. This figure presents a time series plot of the percentage, for each month between December 1982 and December 2009, of the total number of mergers between 1979 and 2009 that occurred in the previous 24 months for public acquirers and public targets and all mergers. 24 month cluster is the 24 month period with the highest acquisition activity.

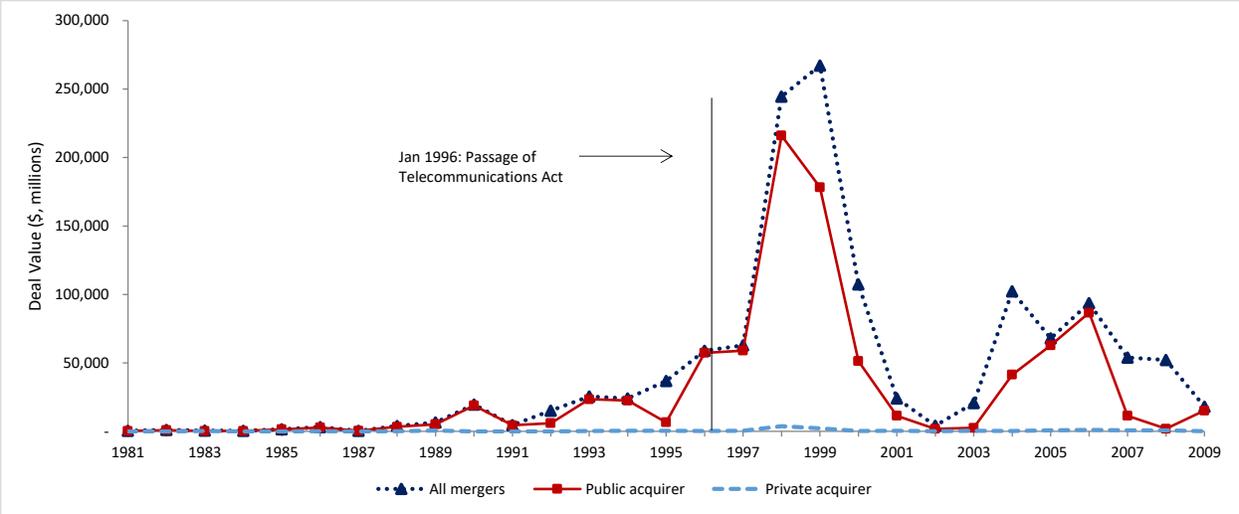


Figure IV: Annual Time Series Comparison of Telecommunications Industry Merger Activity. This figure presents a time series plot of the total annual deal values of annual mergers for the period 1981 to 2009.

Table 1: Merger Volatility and Clusters by Acquirer Type.

	Total Mergers	Std. Dev. of Merger Time Series	M&A in Largest 24 Month Cluster	M&A in Largest 24 Month Cluster	Dates of 24 Month Cluster
Private acquirer	658	0.0612a	117 **	17.8%	Jan-05 to Dec-06
Public acquirer	2,543	0.0441	430 **	16.9%	Oct-98 to Sep-00
Public acquirer & target	135	0.0507	28 **	20.1%	Jul-99 to Jun-01
All mergers	3,887	0.0463	674 **	17.3%	Jun-99 to May-01

This table presents the standard deviation of the time series of merger activity, and the largest merger clusters, for the period 1979 to 2009, by acquirer type. For the volatility analysis presented in the second column, the time series is constructed as the percentage, each month between December 1982 and December 2009, of the total number of mergers between 1979 and 2009 that occurred in the previous 24 months. Data on M&A clusters reported in columns three, four and five are measured as the 24 month period with the highest acquisition activity. Public (private) acquirers and targets are those firms categorized as public (private) firms by SDC.

^a Significantly greater than for All mergers at the 5% level

** Significant at the 5% level.

Table 2: Competition and Merger Activity Before and After Industry Deregulation.

	Before Deregulation (1991 to 1995)		After Deregulation (1996 to 2000)		Mean	
	Count	Mean	Count	Mean	(diff)	<i>t</i> (diff)
<i>Industry – all firms</i>						
Industry (total firms)	22,096	4,419	39,669	7,934	3,515	5.44***
M&A	609	122	1,249	250	128	3.08***
<i>Industry - public acquirers and targets</i>						
Industry (total firms)	409	82	562	112	31	6.30***
M&A	22	4	54	11	7	4.32***

This table presents averages of measures of competition and merger activity for the five year period preceding, and five year period following, industry deregulation in 1996. Our proxy for competition, Industry (total firms), is measured as the annual count of firms in the industry. M&A is measured as the annual count of mergers. *t*(diff) is the t-statistic of the difference in means.

