Are US Industries Becoming More Concentrated?

by

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Abstract

More than 90% of U.S. industries have experienced an increase in concentration levels over the last two decades. Firms in industries with the largest increase in product market concentration have enjoyed higher profit margins, positive abnormal stock returns, and more profitable M&A deals, suggesting that market power is becoming an important source of value. This phenomenon has been mainly driven by the consolidation of publicly-traded firms into larger entities. The increased level of concentration due to public firms' consolidation has not been offset by a larger presence of private or foreign firms. Overall, our findings suggest that the nature of U.S. product markets has undergone a structural shift that has weakened competition.

Introduction

During the second half of the 20th century, several waves of tariff reductions and deregulations drastically changed the industrial landscape of many markets (e.g., Andrade, Mitchell, and Stafford (2001), Irvine and Pontiff (2009), and Fresard and Valta (2014)). While these changes significantly reduced concentration levels in most industries, there is a common perception among market participants and regulators that this phenomenon has continued up to this day.

Contrary to these popular beliefs, this paper shows that U.S. industries have become more concentrated since the beginning of the 21st century. Common measures of industry concentration such as the number of industry incumbents and the Herfindahl-Hirschman index indicate that concentration levels have been systematically increasing in more than 90% of U.S. industries. This surprising economic phenomenon has been mainly driven by the large-scale consolidation of publicly-traded firms. In the past twenty years the U.S. has lost almost 50% of its publicly traded firms. This decline in the number of firms has been so dramatic that the number of firms these days is lower than it was in the early 1970s, when the real gross domestic product in the U.S. was one third of what it is today.

We show that the increase in concentration levels has been associated with meaningful changes in the corporate share of profits, and that the reduction in the number of firms has had implications to both corporate and asset pricing aspects of the remaining firms. Specifically, we find strong association between the reduction in the number of public firms and the remaining firms' profitability, stock returns, and investment opportunities as captured by M&A gains.

We start by examining firm profitability, and find that the return on assets of U.S. public firms has significantly increased in industries with a higher decline in the number of public

firms. To arrive at this conclusion, we regress firm-level returns on assets (ROA) on the change in number of firms in the industry, including firm characteristics and firm fixed effects, and find that the change in the number of firms in the industry is negatively correlated with profitability.[1] When we decompose return on assets into asset utilization (or sales to assets ratio) and operating profit margins, we find that the higher return on assets are mainly driven by the firms' ability to extract higher profit margins, while there is no relation between the change in the number of industry incumbents and asset utilization. The abnormal profits that firms are able to extract are consistent with higher market power and potential changes in the nature of U.S. industries.

We also show that the higher profitability of firms in markets with a declining number of competitors has important implications to their acquisition activity. We find that mergers have become more profitable to shareholders in general, and even more so in concentrated industries. Further, the market reaction is especially high for horizontal mergers in industries with fewer participants, suggesting that market power is becoming an important source of value during M&A transactions.

Finally, we find evidence that the returns to investors of the public firms increase with higher market concentration. To examine the changes to investor welfare, we look at the performance of portfolios sorted on the change in the number of firms in their respective industries. Specifically, we construct a trading strategy of buying firms in industries with the largest decline in the number of firms, and shorting firms in industries with the largest increase in the number of public firms. We find that over the period of 2001-2014, this strategy generates excess returns of 8.76% per year, after controlling for the standard risk factors. Thus, the higher profit margins that firms enjoy as a consequence of the change in concentration are reflected in

[1] We find similar results if we use the Herfindahl-Hirschman index as a measure of industry concentration.

higher profits to shareholders. Although one could argue that these excess returns are a compensation for bearing extra systematic risk (Bustamante and Donangelo (2014)), we find that firms operating in markets with few rivals tend to be less sensitive to macroeconomic shocks than other firms.

Taken together, our results suggest that the decline in the number of firms has potentially weakened competition in the U.S. To further investigate this issue, we examine whether the disappearance of such a large portion of public firms has been offset by other mechanisms that could reduce market concentration. First, using U.S. Census data, we show that private firms did not replace public firms. We calculate the share of public firms' sales in the total revenues of U.S. business enterprises and show that the resulting ratio has remained stable over time. Therefore, even though more private firms have entered the economy, their contribution to the aggregate product market activity was negligible.

Second, we examine whether the intensified foreign competition could provide an alternative source of rivalry to domestic firms. We find that the share of total imports out of the total revenues by U.S. public firms has remained flat since 2000. This finding indicates that public firms have been expanding at a similar rate as import growth, successfully weathering foreign competition, and maintaining their concentrated presence in the U.S. markets.

Third, we show that the decrease in the number of public firms has affected the vast majority of U.S. industries. Furthermore, the decrease in the number of public firms has not been driven by distressed industries, or entire business niches that have disappeared due to technological innovations or changes in consumer preferences. Instead, it has been driven by a combination of fewer IPOs, as well as high M&A activity.

We also ask what could explain the link between increase in concentration and firm profitability. Most importantly, if markets are contestable, a reduction in the number of industry rivals should have a negligible effect on the profitability of the remaining firms as the threat from new entrants keeps markets competitive. Yet, we find evidence that profit margins increase in most industries. One possible explanation for these results is that markets are becoming more concentrated due to greater barriers to entry, mainly driven by changes in technology. Henderson and Cockburn (1996) and Ciftci and Cready (2011) show that technological advances benefit from economies of scale. Given the increased contribution of computer-related technology and innovative property to the growth in output in the past two decades (Corrado and Hulten (2010)), the recent technological advances could have created barriers of entry to new firms. To support this idea in our empirical setting, we examine the relation between the change in the number of firms in the industry and the number of patents that firms generate. We find that while the association has been positive in the early period, it has reversed in the last decade. Hence, higher rate of innovation seems to be associated with industries that have become more concentrated.

To summarize, the trend of increased competition across U.S. industries has reversed in the past two decades. Markets have become more concentrated, and profit margins have increased proportionally to the increase in industry concentration. Further, the increased profit margins are not driven by increases in operational efficiency, but rather by higher operating margins, perhaps due to greater market power. Consistent with this notion, we find that higher market concentration has resulted in more profitable investment opportunities, as the market reaction to M&A announcements has become more positive, especially across horizontal deals.

Product markets have undergone a structural change that had potentially transformed the nature of competition.

Our paper findings are relevant and important to several stands of the literature. First, it adds to the existing research on evolution of product market competition (Irvine and Pontiff (2009), Hoberg, Phillips and Prabhala (2014)), as well as extensive research on the implication of product market competition to financial and investment policy of firms (see, among others, Grullon and Michaely (2007), Valta (2012), Fresard and Valta (2014)). We contribute to this literature by demonstrating that surprisingly, product markets have become more concentrated in the past two decades, and the trend has affected a wide spectrum of the remaining firms' operations.

Second, the paper is related to the literature on the institutional aspects of listings and de-listings. For example, Gao et al. (2013) and Doidge et al. (2013) show that the number of IPOs has decreased dramatically in the early 2000s. In a contemporaneous paper, Doidge et al. (2015) examine the disappearance of U.S. firms from international and regulatory perspectives. Our study complements and extends theirs by exploring the product-market implications of the decrease in the number of public firms.

Finally, our results help understand the motives behind the phenomenal surge in M&A deals over the past few years, widely discussed in the financial press. For example, a recent article by the WSJ (June 27, 2015) shows that in 2015 firms have been merging "at an unseen pace", and argues that "there is a competitive and strategic pressure to act." Our results offer a potential explanation for this phenomenon by demonstrating that mergers have become more profitable over time. We show that the excess profits may be driven by higher market power, thus emphasizing the importance of economy of scale.

The paper is organized as follows. Section I describes the sample selection procedure and documents the systematic decline in the number of public firms and the increase in economy-wide concentration levels. In Section II we investigate the relation between profitability and the declining number of publicly-traded firms. Section III examines whether market power considerations are becoming an important source of value during M&A transactions, and Section IV examines the asset pricing implications. Section V examines whether the disappearance of public firms over the last two decades can be explained by the increasing role of private firms, foreign competition, and/or distressed industries. In Section VI we explore several alternative explanations for the increase in concentration of U.S. industries. Section VII concludes the paper with several policy recommendations.

I. Changes in Industry Concentration

I.A. Data

Our main sample consists of all firms on the CRSP-Compustat merged dataset over the period of 1972-2014. We limit our analysis to firms incorporated in the U.S. that trade on major stock exchanges (NYSE, AMEX, and NASDAQ), and have information on their ordinary common shares traded.[2] Otherwise, we do not apply any additional filters, and include financial firms as well as utilities.[3]

Throughout the paper, we use NAICS classification to define a firm's industry. Relying on NAICS, rather than SIC, provides several advantages.[4] First, NAICS codes have a greater level of detail about a firm's activity than SIC, so that NAICS has twice the number of aggregate

[2] For robustness, we repeat the analysis including firms incorporated outside of U.S., as well as ADRs. The pattern of the change in the number of firms and HHI is similar to the one presented here, but is of a smaller magnitude.
[3] Excluding financial firms and utilities from our analysis does not affect any of our main results.
[4] The detailed information on NAICS industry classification system can be obtained on the Bureau of Labor Statistics website at http://www.bls.gov/ces/cesnaics.htm.

industry groupings as SIC. Second, NAICS codes are based on a consistent, economic concept, and group together establishments that use the same or similar production processes. Under the SIC system, some establishments are classified according to production processes, but others are classified using different criteria, such as class of customer, which creates inconsistent groupings across firms. Finally, since all government agencies have switched to NAICS classification by the year of 2003, using NAICS industry code system allows for an easier merge between the Compustat-CRSP data on one side, and economic indicators, provided by the US Census Bureau, and Bureau of Labor Statistics, on the other. Using SIC codes, however, does not qualitatively affect any of our results.

I.B. General Trend

In this sub-section we examine how industry concentration levels have changed over time. To investigate this issue, we report in Figure 1-A the trend in the aggregate number of publicly-traded firms over time, as well as the trend in the Herfindahl-Hirschman (HHI) concentration index. To construct the HHI index, within every NAICS 3-digit industry-year we sum up the squared ratios of firm sales to the total industry sales. Following the approach by Irvine and Pontiff (2009), we assign the industry-level HHI to each firm, essentially weighting each industry ratio by the number of public firms, and aggregate across firms in every year.