*** Significant at the 1% level.

Table 3: Correlations between Monthly Frequencies of Mergers and IPO Listings.

	IPO Listings	Lagged IPO Listings
Private acquirer		
Correlation coefficients	0.214	0.350*
Number of acquisitions	658	658
Number of listings	170	170
Public acquirer		
Correlation coefficients	0.581***	0.588***
Number of acquisitions	2,543	2,536
Number of listings	170	170
Public acquirer & target		
Correlation coefficients	0.514***	0.618***
Number of acquisitions	135	135
Number of listings	170	170
All mergers		
Correlation coefficients	0.478***	0.555***
Number of acquisitions	3,883	3,870
Number of listings	170	170

This table presents Pearson correlation coefficients for the relation between monthly merger frequencies and IPO listing frequencies, by acquirer type. The column IPO Listings matches the month of the IPO frequencies to the month of the merger frequencies, as defined by the merger announcement date. The column Lagged IPO Listings matches the month of the merger frequency to the IPO frequencies of the previous year. Public (private) acquirers and targets are those firms categorized as public (private) firms by SDC.

*** Significant at the 1% level.

* Significant at the 10% level.

Table 4: Competition, Performance and Valuation Before and After Industry Deregulation.

	5 Year Averages		% Change	<i>t</i> (diff)
	Before Deregulation	After Deregulation		
	1991 to 1995	1996 to 2000		
Competition				
<i>Industry investment (count)</i>				
IPOs	7.80	16.00	105%	3.11***
<i>Exit activity (count)</i>				
Total exit	6.40	15.60	144%	3.11***
M&A	4.40	10.80	145%	4.49***
Bankruptcy	0.20	2.00	900%	2.45**
<i>Industry turnover</i>				
Turnover (count)	0.21	0.33	57%	3.67***
Turnover (value)	0.03	0.15	400%	2.48**
<i>Market power</i>				
Herfindahl-Hirschman index	0.14	0.11	-21%	-8.84***
Return on assets	0.11	0.06	-45%	-9.18***
Performance & valuation				
<i>Performance</i>				
Economic shock index	0.19	0.31	63%	4.73***
Inter-firm dispersion in cash flow shocks	0.21	1.11	435%	1.76*
Inter-firm dispersion in ROS	0.26	0.32	23%	6.35***
<i>Valuation</i>				
M/B	1.08	1.05	-3%	-0.25
Industry error	0.12	-0.07	-158%	-1.84*
V/B	0.96	1.12	17%	1.12

This table presents averages of competition, performance and valuation measures of public firms in the U.S. telecommunications industry for the five year period preceding, and five year period following, industry deregulation in 1996. IPOs is the annual count of initial public offerings in the industry. Total exit is the sum of the annual count of mergers, bankruptcies and delistings in the industry. M&A is the annual count of mergers in the industry. Bankruptcy is the annual count of bankruptcy filings by firms in the industry. Turnover is the sum (count or value) of annual industry entry and exit divided by the annual sum (count or value) of firms in the industry. Herfindahl-Hirschman index is the sum of the squared market shares (sales scaled by total industry sales) of firms in the industry each year. Return on assets is the sum of firm net income and interest income scaled by total assets. Economic shock index (Harford, 2005) is the first principal component of the median absolute changes in annual: sales/assets, net income/sales, capital expenditures/assets, R&D/assets, ROA, sales growth, and employee growth for firms in the industry. Inter-firm dispersion in cash flow shocks is the cross-sectional standard deviation of firms' quarterly cash flow shocks. Inter-firm dispersion in ROS is the cross-sectional standard deviation of firms' return on sales (cash flow/sales). M/B, or market/book, is the log of firm market value equity/book value equity. Industry error is a proxy for industry-level stock misvaluation. V/B, or value/book, is a proxy for the level of firm growth options. Industry error and V/B are estimated using the Rhodes-Kropf, Robinson and Viswanathan (2005) M/B decomposition. All measures are expressed in means. *t*(diff) is the *t*-statistic of the difference in means.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table 5: Characteristics of Firms That Enter and Exit the Industry Before and After Deregulation.

	Averages			
	Before Deregulation	After Deregulation	% Change	t(diff)
	1979 to 1995	1996 to 2009		
<i>Size measures (\$millions)</i>				
Assets (book value)	5,281	9,003	70%	4.25***
Assets (market value)	5,993	12,198	104%	7.87***
Equity (book value)	1,839	2,849	55%	3.70***
Equity (market value)	3,093	6,810	120%	7.09***
Sales	2,897	3,959	37%	2.70**
Net income	188	107	-43%	0.87
Cash flow	912	1,285	41%	3.01***
Capital expenditures	584	745	28%	2.19**
R&D	45	10	-78%	10.63***
Employees (in 000s)	26	12	-56%	3.91***
<i>Efficiency measures</i>				
Sales/assets	0.51	0.51	1%	0.17
Income/sales	0.04	-0.09	-317%	3.92***
Income/assets	0.06	0.00	-103%	4.44***
Cash flow/sales	0.22	0.15	-31%	1.82*
Cash flow/assets	0.13	0.08	-37%	2.96***
Capital expenditures/assets	0.10	0.09	-11%	1.43
R&D/assets	0.00	0.00	0%	1.10
Market/book equity	1.73	2.08	20%	1.33
<i>Leverage measures</i>				
Leverage (market)	0.48	0.45	-5%	0.61
Leverage (book)	0.65	0.68	5%	1.69
CRSP sample size	1001	1185		
CRSP/Compustat sample size	909	1116		

This table presents averages of the size, efficiency and leverage measures of public firms in the U.S. telecommunications industry for the 1979 to 1995 period preceding, and the 1996 to 2009 period following, industry deregulation in 1996. Assets (book value) is firm total assets. Assets (market value) is calculated as firm equity (market value) + book assets – book equity – deferred taxes. Equity (book value) is total firm common equity, calculated as common stock outstanding + capital surplus + retained earnings - treasury stock adjustments. Equity (market value) is firm share price x shares outstanding. Sales is calculated as firm gross sales - cash discounts - trade discounts - returned sales/allowances. Net income is firm net income (loss). Cash flow is calculated as firm operating income before depreciation – taxes. Capital expenditures is defined as firm expenditures used for additions to property, plant, and equipment (excluding amounts arising from acquisitions). R&D is defined as firm research and development expense. Employees is the number of people employed by the firm. The ratios Sales/assets, Income/sales, Income/assets, Cash flow/sales, Cash flow/assets, Capital expenditures/assets, R&D/assets, Market/book equity are quotients of the preceding size measures (assets is firm total assets and income is firm net income). Market/book equity is firm market value equity/book value equity. Leverage (market) is calculated as 1 – equity (market value)/ assets (market value). Leverage (book) is calculated as 1 – equity (book

value)/total assets. Firm accounting data is from CRSP/Compustat Merged. Market value is from CRSP. Size measures are expressed in means; efficiency and leverage measures are expressed in medians. $t(\text{diff})$ is the t -statistic of the difference in means.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Table 6: Characteristics of Incumbents, Survivors and Exits: 1996 - 2006.

	Incumbents	Survivors, 2001	Exits, 1996 - 2001	<i>t</i> (diff)	Survivors, 2006	Exits, 1996 - 2006	<i>t</i> (diff)
<u>Size measures (\$millions)</u>							
Assets (book value)	4,373	6,195	3,525	0.91	5,691	4,093	0.62
Assets (market value)	7,939	11,323	6,367	0.88	10,350	7,436	0.57
Equity (book value)	1,247	1,746	1,013	1.06	1,916	1,077	1.11
Equity (market value)	5,021	7,207	3,995	0.92	6,867	4,607	0.67
Sales	2,762	4,287	1,977	0.96	3,299	2,682	0.35
Net income	-31	27	-71	0.83	48	-53	0.72
Cash flow	844	1,175	708	0.82	1,263	743	0.89
Capital expenditures	465	573	429	0.53	642	423	0.76
R&D	52	117	10	0.93	0	69	-1.12
Employees (in 000s)	13	19	10	0.94	16	12	0.52
<u>Efficiency measures</u>							
Sales/assets	0.55	0.81	0.80	0.02	0.80	0.76	0.19
Income/sales	-0.02	-0.07	-0.21	1.41	0.05	-0.98	1.74*
Income/assets	0.01	0.03	-0.05	2.51**	0.07	-0.05	5.42***
Cash flow/sales	0.15	0.17	0.02	1.50	0.27	-0.70	1.73*
Cash flow/assets	0.10	0.12	0.05	1.94*	0.18	0.04	4.65***
Capital expenditures/assets	0.09	0.08	0.10	-1.74*	0.08	0.11	-1.99**
R&D/assets	0.00	0.01	0.01	-0.16	0.00	0.01	-1.28
Market/book equity	2.68	4.46	3.95	0.33	2.56	4.34	-1.67*
<u>Leverage measures</u>							
Leverage (market)	0.35	0.35	0.36	-0.31	0.37	0.35	0.38
Leverage (book)	0.63	0.58	0.65	-1.30	0.57	0.62	-1.11
CRSP sample size	90	41	49		22	68	
CRSP/Compustat sample size	87	35	47		20	66	