This figure shows that the number of public firms steadily increased during the first part of the sample (1972-1997). The concentration ratio, on the other hand, increased in the 1970s, but then declined in the 1980s, perhaps as a result of the deregulation wave (Borenstein, 1992; Winston, 1998; Strahan, 2003). More strikingly, in the later period there has been a sharp drop in the number of firms, from 7,054 in 1997 to 3,691 in 2014. The decrease in the number of firms has been so substantial that the current number of publicly traded firms in the economy is

similar to its level in mid 1970s, when the real gross domestic product was one third of what it is today. The HHI increased in tandem with the drop in the number of firms, indicating higher concentration. While some of the increase in the concentration ratio is negatively associated with a higher number of firms by the nature of the index construction, the evidence from the 1970s and 1980s indicates that the number of public firms does not always proxy for industry concentration. Thus, during the 1973-1990 period the correlation between the number of firms and the HHI was 0.19, and for a large part of the period both metrics were moving in the same direction. Yet, during the second half of the sample the correlation between these two variables dropped to -0.79. The significant change in correlation between the two periods suggests that our evidence is more than a simple mechanical relation, and points to a structural change in the nature of market competition.

To further support the argument that U.S. industries have undergone a structural change, we look at historical changes in the size of publicly traded firms. Every year we calculate the mean and median size of public firms (based on total sales in constant dollars of 1970), and present the resulting time-series in Figure 1-B. Our findings indicate that while there has been a decreasing trend in the firm size starting from the 1970, it has reversed in the late 1990s, so that an average [median] U.S. firm is almost three times as large now as it was 20 years ago. Combined with a decrease in the number of firms, larger size of remaining publicly traded firms provides additional evidence of an increase in industry concentration.

Next, we explore the prevalence of the decline in the number of public firms across industries. We start by calculating the percentage change in the number of firms in each industry during the 1997-2014 period. We use 1997 as our starting period since this is the year in which the number of public firms in our sample peaks. Figure 2-A shows that the decrease in the

number of firms is a general pattern. 67 out of 71 industries have experienced a negative change over that time period. Moreover, the largest mass of the distribution is concentrated in the most extreme range, indicating that half of the industries have lost over 50% of their publicly traded peers. Next, we look at the industry-level changes in HHI index. To be able to compare the changes across industries with different levels of concentration ratio, for every industry we calculate a percentage change in HHI index over the 1997-2014 period, and present the distribution of all the changes in Figure 2-B. The results point to a similar trend. The concentration ratio has been increasing across most industries, and the magnitude of the change is primarily concentrated in the extreme range of the spectrum.

One potential issue with using the Compustat-based HHI index is that this measure does not include private firms. To address this issue, we use the HHI index provided by the U.S. Bureau of Census, which includes revenues by both public and private firms. This measure is based on the 50 largest firms in each industry, and is limited to manufacturing industries. Since Ali, Klasa, and Yeung (2009) demonstrate that Compustat and Census-based concentration ratios have low correlation and may lead to opposite conclusions, we want to ensure that the increase in concentration is not sensitive to the choice of concentration measure. In Figure 2-C we examine the changes in concentration ratios using this alternative measure of the HHI, and find that trend of increased concentration remains robust to including the share of sales generated by private firms.[5]

The results in this subsection consistently point to an increase in product market concentration over the past two decades. There are fewer public firms in the U.S., which have

[5] This concentration ratio is available at a 5-year intervals, for calendar years that end in 2 or 7 (Economic Census years), when Census conducts more comprehensive data collection. The Bureau of Census has not yet released information for the year 2012.

become bigger and more prominent in their particular markets. The pattern is economically large, robust to different measures of product market concentration, and prevalent across the vast majority of U.S. industries.

I.C. The Decomposition of the Change in the Number of Public Firms

We investigate the mechanism through which the decline in the number of firms occurred. Generally speaking, there are three possible vehicles: change in the number of IPOs, change in the number of firms delisting due to bankruptcy, and change in the pace of M&A activity.

To understand which component of entry and exit is responsible for the systematic decline, we examine firms' entries and exists, as reported in CRSP. Since most additions in the 1970-1973 period were driven by the introduction of NASDAQ, we perform the analysis of this subsection starting from 1974. To identify an entry, we record the first year that a firm appears in the sample as its entry year. A new firm enters public markets primarily through an IPO process, or a spin-off from another firm.[6] To identify the source of a firm exit, we rely on the delisting information on CRSP, and classify the delisting codes into three categories: mergers, bankruptcy and liquidations, and other exits. Other exits primarily include delisting by current exchanges due to insufficient capital; not meeting financial guidelines for continued listing due to share price falling below an acceptable level; or insufficient flow of assets. This category can

[6] Additional cases of a new firm entry include cross-listings of domestic firms, listings by foreign firms, and mergers. We exclude cross-listing events from our sample, as we are interested in the first time the company becomes public, rather than the number of exchanges it trades on. We also limit our sample to US-based firms, so that foreign listings are also excluded. Another reason for a firm appearance in CRSP is as a result of a merger deal, when the newly consolidated firm receives a new PERMNO, and both the bidder and the target exit the sample. Although this recording method reduces the precision of a firm entry classification, it does not bear a systematic effect on the differences between entries and exits, as it increases the level of both. In addition, in unreported results we find that our time-series of CRSP-based entries has a 0.63 correlation with the time-series IPO activity (as reported on Jay Ritter's website at http://bear.warrington.ufl.edu/ritter/ipodata.htm), suggesting that it captures the time-series trend fairly well.

be broadly viewed as another type of bankruptcy, when a firm is unable to sustain its publicly traded status due to a poor financial performance.

Figure 3 presents the decomposition of the change in the number of public firms into entries and exits, with exits further decomposed into mergers, liquidations, and other exits. The rate of firm entries increases through the earlier period, but reverses in the late 1990s, consistent with previous studies that document the disappearing of IPOs (e.g., Gao, Ritter, and Zhu (2013)). However, the decline in IPOs is not the only mechanism behind the disappearance of public firms. The level of M&A activity starting from early 2000 has also remained stable. In fact, the exit of public firms as a result of M&A deals is sufficiently high to offset all the entries into the public market during most years of that period. This contrasts with the trend during the 1980s and most of the 1990s, in which the rate of firm entries into the market was almost twice as high as the rate of mergers.

To further analyze the time-series changes in the M&A activity, Figure 4 shows all the M&A deals completed by U.S. public firms over the period of 1980-2013. Notably, the last two decades have been characterized by much more intense M&A activity than in the 1980s and early 1990s. Excluding the merger wave, there was an average of 486 mergers a year during the 1980-1995 period, and 713 mergers per annum over the years 2001-2013. When we look separately at public and private targets, we find that the number of M&A deals per year that involved public targets was only slightly larger during 2001-2013 than over the period of 80s through mid-90s (an average of 157 and 146 mergers a year, respectively). However, when we scale these numbers by the average number of publicly traded firms over each corresponding period, we find that the likelihood of a public firm to become an acquisition target in a given year has essentially increased by 23%. The spike in the M&A activity across private firms, and

the increase in the probability of being acquired among public ones provide additional evidence of product market consolidation over the past two decades, and further supports the idea that the reduction in the number of public firms is driven by structural changes in the nature of M&A transactions.

To summarize, there are primarily two mechanisms that are responsible for the decline in the number of public firms. The first is a decline in the number of IPOs, and the second is the higher rate of M&As relatively to the number of remaining public firms. Firms do not exit the public markets due to liquidation or involuntary delisting. Figure 3 illustrates that the number of exits due to liquidation, as well as involuntary delisting (other exists) has remained low, even after accounting for the 2007-2009 recession.

II. The Economic Implications of the Decline in the Number of Public Firms

In this section we test whether the systematic decline in the number of publicly-traded firms has economic implications, and explore whether it has an effect on the fundamentals of the remaining firms. We first analyze the relation between profitability and the change in the number of industry incumbents in a panel-data setting, while controlling for other factors that could influence firms' profitability levels. Next, we examine the potential sources of abnormal profitability.

II.A. Number of Firms and Profitability

If markets are contestable (e.g., few barriers to entry), then even firms operating in highly concentrated industries should behave as if they had many competitors (Baumol (1982)). This implies that profitability should not be affected by the change in the number firms in an industry

because the threat of potential entrants would not affect the competition.[7] Alternatively, if there are significant barriers to entry (e.g., economies of scale, technological barriers, large capital requirements, etc.), then firms operating in industries that become more concentrated could generate larger abnormal profits by exercising market power. Under this scenario, one would expect firms' profitability levels to increase as the number of industry participants declines as firms compete against fewer competitors without facing the threat of entry by potential rivals. In this sub-section we test these two hypotheses.

Using a sample consists of all observations in the Compustat-CRSP dataset over the period 1972-2014, we examine the relation between profitability and the change in the number of firms in an industry by estimating the parameters of the following model:

$$ROA_{ijt} = \alpha_i + \alpha_t + \beta_1 \log(Assets_{it}) + \beta_2 \log(Age_{it}) + \beta_3 \log(Number\ of\ Firms_{jt}) + \varepsilon_{ijt} \quad (1)$$

where *ROA* is the operating income before depreciation (Compustat item OIBDP) scaled by the book value of assets (item AT), α_i is a firm-fixed effect, α_t is a year-fixed effect, *Assets* is the book value of total assets, *Age* is the time (in years) from the firm's CRSP listing date, and $Number\ of\ Firms_{jt}$ is the total number of public firms in industry *j* at time *t*. We define industry using a firm's three-digit NAICS code.[8] To control for potential time-series dependence in the residuals, we cluster the standard errors at the firm level. Since we include firm-fixed effects and firms rarely switch industries, the number of firms can be interpreted as the change in the number of firms relative to the industry mean. The inclusion of firm fixed effects also helps address a number of alternative explanations. For example, if profitable firms systematically

[7] Baumol (1982) argues that "in the limiting case of perfect contestability, oligopolistic structure and behavior are freed entirely from their previous dependence on the conjectural variations of *incumbents* and, instead, these are generally determined uniquely and, in a manner that is tractable analytically, by the pressures of *potential* competition."