This table presents averages of the ex-ante size, efficiency and leverage characteristics of public incumbent firms that survive or exit the U.S. telecommunications industry via merger, bankruptcy or non-voluntary delisting during the 1996 to 2001 and 1996 to 2006 periods. The sample is comprised of firms incumbent to the telecom industry at the beginning of 1996. All variables are measured as of year-end 1995. Assets (book value) is firm total assets. Assets (market value) is calculated as firm equity (market value) + book assets – book equity – deferred taxes. Equity (book value) is total firm common equity, calculated as common stock outstanding + capital surplus + retained earnings - treasury stock adjustments. Equity (market value) is firm share price x shares outstanding. Sales is calculated as firm gross sales - cash discounts - trade discounts - returned sales/allowances. Net income is firm net income (loss). Cash flow is calculated as firm operating income before depreciation – taxes. Capital expenditures is defined as firm expenditures used for additions to property, plant, and equipment (excluding amounts arising from acquisitions). R&D is defined as firm research and development expense. Employees is the number of people employed by the firm. The ratios Sales/assets, Income/sales, Income/assets, Cash flow/sales, Cash flow/assets, Capital expenditures/assets, R&D/assets, Market/book equity are quotients of the preceding size measures (assets is firm total assets and income is firm net income). Market/book equity is firm market value equity/book value equity. Leverage (market) is calculated as 1 – equity (market value)/ assets (market

value). Leverage (book) is calculated as $1 - \text{equity (book value)}/\text{total assets}$. Firm accounting data is from CRSP/Compustat Merged. Market value is from CRSP. Size measures are expressed in means; efficiency and leverage measures are expressed in medians. $t(\text{diff})$ is the t -statistic of the difference in means.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Table 7: Characteristics of Incumbent Survivors and Merger Exits: 1996 - 2001.

	Survivors		Merger Exits		Difference	t(diff)
	Mean	Median	Mean	Median		
<i>Size measures (\$millions)</i>						
Assets (book value)	6,195	341	5,387	291	808	0.25
Assets (market value)	11,323	475	9,723	585	1,601	0.26
Equity (book value)	1,746	155	1,552	78	194	0.25
Equity (market value)	7,207	280	6,099	373	1,108	0.29
Sales	4,286	163	3,047	207	1,239	0.49
Net income	27	7	-104	-1	131	0.80
Cash flow	1,175	22	1,102	27	73	0.11
Capital expenditures	573	30	633	36	-60	-0.20
R&D	117	0	15	0	102	0.88
Employees (in 000s)	19	1	15	1	4	0.36
<i>Efficiency measures</i>						
Sales/assets	0.81	0.55	0.75	0.57	0.06	0.34
Income/sales	-0.07	0.05	-0.10	-0.02	0.02	0.34
Income/assets	0.03	0.05	-0.01	0.02	0.03	1.27
Cash flow/sales	0.17	0.27	0.18	0.22	0.00	-0.04
Cash flow/assets	0.12	0.14	0.12	0.10	0.01	0.22
Capital expenditures/assets	0.08	0.08	0.12	0.10	-0.04	-2.44**
R&D/assets	0.01	0.00	0.00	0.00	0.01	1.46
Market/book equity	4.46	2.61	4.37	3.52	0.09	0.05
<i>Leverage measures</i>						
Leverage (market)	0.35	0.32	0.38	0.36	-0.04	-0.69
Leverage (book)	0.58	0.61	0.67	0.66	-0.09	-1.39
CRSP sample size	41	41	34	34		
CRSP/Compustat sample size	35	35	30	30		