[8] As a robustness check, we also define industry using three-digit SIC codes and Fama and French 48 industries grouping system. Our results are unaffected by these alternative definitions.

acquire the non-profitable ones, this matching could lead to a mechanical relation between the number of firms and profitability. The inclusion of firm fixed effect addresses this concern by focusing the analysis on the within-firm variation in profitability over time. .

We use *ROA* as a proxy for profitability because this metric is not affected by changes in capital structure or by the presence of unusual and nonrecurring items. Further, simulation evidence (Barber and Lyon (1996)) suggests that *ROA* is superior to other measures of profitability in detecting abnormal operating performance. Following Bertrand and Mullainathan (2003) and Giroud and Mueller (2010), we include firm size and age in all our regressions to control for the effect of economies of scales and learning on profitability. We also include firm-fixed effects to control for unobserved time-invariant firm-specific characteristics and year-fixed effects to control for unobserved time-specific shocks affecting all firms. To mitigate the effect of outliers, we winsorize *ROA* at the 1% and the 99% of its empirical distribution.

The first column of Table 1 reports the coefficients of Equation 1 estimated over the period 1972-2014. Consistent with the idea that industries with fewer firms tend to be more profitable, we find that the relation between *ROA* and the change in the number of industry participants is negative and statistically significant at the 1% level. As for the economic significance, the magnitude of the effect is large; a change in the number of firms from the 75^{th} to the 25^{th} percentile leads to an increase in *ROA* of about 102 basis points (10.4% relative to the median ROA). This result shows that firms tend to generate significantly higher profits when their industry experiences a greater drop in the number of firms in that industry. More importantly, it further suggests that the decline in the number of firms is not because of declining profitability. This table also shows that profitability is positively correlated with firm size, suggesting that economies of scale are an important determinant of firms' profitability.

Most of the decline in the number of public firms occurs in the latter part of our sample (Section I). Therefore, we test whether the empirical relation between profitability and change in the number of firms has changed over that particular time period. To perform this analysis, we estimate the regression parameters of Equation 1 over three different sub-periods (1972-1986, 1987-2000 and 2001-2014).[9] Columns 2, 3 and 4 of Table 1 report the results from this analysis. Interestingly, we find that the negative relation between *ROA* and the change in the number of firms is only statistically significant over the period 2001-2014. The coefficient of *Number of Firms* in the last column of Table 1 indicates that a change in the number of firms from the 75th to the 25th percentile leads to an increase in *ROA* of about 303 basis points (29.7% relative to the median ROA). Thus, our analysis indicates that firms operating in industries with few rivals tend to earn significantly higher profits, and points to a significant structural shift over the past fifteen years in the economic relation between industry structure and firm's profitability. Figure 5 illustrates our regression results for the 2001-2014 period by depicting ROA across quintiles of change in the number of firms. To construct the quintiles, for every industry-year we calculate the deviation of the number of firms in that industry from the long-term industry mean. Next, for every firm-year we calculate net ROA by subtracting the firm-level mean ROA, and average the results within every quintile. The figure shows that the link between the number of firms and profitability is economically significant: A large drop in the number of firms in the industry (quintile 1) generates a 1% extra return, while an entry of public firms into an industry shaves more than 3% off the profit margins for all the incumbents (quintile 5).

We use alternative measures of concentration to the check the robustness or our results. First, we use the HHI at the NAICS 3-digit level using sales data from Compustat. Second, we

[9] Splitting the sample into alternative sub-periods does not qualitatively affect any of our main results.

use a composite measure that is equal to the sum of the annual rank value of the number of industry incumbents and the annual rank of the inverse value of the HHI. Our main results are unaffected by the use of these alternative measures.

II.B. The Sources of Abnormal Profits

In this sub-section we investigate the sources of abnormal profits in industries with a decreasing number of competitors. One potential explanation for the increase in profitability in industries with a declining number of firms is that increasing barriers to entry are making markets less contestable over time. Thus, the decline in the number of firms could allow the remaining firms to enjoy wider profit margins by setting higher prices relative to production costs. Alternatively, the consolidation of firms within an industry could increase efficiency. For example, a large firm could have more flexibility in reallocating its existing resources in a way that extracts the highest productivity from any unit of capital, consequently increasing firm profitability. To test the validity of these two explanations, we examine whether the negative correlation between profitability and change in the number of firms in an industry stems from higher profits margins, higher operational efficiency, or both.

We start by decomposing return on assets into two components: the *Lerner index* and the *asset utilization* ratio. The *Lerner index* measures the extent to which prices exceed marginal costs (price-cost margins), while the *asset utilization* ratio measures how efficiently firms manage their assets to generate sales. Following Aghion et al. (2005), we define the *Lerner index* as operating income before depreciation (Compustat item OIBDP) minus depreciation (item DP) scaled by total sales (item SALE). We exclude depreciation from operating income to

take into account the cost of physical capital (Hall and Jorgenson (1967)).[10] *Asset utilization* is simply defined as total sales scaled by total assets. As in the case of *ROA*, we winsorize the *Lerner index* and the *asset utilization* ratio at the 1% and the 99% of their empirical distributions.

Using the same specification as in Equation 1, we estimate the coefficients of the model using the *Lerner index* and the *asset utilization* ratio as dependent variables. The results from this analysis are reported in Table 2. Panel A shows that over the period 1972-2014 the *Lerner index* is negative correlated with the change in the number of firms in an industry. This empirical relation is not only statistically significant, but also economically significant. The magnitude of the coefficient suggests that a change in the number of industry incumbents from the 75th to the 25th percentile leads to an increase in the *Lerner index* of about 477 basis points (65.2% of the median *Lerner index*). The last three columns of Table 2 show that the negative relation between the *Lerner index* and change in the number of industry incumbents is only statistically significant over the period 2001-2014, and the coefficient of the *Number of Firms* estimated over this period is significantly larger than the one estimated over the entire sample.

In Panel B of Table 2 we examine the effect of the number of firms in an industry on operational efficiency. The first column of this table shows that the relation between asset utilization and number and firms is statistically insignificant over the period 1972-2014. In addition to this, the positive sign of the coefficient of the *Number of Firms* cannot explain the negative relation between *ROA* and the change in the number of industry incumbents documented in Table 1.

In summary, the empirical relation between profitability and the change in the number of firms appears to be mainly driven by the negative effect of the number of industry rivals on

[10] Our main results are qualitatively similar if we use a version of the Lerner index that does not exclude depreciation from operating income.

profit margins. In contrast, there is no evidence that this empirical relation is driven by improvements in operational efficiency. These results are consistent with the idea that the systematic decline in the number of public firms allows firms to generate abnormal profits by increasing market power, rather than by creating an incentive across firms to enhance the efficiency of their existing assets.

III. The Effect of Changes in the Number of Publicly-Traded Firms on the Market Reaction around M&A Announcements

Do changes in the number of firms affect investors' reaction to mergers and acquisitions announcements? From a theoretical perspective, mergers can create value by improving efficiency (e.g., economies of scale and scope, synergies, elimination of duplicate functions) or by increasing market power. The latter effect should become more dominant as concentration increases and competition declines. We disentangle these two effects by examining how a firm's product market environment affects the market reaction around mergers and acquisitions announcements. If investors perceive that the wealth effects in mergers are partially due to increases in market power, then the market reaction to these corporate events should be stronger in industries with few rivals. The rationale for this is that, keeping everything else constant, mergers in concentrated markets are more likely to further reduce competition than mergers in competitive markets. This assumption is consistent with the antitrust polices of the Federal Trade Commission and the Department of Justice of mainly investigating or blocking mergers in highly-concentrated markets.

To examine this issue, we gather data from the Securities Data Corporation's (SDC) Mergers and Acquisition database. Our sample consists of mergers and acquisitions transactions over the period 1980-2014 that meet all of the following conditions: (i) percent of ownership by acquirer prior to event is less than 50%; (ii) percent of ownership by acquirer after event is more

than 50%; (iii) both acquirer and target are identified as public firms (since we are interested in total market reaction, to both public and target firms); (iv) acquirer and target firm have different identifiers; (v) the transaction is completed; (vi) return data around the announcement date is available on CRSP; and (vii) offer price is available on SDC.

In our tests, we focus on the change in the combined value of the target and the acquiring firm to gauge the magnitude of the total wealth creation around the merger announcement. To this end, we calculate the cumulative abnormal return (CAR) of the combined firm over a three-day event window [-1, 1] around the merger announcement:

$$Combined\ CAR_{i,t} = \frac{MV_{A,t+1}+MV_{T,t+1}}{MV_{A,t-1}+MV_{T,t-1}} - 1 - r_{CRSP,t-1,t+1} \quad (2)$$

where t is the announcement date of the transaction, MV_A (MV_T) is the market value of equity of the acquiring (target) firm, and $r_{CRSP,t-1,t+1}$ is the cumulative return on the CRSP value-weighted market portfolio from t-1 to t+1. Using a similar approach, we also calculate the cumulative abnormal returns for the target firm (*Target CAR*) and the acquirer (*Acquirer CAR*). We compute these returns to examine how the number of firms in an industry affects the ability of the target and the acquiring firm to capture the economic gains from a merger.

To examine the effect of the change in the number of firms on cumulative abnormal returns, we estimate the parameters of the following model:

$$CAR_{ijt} = \alpha_t + \alpha_j + \beta_1 B/M_{T,i,t-1} + \beta_2 B/M_{A,i,t-1} + \beta_3 \log(MV_{T,i,t-1}) + \beta_4 \log(MV_{A,i,t-1}) + \beta_5 \log(Number\ of\ Firms_{jt-1}) + \varepsilon_{ijt} \quad (3)$$

where α_t is a year-fixed effect, α_j is an industry-fixed effect, and B/M_T (B/M_A) is the book-to-market ratio of the target (acquiring) firm. Following the definition in Davis, Fama, and French (2000), we define the book-to-market ratio as stockholder's book equity, plus balance sheet deferred taxes and investment tax credit, if available, minus the book value of preferred stock.

Further, we cluster the standard errors at the industry level and winsorize the book-to-market ratios at the 1% and the 99% of their empirical distributions.