This table presents averages of the ex-ante size, efficiency and leverage characteristics of public incumbent firms that survive or exit the U.S. telecommunications industry as the target of a merger during the 1996 to 2001 period. The sample is comprised of firms incumbent to the telecom industry at the beginning of 1996. All variables are measured as of year-end 1995. Assets (book value) is firm total assets. Assets (market value) is calculated as firm equity (market value) + book assets – book equity – deferred taxes. Equity (book value) is total firm common equity, calculated as common stock outstanding + capital surplus + retained earnings - treasury stock adjustments. Equity (market value) is firm share price x shares outstanding. Sales is calculated as firm gross sales - cash discounts - trade discounts - returned sales/allowances. Net income is firm net income (loss). Cash flow is calculated as firm operating income before depreciation – taxes. Capital expenditures is defined as firm expenditures used for additions to property, plant, and equipment (excluding amounts arising from acquisitions). R&D is defined as firm research and development expense. Employees is the number of people employed by the firm. The ratios Sales/assets, Income/sales, Income/assets, Cash flow/sales, Cash flow/assets, Capital expenditures/assets, R&D/assets, Market/book equity are quotients of the preceding size measures (assets is firm total assets and income is firm net income). Market/book equity is firm market value equity/book value equity. Leverage (market) is calculated as $1 - \text{equity (market value)} / \text{assets (market value)}$. Leverage (book) is calculated as $1 - \text{equity (book value)} / \text{assets (book value)}$.

value)/total assets. Firm accounting data is from CRSP/Compustat Merged. Market value is from CRSP. Size measures are expressed in means; efficiency and leverage measures are expressed in medians. The difference column reports the difference in means between the acquirers and targets. $t(\text{diff})$ is the t -statistic of the difference in means.
** Significant at the 5% level.

Table 8: Characteristics of Incumbent Acquirers and Targets in Intra-Industry Mergers: 1996 - 2001.

	Acquirers		Targets		Difference	t(diff)
	Mean	Median	Mean	Median		
<u>Size measures (\$millions)</u>						
Assets (book value)	14,505	6,635	7,097	492	7,410	1.29
Assets (market value)	29,226	11,233	12,584	1,215	16,643	1.50
Equity (book value)	3,727	2,188	1,876	120	1,851	1.45
Equity (market value)	19,104	6,812	7,642	805	11,463	1.67
Sales	9,916	3,640	4,150	182	5,766	1.23
Net income	42	1	-257	-10	299	1.00
Cash flow	2,993	987	1,507	34	1,486	1.34
Capital expenditures	1,347	507	858	49	490	0.97
R&D	241	0	24	0	217	0.93
Employees (in 000s)	42	8	20	1	21	1.15
<u>Efficiency measures</u>						
Sales/assets	0.60	0.56	0.52	0.53	0.09	1.03
Income/sales	-0.02	0.00	-0.14	-0.13	0.12	2.00*
Income/assets	0.03	0.02	-0.03	-0.03	0.06	2.41*
Cash flow/sales	0.29	0.27	0.24	0.26	0.05	1.01
Cash flow/assets	0.18	0.22	0.13	0.12	0.05	1.67
Capital expenditures/assets	0.12	0.11	0.13	0.11	-0.02	-0.64
R&D/assets	0.00	0.00	0.00	0.00	0.00	0.69
Market/book equity	3.63	3.11	5.85	3.40	-2.22	-1.19
<u>Leverage measures</u>						
Leverage (market)	0.31	0.32	0.45	0.40	-0.14	-2.37*
Leverage (book)	0.60	0.67	0.74	0.71	-0.14	-1.51
CRSP sample size	18	18	18	18		
CRSP/Compustat sample size	17	17	18	18		

This table presents averages of the ex-ante size, efficiency and leverage characteristics of public incumbent acquirers and public incumbent targets in intra-industry mergers in the U.S. telecommunications industry during the 1996 to 2001 period. The sample is comprised of mergers in which both acquirers and targets were incumbent to the telecom industry at the beginning of 1996. All variables are measured as of year-end 1995. Assets (book value) is firm total assets. Assets (market value) is calculated as firm equity (market value) + book assets – book equity – deferred taxes. Equity (book value) is total firm common equity, calculated as common stock outstanding + capital surplus + retained earnings - treasury stock adjustments. Equity (market value) is firm share price x shares outstanding. Sales is calculated as firm gross sales - cash discounts - trade discounts - returned sales/allowances. Net income is firm net income (loss). Cash flow is calculated as firm operating income before depreciation – taxes. Capital expenditures is defined as firm expenditures used for additions to property, plant, and equipment (excluding amounts arising from acquisitions). R&D is defined as firm research and development expense. Employees is the number of people employed by the firm. The ratios Sales/assets, Income/sales, Income/assets, Cash flow/sales, Cash flow/assets, Capital expenditures/assets, R&D/assets, Market/book equity are quotients of the preceding size measures (assets is firm total assets and income is firm net income). Market/book equity is firm market value equity/book value equity. Leverage (market) is calculated as 1 – equity (market value)/ assets (market

value). Leverage (book) is calculated as $1 - \text{equity (book value)}/\text{total assets}$. Firm accounting data is from CRSP/Compustat Merged. Market value is from CRSP. Size measures are expressed in means; efficiency and leverage measures are expressed in medians. The difference column reports the difference in means between the acquirers and targets. $t(\text{diff})$ is the t -statistic of the difference in means.