We include the book-to-market ratios of the target and the acquiring firm as control variables to capture the effect of investment opportunities (Jovanovich and Rousseau (2002)) and/or potential misvaluation (Shleifer and Vishny (2003)) on the wealth effects of mergers. We also include the market values as proxies for firm size to control for the potential economies of scales generated by the merger, year-fixed effects to control for the impact of merger waves and macroeconomic conditions on announcement returns, and industry-fixed effects to control for time-invariant industry factors.

Table 3 reports the estimated coefficients of Equation 3. Panel A shows the results for the specification using the cumulative abnormal return of the combined acquirer and target firms as dependent variable. Consistent with the idea that M&A transactions in concentrated industries are more likely to benefit from market power considerations, we find that the market reaction of the combined firm around M&A announcements is negatively correlated with the changes in the number of firms in the acquirer's industry. That is, our evidence indicates that investors expect synergies to be larger when the acquirer operates in an industry with fewer rivals. As in the case of profitability, the second and third columns show that the relation between *Combined CARs* and the *Number of Firms* is stronger during the post-2000 period.

In Panels B and C of Table 3 we examine the effect of the change in the *Number of Firms* on the cumulative abnormal returns of the target and acquiring firm to determine how the intensity of the change in competition in an industry affects the allocation of synergies between the firms involved in the M&A transaction. The evidence indicates that the change in number of industry incumbents has a negative effect on acquiring firms, and there is no effect on targets.

This evidence suggests that acquiring firms in more concentrated markets generate more wealth during M&A deals than those in less concentrated markets.

To further investigate the effect market power considerations value creation during M&A transactions, we test whether the effect of the change in the number of firms on announcement returns is stronger when the target and the acquirer are in the same industry (related mergers) than when the target and the acquirer are in different industries (unrelated mergers). The rationale for this test is that if the impact of the change in the number of firms on expected synergies is mainly driven by the effect of the merger on the competitive landscape of the industry, then the effect should be stronger during related mergers.

To test this hypothesis, we augment Equation 3 by including a dummy variable (*Related*) that is equal to one if the target and the acquiring firm are in the same industry, and an interaction variable equal to the product of *Related* and *Number of Firms*:

$$CAR_{ijt} = \alpha_t + \alpha_j + \beta_1 B/M_{T,i,t-1} + \beta_2 B/M_{A,i,t-1} + \beta_3 \log(MV_{T,i,t-1}) + \beta_4 \log(MV_{A,i,t-1}) \quad (4)$$
$$+ \beta_5 \log(Number\ of\ Firms_{jt-1}) + \beta_6 Related_i$$
$$+ \beta_7 Related_i \times \log(Number\ of\ Firms_{jt-1}) + \varepsilon_{ijt}$$

If market power considerations are driving our results, we should observe a negative coefficient on the interaction variable. Table 4 reports the estimated coefficients from this regression. Further supporting the predictions of the market power hypothesis, our results indicate that the negative relation between *Combined CARs* and the *Number of Firms* comes largely from related mergers. Note that the coefficient on the *Number of Firms* is now statistically insignificant while the coefficient on the interaction variable is negative and statistically significant. Once again, we find that this effect is much stronger over the post-2000 period. Furthermore, while Panel B shows that the change in the number of firms negatively

affects the market reaction of acquiring firms during horizontal mergers, Panel C shows that there is no such effect on the target firms.

Overall, the findings in this section suggest that market power considerations appear to be important source of value during M&A transactions.

IV. Change in the Number of Firms and the Cross-Section of Stock Returns

Several theoretical models predict that industry concentration could affect the cross-section of stock returns through its impact on systematic risk. Hou and Robinson (2006) argue that because barriers to entry protect firms operating in concentrated industries from non-diversifiable distress risk, these firms should have lower expected returns. More recently, Bustamante and Donangelo (2014) develop a theoretical model in which industry concentration levels can have two opposing effects on expected returns. On the one hand, low levels of industry concentration can lead to higher expected returns by reducing profit margins, and consequently, exposing firms in these markets to systematic risk. On the other hand, because the investment opportunity set of firms operating in concentrated industries is more sensitive to systematic shocks (most of their value comes from growth opportunities), these firms command higher returns. In this sub-section we test these competing theories by examining the effect of the decline in the number of public firms on expected stock returns.

We calculate the relative change in the number of firms in each industry (defined using a firm's three-digit NAICS code) over the period 1972-2014:

$$RelChg_{t-1} = (Number\ of\ Firms_{t-1}/Number\ of\ Firms_{t-2}) - 1 \qquad (5)$$

We then sort industries based on the magnitude of the change, and form the three portfolios. The high *RelChg* portfolio contains the top 10 industries, the low *RelChg* portfolio

contains the bottom 10 industries, and the middle portfolio the rest of the industries.[11] To calculate returns on year *t*, we first calculate equally-weighted and value-weighted returns by industry. After these industries are assigned to one of the three portfolios based on the relative change in the number of firms, we calculate equally-weighted industry returns for each portfolio. For value-weighted returns, we aggregate the market value of equity of all firms within an industry and calculate value-weighted industry returns for each of the three portfolios. Using this portfolio formation, we calculate monthly equally-weighted and value-weighted returns from July of year *t* to June of year *t*+1.

To control for differences in systematic risk across portfolios, we use three different asset-pricing models: CAPM, Fama and French (1993) three-factor model, and Carhart (1997) four-factor model. Table 5 reports the alphas for the three portfolios sorted on the relative change in the number of firms. Not surprisingly, Panel A shows that the differences in alphas between the high and low *RelChg* portfolios are not statistically different from zero over the period 1972-2014. When we isolate the period of the significant decline in the number of firms the results change quiet dramatically. Panels B, C, and D report alphas estimated over three different sub-periods. While there is no evidence of abnormal performance over the periods 1972-1986 and 1987-2000, we find that the differences in alphas between the high and low *RelChg* portfolios are negative and statistically significant over the period 2001-2014. Even after controlling for Fama-French (1993) three factors and the momentum factor, an investment strategy consisting of buying the low *RelChg* portfolio and shorting the high *RelChg* portfolio generates abnormal returns of about 8.76% per year. These abnormal returns are much larger in

[11] Because the relative change may have many ties, we use a dense ranking system, which means that we may have more than 10 industries in the top and bottom portfolios depending on the number of ties.

magnitude to the ones generated by other important investment strategies. For example, the momentum strategy generated a negative alpha over the same time period.

One potential explanation for these empirical results is that firms in industries with fewer rivals command higher expected returns because their investment opportunity set is extremely sensitive to macroeconomic shocks (Bustamante and Donangelo (2014)). To examine this possibility, we examine the returns of our investment strategy during one of the largest negative systematic shocks in recent history: the global financial crisis of 2007-2008. We find that the low *RelChg* portfolio outperforms the high *RelChg* portfolio over the crisis period (untabulated). These findings suggest that the alphas documented in this paper are not related to a risk premium, and point to a possible market anomaly in which investors underestimate the effect of industry concentration on stock returns.

V. Market Concentration and the Number of Public Firms: Potential Explanations

The evidence in previous sections suggests that the decrease in the number of public firms has affected the competitive landscape of U.S. industries. In this section we ask whether other mechanisms have helped sustain low levels of market concentration despite a decline in the number of public firms. We examine whether the decline is the number of public firms was offset by an increasing presence of private firms, whether foreign firms' activity filled the gap left by public firms and finally, whether the decline was particularly pronounced in distressed industries.

V.A. Substitution by Private Firms

It is possible that the decline in the number of public firms is driven by the increasing importance of private firms, especially after the approval of Sarbanes-Oxley in 2002, which significantly increased the cost of being a public entity. Consistent with this line of thinking,

Doidge et al. (2015) demonstrate that the total number of public and private firms in U.S. has increased from 4.75M in 1997 to 5.03M in 2012.

However, a simple back-of-the envelope calculation illustrates that private firms are far too small to fill in the void left by public firms. For example, the approximate size of an average private firm in 2012 was $3.4M,[12] while the size of an average publicly-traded firm was $3.6B. As a result, it takes more than 1,000 private firms to replace one public firm. Therefore, on its own, the increase in the number of private firms could not have filled the void left by the decline in the number of public firms.

It is still possible that the distribution of sales within the private firms' universe has changed over time. While private firm are on average very small, a fraction of them could become large enough to take over the product market space, previously occupied by public firms. To account for the size of private firms, we start by referring back to the Census-based HHI index, which is based on sales of both public and private firms. If some private firms were to become more dominant, we would expect to find a smaller or no increase in the Census-based industry concentration measure. Yet, the increase in Census-based HHI index (Figure 2-C) is similar to the increase we observe based on Compustat-based HHI index (Figure 2-B). Thus, private firms did not become large enough to dilute the higher levels of product market concentration, driven by the disappearance of public firms.

Since the importance of manufacturing industries in the overall economy has also been also declining over the past several decades, we next ensure that our conclusions regarding the role of private firms are valid when we look beyond the manufacturing sector. As Census-based

[12] To arrive at this number, we obtain total revenues and the number of private and public firms from the U.S. Bureau of Census Statistics of U.S. Businesses report. We subtract the sales of all public firms (based on Compustat data) from the total revenues, and divide it by the total number of firms net of the number of public firms.

HHI index is not available for non-manufacturing industries, we perform a different type of analysis and examine the economic importance of publicly-traded firms by looking at the share of sales by public firms out of the total sales by public and private firms. If public firms were displaced by private firms, then one would expect the public-to-total sales ratio to decline over time. We obtain data on total revenues of public and private firms from the U.S. Census Bureau (similarly to the concentration ratio, it is only available at five-year intervals).[13] To construct our measure of interest, we sum up the sales of all public firms based on Compustat data, and divide that sum by total sales of public and private firms, as reported by Census. Similarly, we calculate the ratio of the number of public firms to the total number of firms in U.S. economy.

Figure 6-A shows that the share of public sales in the total revenues of U.S. business enterprises has remained stable, and if anything, has increased over time. Therefore, even though more private firms have entered the economy, their contribution to the aggregate product market activity was negligible. To zoom in on a potential role of large private firms, we repeat our analysis for the subsample of firms with sales over $100M (the largest size category classified in U.S. Businesses report). The results, presented in Figure 6-B, depict a similar picture. The share of public firms in the total revenues of large corporations has remained flat, demonstrating that although the number of public relative to the private firms has dropped, public firms have continued to dominate the U.S. economy. Thus, even within the subsample of large firms any substitution of public firms by private ones has been economically small.

For robustness, we also calculate the aggregate revenues of publicly-traded firms as a percentage of the U.S. gross domestic product. Consistent with the evidence in Gabaix (2011), we find that despite their shrinking numbers, public firms still represent a large fraction of the

[13] The historical data on US businesses are obtained from U.S. Businesses (SUSB) report, managed by the U.S. Census https://www.census.gov/econ/susb/historical_data.html.

U.S. economy, as the contribution of their sales to the total GDP has remained stable over time (unreported).

V.B. Distressed Industries

In this subsection we address the possibility that the increase in industry concentration could be driven by distressed industries. Changes in consumer tastes along with technological changes (e.g., advances in computers and telecommunications) have made some industries obsolete, potentially leaving few large publicly-traded players, but eliminating the majority of smaller private incumbents. Therefore, the reduction in the number of firms could be driven by industries that are shrinking due to a declining demand for their products, and therefore, experience extremely low entry rates into the public markets.

The decomposition of exit reasons by public firms (Figure 3) further confirms that liquidation and involuntary listings are not the reason behind the decline in the number of public firms. In fact, the level of delisting cases due to those reasons has decreased over time. Taken together, our results are the opposite of what we would expect to find if the decline in the number of public firms were driven by distressed or declining industries. In contrast, they suggest that the remaining firms are doing well and expanding at a persistent and positive rate.

V.C. Substitution by Foreign Firms

Since the 1970s, the globalization process has significantly increased the volume of international trade across countries. Consequently, if foreign firms have been filling the gap left by the disappearing U.S. public firms, then it is possible that the level of product market competition in U.S. industries may not have been adversely affected by the systematic decline in the number of public firms over the last two decades.

To evaluate the impact of foreign competition on U.S. publicly-traded firms, we obtain import data at the industry level, and calculate the proportion of sales by foreign firms to sales by domestic public corporations. Specifically, we scale the aggregate import volume by the total revenues of publicly traded firms, and examine the change in this ratio over time. We obtain the information on U.S. International Trade Data from the public releases of the U.S. Census Bureau.[14] We sum up the revenues of public firms for every NAICS 3-digit level industry, and calculate the ratio of imports to the total revenue of public firms (industries with no imports data as well as industries with no presence of public firms are excluded from the analysis). To aggregate the results across industries, we weigh each industry ratio by the number of public firms, consistent with the analysis in Section I.

Figure 7 summarizes the results. The mean ratio does not exhibit any consistent pattern, and the median import-to-sales ratio exhibits a slight decrease. In general, these findings indicate that public firms have been able to successfully weather foreign competition. The idea that foreign firms have been filling the gap left by U.S. public firms is not supported by the data.

VI. Discussion

So far we have shown that the decline in the number of firms has a real effect on the corporate landscape: remaining firms become more profitable, profit margins increase primarily due to in increased profit margins (and not due to increased efficiency), and M&A transactions, especially those done within an industry, generate greater wealth gains to acquiring firms' shareholders increase. What are the causes for this change in the competitive landscape? While

[14] The data is available at http://censtats.census.gov/naic3_6/naics3_6.shtml. Unfortunately, the information on foreign trade at a NAICS level is available starting from year 2000 only, so we limit our analysis to the period of 2000-2013.

gauging the channel at work in a causal way is a challenging task, we can think of a few possible factors that contribute to the decline in the number of firms and competition.

The first factor we consider is the change in monitoring over M&A transactions in the past 15 years. Several studies document the importance of regulatory changes in explaining the volume of M&A activity of US firms (Mitchell and Mulherin (1996), Kaplan (2000)). While no new M&A reforms were implemented in the past two decades, the majority of this period overlapped with the presidency of George W. Bush. His view on antitrust laws was that they need "to be applied where there are clear cases of price fixing", and there should be no other roles for antitrust enforcement (Harty, Shelanski, and Solomon (2012)).

To evaluate the impact of George W. Bush's administration on merger antitrust enforcement, Table 6 summarizes horizontal merger investigations conducted by the Federal Trade Commission over the periods 1996-2003 and 2004-2011. This table shows the number of FTC requests (formally known as Hart-Scott-Rodino (HSR) second requests), which are usually triggered during transactions that could potentially affect competition over time. The number of requests has dropped from 281 over the 1996-2003 period to 183 over the 2004-2011 period. The change is even more dramatic when evaluated at a per year basis. Interestingly, the later period includes the first presidency term by Barack Obama, who joined the office in 2009, and emphasized aggressive antitrust enforcement as part of his presidential campaign. Yet, while merger challenge rates increased under President Obama, their rate was only 1.5%, compared to the rates of 0.75% and 0.9% under President Bush.[15] In addition, Crane (2012) shows that from 2007 to 2008, the Bush administration made 52 second requests, while from 2010 to 2011, the Obama administration made 53 requests.

[15] "How antitrust authorities view mergers and acquisitions", InsideCousel, March 26, 2013.

Clearly we should be very careful with drawing causal inferences from this analysis. Yet, given the positive correlation between the more relaxed compliance requirements and the decrease in the number of firms, it is possible that fewer regulatory barriers could have direct implications on the product market competition and the level of industry concentration. It increases the aggregate M&A activity, especially deals between large public firms, which further reduces the number of public firms. Low antitrust enforcement also allows for mergers with more market power potential, leading to a higher market reaction and wider profit margins.

Another potential source of industry consolidation is technological changes. Over the past 60 years the investment in tangible capital as a proportion of the total output has remained flat, while the investment in intangible assets has doubled (Corrado and Hulten (2010)). Public adoption of the Internet in late-1990s, as well as the popularization of personal computers around the same time, has had a large impact on productivity and growth. Corrado and Hulten (2010) quantify the sources of growth in output and demonstrate that during the 1995-2007 period the contribution on intangible capital, and its components, such as computerized information, innovative property, and economic competencies has doubled. Thus, the innovation-related intangible inputs have been increasingly important to the U.S. economy growth.

Could technological advances, as well as innovation, benefit from economies of scale and firm consolidation? Studies in industrial organization examine this issue by estimating the effects of economies of scale on R&D. Although Schumpeter (1942) proposes that larger firms are better positioned than smaller firms to implement and successfully exploit R&D efforts, the empirical evidence has arrived at mixed conclusions. Yet, several recent papers have presented evidence in favor of the economy of scale hypothesis. Henderson and Cockburn (1996) examine the search productivity in drug discovery and show that larger research efforts in the

pharmaceutical industry benefit from economy of scale. Ciftci and Cready (2011) derive R&D value based on its association with future earnings realizations, and show strong evidence in favor of the economy of scale hypothesis across the CRSP-Compustat universe of firms. If technology is better developed and implemented among large firms, the recent technological advances could essentially create barriers of entry to new firms, increasing the incentives of technological start-ups to exit through M&As rather than organic growth.

The benefits of economies of scale could also lead to consolidation of large firms, and exit of the small ones. To examine the validity of this claim, we report in Table 7 results from regressions relating the change in the number of patents granted (to publicly traded firms), to firm characteristics and the number of firms in the industry. We find that while the relationship between the number of firms in the industry and number of patents granted has been positive in the early period, it has reversed in the last decade, so that now firms in concentrated markets patent more. This result is consistent with the idea that advances in technology have made innovation more resource-consuming, thus essentially creating entry barriers to new firms, and encouraging them to sell their inventions to larger corporations at early stages of development. Overall, this explanation is consistent with the reduction in the number of firms, higher volume of M&A activity, and potentially higher profit margins, if more complex technology also facilitates synergy potentials.

Lastly, it is possible that the increase in market concentration is driven by a combination of factors. Doidge et al. (2015) find that other countries of comparable level of economic development and quality of financial intermediary system have not experienced a decline in the number of public firms. The uniqueness of the pattern in U.S. suggests that additional factors must have played a role along with technological advances, allowing U.S. to exploit the

consolidation benefits to a greater extent than other countries. Regulatory differences regarding competition laws in U.S. and other developed countries could be an additional contributing factor.

Consistent with this argument, existing research in law and economics suggests that although U.S. and European competition systems have similar objectives, the differences in laws, policy, and rules lead to different enforcement outcomes. For example, Fox (1997) shows that even the definition of a dominant firm differs across the two jurisdictions: leading U.S. cases treat a firm as holding monopoly power only if it control two-thirds or more of a relevant market, while according to the E.U. law even a 40% market share can constitute dominance. The recent European antitrust investigation into Google, Apple, Facebook and potentially other technological giants highlight those differences, and provide an example of Europe's increasing willingness to police powerful companies, in contrast to a "relatively hands-off approach, favored by U.S. authorities" (New York Times, April 2, 2015). Thus, the combined evidence suggests that while many countries could also benefit from the economy of scale due to technological innovations, U.S. firms were able to act on those changes due to lenient anti-trust regulations.

VII. Conclusion

This paper documents that over the last 15 years the level of product market concentration in the U.S. has increased across most industries. This phenomenon has been fueled by consolidation of public firms into mega firms.

We show that the increase in concentration levels has implications to firm performance, as it affects profitability, investment, and returns to investors. First, the decline in the number of industry incumbents is associated with remaining firms generating higher profits through higher

profit margins. The results suggest that the increase in profit margin cannot be attributed to increased efficiency but rather to increased market power. Second, mergers in industries with a decreasing number of firms enjoy more positive market reactions, consistent with the idea that market power considerations are becoming a key source of value during these corporate events. Finally, firms in industries with a declining number of firms experience significant abnormal stock returns, suggesting that considerable portion of the gains accrues to shareholders. In general, our findings suggest that despite popular beliefs, competition could have been fading over time.

The findings that firms in industries with the largest decline in the number of public firms generate higher profit margins, and enjoy better investment opportunities through M&A deals should be of interest to policy makers. While those gains appear to be transferred to the firms' shareholders, it is not clear whether the higher market concentration benefits consumers or other stakeholders. The increase in profit margins without a corresponding decline in production costs may suggest the opposite. Although it is possible that a more concentrated nature of product markets improves the quality or variety of products offered, it is unclear whether those changes are sufficient to compensate customers for the higher profit margins that the firms enjoy. Our findings may motivate policy makers to examine this issue further.