* Significant at the 10% level.

Table 9: Merger Participant Likelihood Regression.

<i>Dependent Variable: Acquirer = 1, All Else = 0</i>				
Explanatory Variables	I	II	III	IV
Assets (book value)	0.550** (6.07)		0.443** (4.24)	
Equity (market value)		0.423* (3.64)		0.311 (1.98)
ROS		1.879 (0.15)		3.790 (0.46)
ROA	22.264 (2.17)		21.753* (2.85)	
Industry error	-4.379 (0.45)	2.845 (0.62)	-4.511 (0.56)	2.835 (0.58)
V/B	-1.436 (0.33)	0.709 (0.18)	-1.347 (0.35)	0.680 (0.16)
Constant	-4.45 (1.39)	-7.09** (4.83)	-3.00 (0.68)	-6.03* (3.82)
Log likelihood	-17.06	-18.67	-14.15	-16.14
χ^2	13.36	9.00	12.78	7.91
Observations	80	74	52	49

This table presents the results from logit regression analysis of the merger activity of public firms in the U.S. telecommunications industry for the 1979 to 2009 sample period. The dependent variable in Models I and II takes on a value of 1 if a public industry firm acquires another industry firm, or 0 if a public industry firm exits the industry via bankruptcy/delisting, exits the industry via merger, or survives the industry but does not acquire another firm. The dependent variable in Models III and IV eliminates the outcome “survives the industry but does not acquire another firm”. Assets (book value) is the natural log of firm total assets. Equity (market value) is the natural log of the product of firm share price x shares outstanding. ROS, or return on sales, is firm cash flow/sales. ROA, or return on assets, is the sum of firm net income and interest income scaled by total assets. Industry error is a proxy for industry-level stock misvaluation. V/B, or value/book, is a proxy for the level of firm growth options. Industry error and V/B are estimated using the Rhodes-Kropf, Robinson and Viswanathan (2005) M/B decomposition. Wald chi-square statistics are reported in parentheses.

** Significant at the 5% level.

* Significant at the 10% level.

Table 10: Regression of Annual Merger Count on Explanatory Variables.

<i>Dependent Variable = Merger Activity (Count)</i>				
Explanatory Variables	I	II	III	IV
Economic shock index	20.86*** (2.78)			10.55 (1.26)
Annual IPOs		0.43*** (4.50)		0.45*** (4.07)
Cash flow dispersion		1.79** (2.10)		1.65* (1.76)
Dispersion in ROS			38.37*** (2.66)	-17.11 (0.97)
Industry error	1.75 (0.79)	-2.03 (1.09)	0.02 (0.01)	-1.45 (0.74)
V/B	3.24* (1.68)	-1.57 (0.93)	1.32 (0.63)	-0.83 (0.46)
Constant	-2.52 (1.08)	2.64* (2.00)	-6.68 (1.84)	4.27 (1.21)
Adj. R-square	0.21	0.55	0.20	0.55
Observations	31	31	31	31

This table presents the results from OLS regression analysis of annual merger count in the U.S. telecommunications industry on explanatory variables for the 1979 to 2009 sample period. Merger activity (count) is the number of annual mergers of public firms across the sample period. Economic shock index (Harford, 2005) is the first principal component of the median absolute changes in annual: sales/assets, net income/sales, capital expenditures/assets, R&D/assets, ROA, sales growth, and employee growth for firms in the industry. Annual IPOs is the annual count of initial public offerings in the industry. Cash flow dispersion is the cross-sectional standard deviation of firms' quarterly cash flow shocks. Dispersion in ROS is the cross-sectional standard deviation of firms' return on sales (cash flow/sales). Industry error is a proxy for industry-level stock misvaluation. V/B, or value/book, is a proxy for the level of firm growth options. Industry error and V/B are estimated using the Rhodes-Kropf, Robinson and Viswanathan (2005) M/B decomposition. *t*-statistics are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.