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Figure 1
Number and size of public firms

This figure shows the number of publicly-traded firms, as well as the Herfindahl-Hirschman (HHI) concentration index (Panel A) and the average [median] size (Panel B) for all U.S. publicly-traded firms that appear in CRSP and Compustat over the period 1972-2014. To construct the HHI index, every year we sum up the squared total sales of each firm in a given NAICS 3-digit industry divided by the aggregate number of firms in the industry. Firm size is based on total sales in dollar of 1970.

Figure 1-A: Number of public firms and HHI

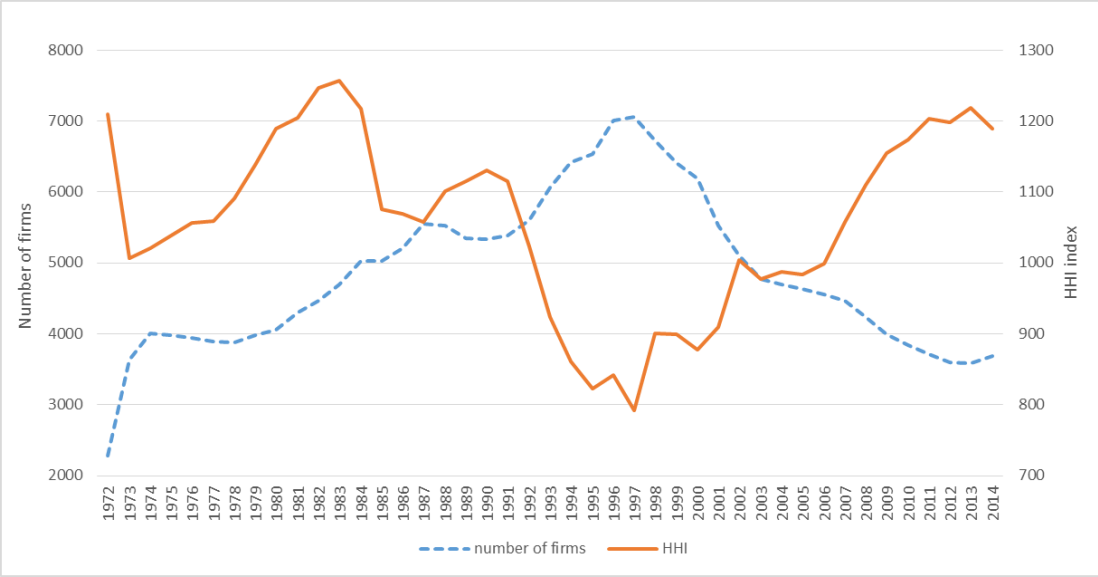


Figure 1-B: Average and median size of public firms

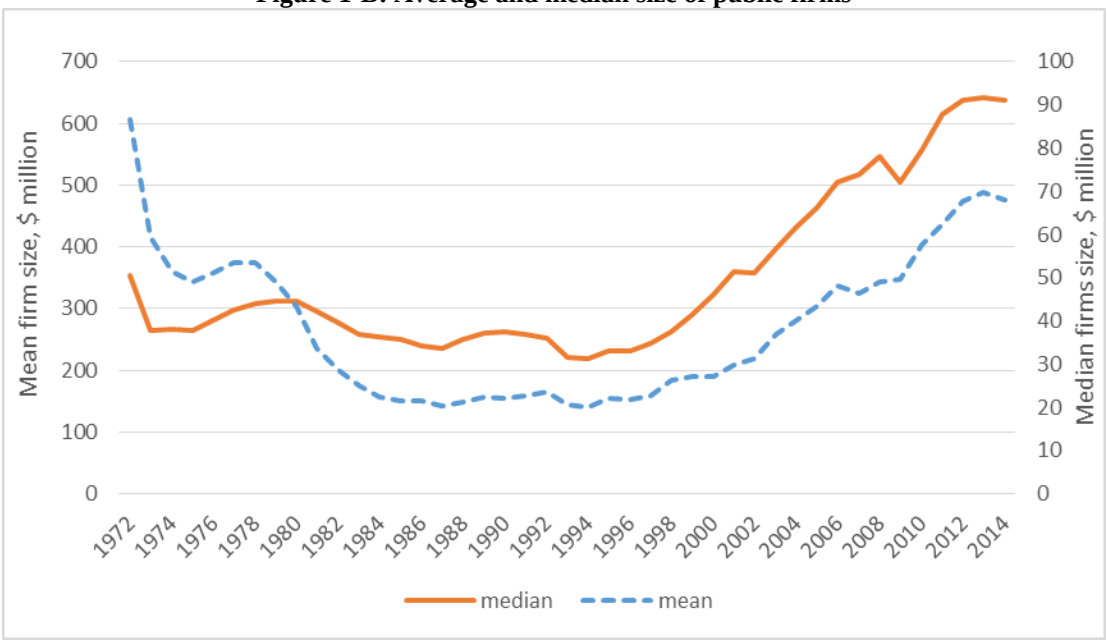


Figure 2
Change in the Number of Firms and HHI Index across Industries

This figure depicts the distribution of percentage changes in the number of publicly-traded firms in each industry (Figure A) and the HHI Compustat-based index (Figure B). The changes are calculated over the 1997 – 2014 period. Figure C shows the change in Census-based HHI index, calculated over the 1997 – 2007 period. The industries are defined based on NAICS 3-digit classification.

Figure 2-A: Change in the number of firms

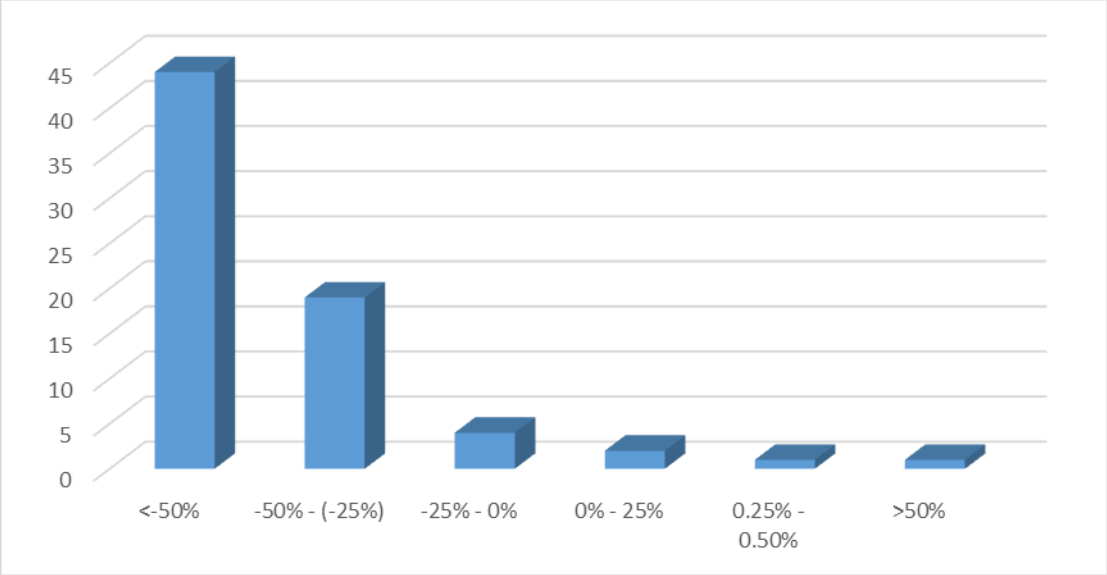


Figure 2-B: Change in the HHI index (Compustat-based)

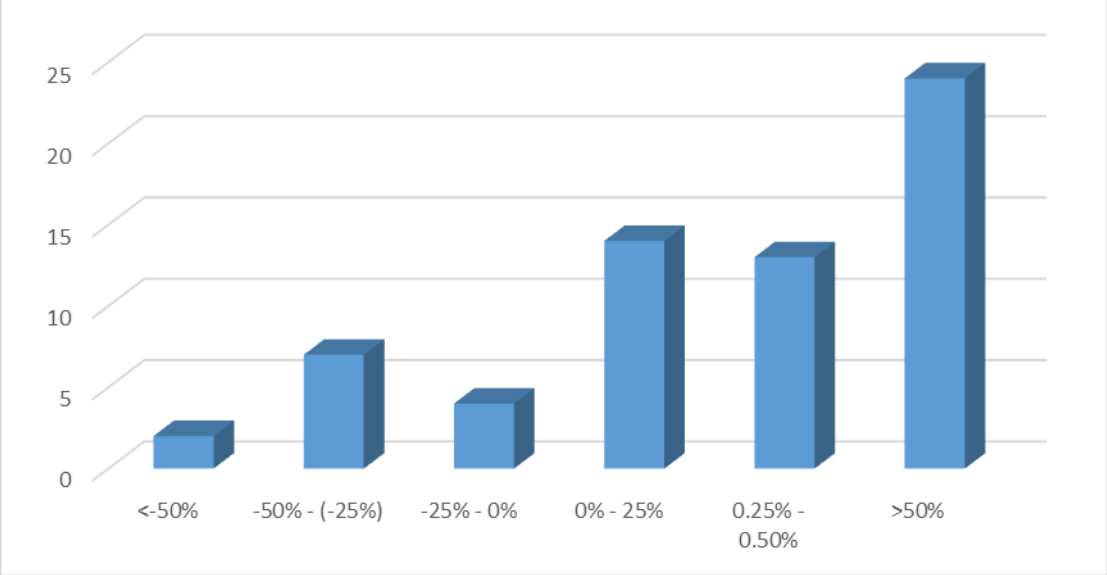


Figure 2-C: Change in the HHI index (Census-based)

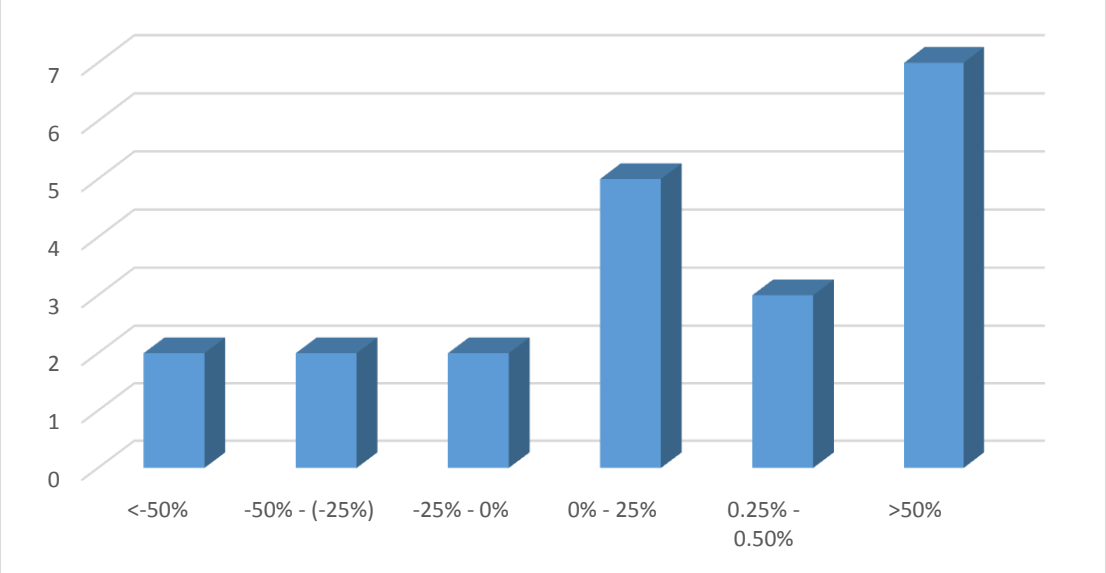


Figure 3
Entries and Exits in Public Markets

This figure decomposes the changes in the number of public firms into entries and exits, as reported in the CRSP database. Firm exits are further split into mergers (delisting codes 200 through 299); liquidations (delisting codes 400 through 499, 574, and 580); and other exits (all the other delisting codes).

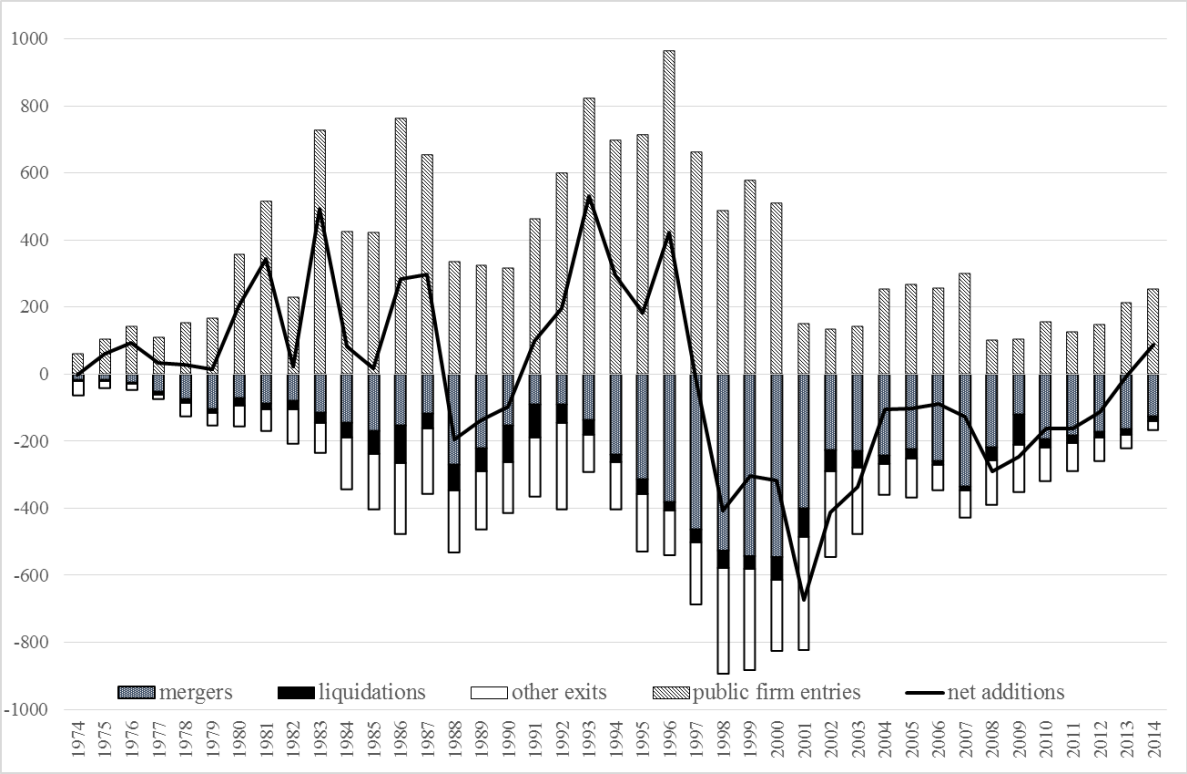


Figure 4
Mergers and Acquisitions by Public Firms

This figure presents all the M&A deals over the period of 1980-2013 where the bidder is a publicly traded U.S. firm, and the target is public or private U.S. firm. The sample includes all completed deals with transaction value of at least $1 million. We further require that the bidder acquire at least 50% of the target shares, and that the deal is completed within 1,000 days of the announcement.

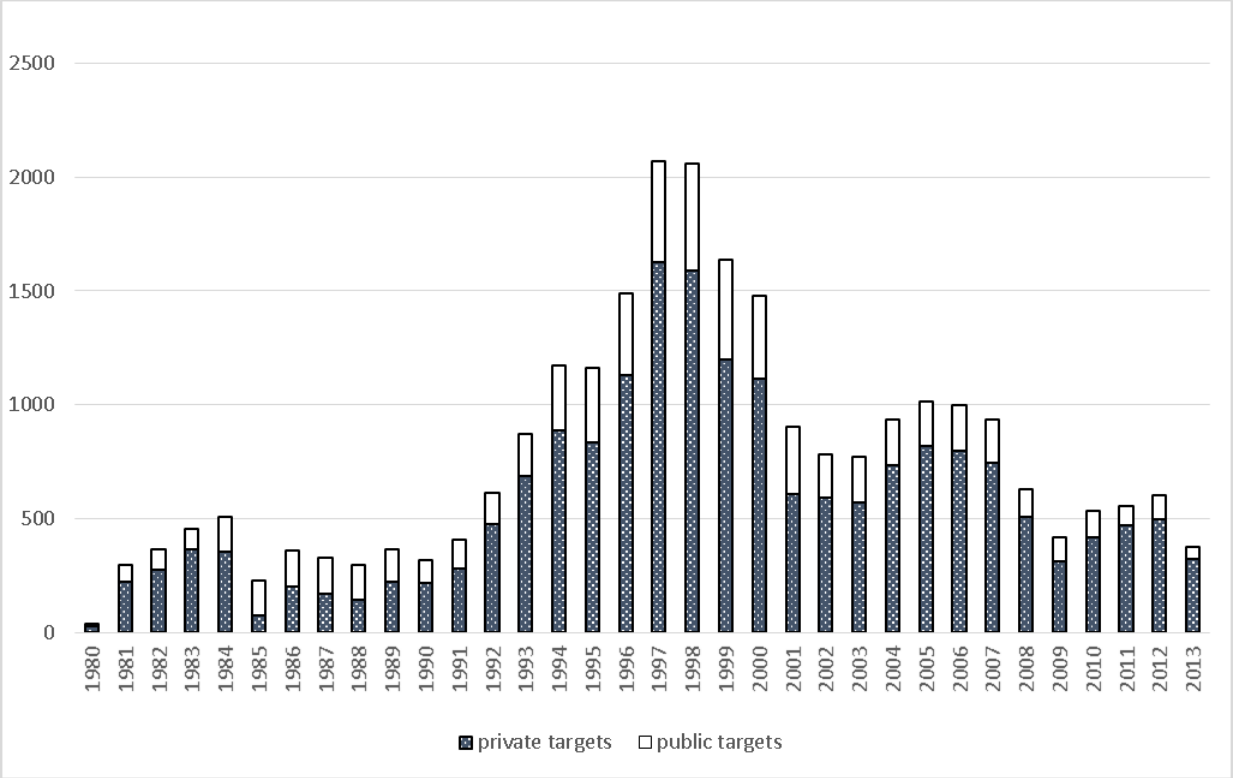


Figure 5
ROA and Change in the Number of Firms

Figure 5 shows net ROA across quintiles of change in the number of firms. The sample period is 2001-2014. To construct the quintiles, for every industry-year we calculate the deviation of the number of firms from the industry mean (over the entire sample period), and assign the resulting difference to each firm in that industry. Next, we allocate all the firms in the sample into quintiles based on the deviation in the number of firms from industry mean. Finally, we subtract the long-term firm mean ROA (also calculated over the entire sample period) from every firm-year ROA, and average the resulting net ROA within every quintile of change in the number of firms.

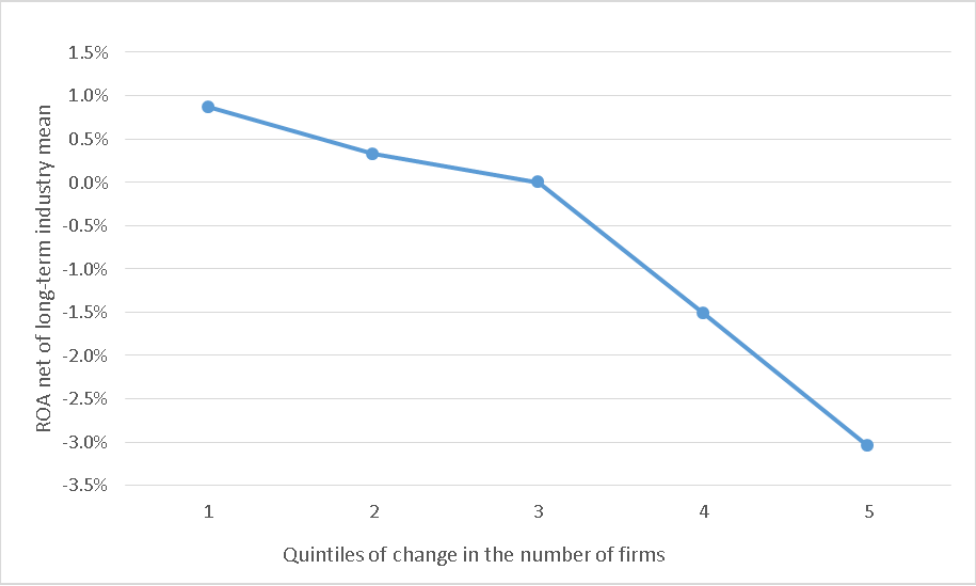
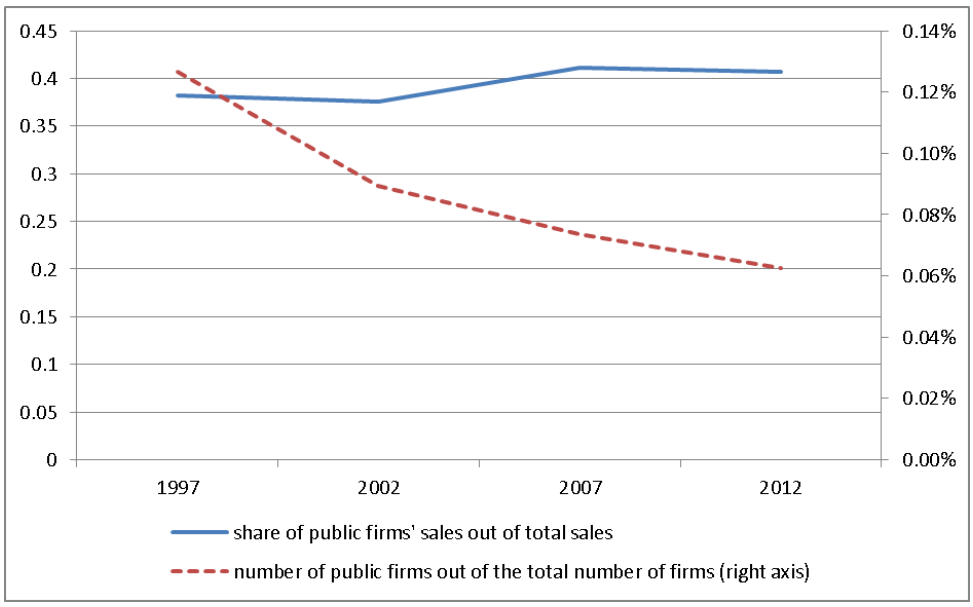


Figure 6
Total Public Firms' Revenues as a Fraction of Public and Private Firms' Revenues

This figure shows total revenues [number] of public firms as a fraction of total revenues [number of firms] of public and private firms for the period 1997-2012. The information on public firms is obtained from Compustat, and the information on public and private firms are from Statistics of U.S. Businesses (SUSB) report, managed by the U.S. Census. Panel A is based on the overall sample, while Panel B is based on the subsample of firms with sales over $100M.

Panel A: All firms



Panel B: Firms with sales over $100M

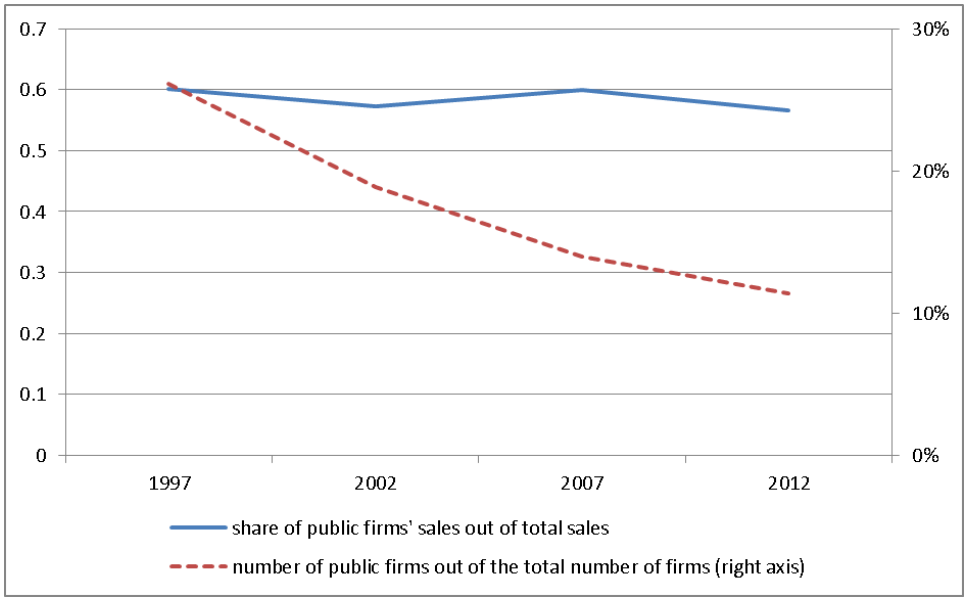


Figure 7
The Share of Imports Out of Total Public Firms' Revenues

This figure shows the ratio of U.S. imports at a NAICS 3-digit industry level to the total sales by publicly traded firms in that industry. To aggregate across industries, industry ratios are scaled by the number of public firms in that industry. Information on U.S. imports is obtained from the U.S. Census Bureau website.

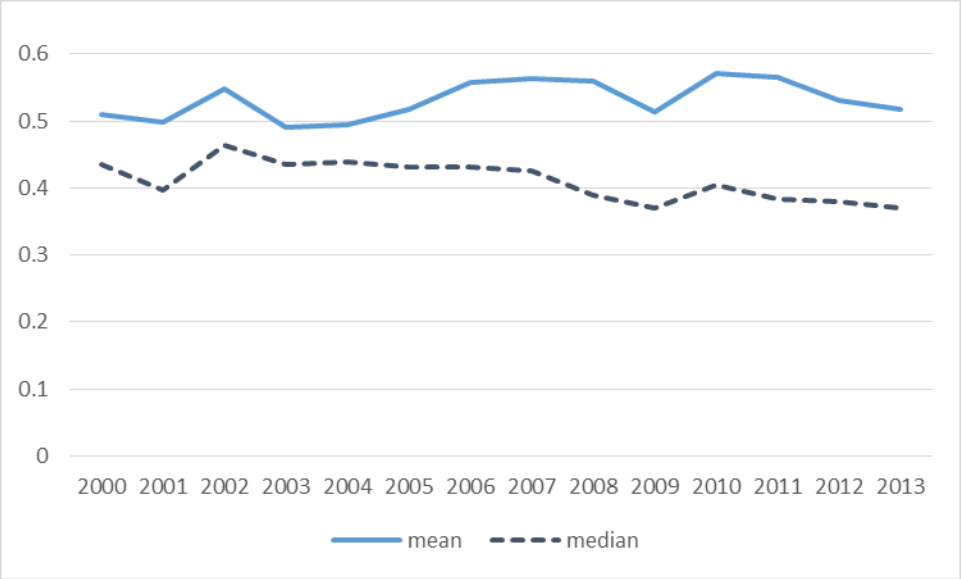


Table 1
Change in the Number of Firms in an Industry and Profitability

This table reports coefficients from regressions of firm profitability on the number of firms in an industry and other control variables. *ROA* is the operating income before depreciation scaled by the book value of assets. *Assets* is the book value of total assets. *Age* is the time (in years) from the firm's CRSP listing date. *Number of Firms* is the total number of public firms in an industry. Industry is defined using a firm's three-digit NAICS code. Standard errors (reported in parentheses) are clustered at the firm level. Symbols [a], [b], and [c] indicate significance at 1%, 5%, and 10%, respectively.

	Dependent Variable: *ROA*			
	1972-2014	1972-1986	1987-2000	2001-2014
Constant	-0.0097	0.0506[a]	-0.1251[a]	-0.2011[a]
	(0.0072)	(0.0127)	(0.0170)	(0.0251)
Log(*Assets*)	0.0390[a]	0.0242[a]	0.0532[a]	0.0569[a]
	(0.0015)	(0.0029)	(0.0025)	(0.0032)
Log(*Age*)	-0.0146[a]	-0.0224[a]	-0.0309[a]	0.0036
	(0.0013)	(0.0020)	(0.0024)	(0.0030)
Log(*Number of Firms*)	-0.0059[a]	0.0004	-0.0008	-0.0169[a]
	(0.0015)	(0.0022)	(0.0030)	(0.0034)
N	194,604	57,567	76,785	60,252
Adjusted R^2	66.79%	67.02%	69.35%	75.47%
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Clustering at Firm Level	Yes	Yes	Yes	Yes

Table 2
Change in the Number of Firms in an Industry, Profit Margins and Efficiency

This table reports coefficients from regressions of profit margins and efficiency measures on the number of firms in an industry and other control variables. *Lerner index* is the operating income before depreciation minus depreciation scaled by total sales. *Asset utilization* is defined as total sales scaled by total assets. *Assets* is the book value of total assets. *Age* is the time (in years) from the firm's CRSP listing date. *Number of Firms* is the total number of public firms in an industry. Industry is defined using a firm's three-digit NAICS code. Standard errors (reported in parentheses) are clustered at the firm level. Symbols [a], [b], and [c] indicate significance at 1%, 5%, and 10%, respectively.

Panel A

	Dependent Variable: *Lerner Index*			
	1972-2014	1972-1986	1987-2000	2001-2014
Constant	-0.5456[a]	-0.3670[a]	-1.1215[a]	-0.8089[a]
	(0.0655)	(0.0680)	(0.1591)	(0.2432)
Log(*Assets*)	0.1266[a]	0.1073[a]	0.1401[a]	0.1005[a]
	(0.0110)	(0.0177)	(0.0192)	(0.0289)
Log(*Age*)	0.0878[a]	0.0253[c]	0.0875[a]	0.2267[a]
	(0.0114)	(0.0139)	(0.0213)	(0.0304)
Log(*Number of Firms*)	-0.0266[c]	-0.0165	0.0173	-0.1179[a]
	(0.0156)	(0.0121)	(0.0275)	(0.0385)
N	187,339	54,320	74,181	58,838
Adjusted R^2	63.38%	70.12%	66.36%	71.52%
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Clustering at Firm Level	Yes	Yes	Yes	Yes

Panel B

	Dependent Variable: *Asset Utilization*			
	1972-2014	1972-1986	1987-2000	2001-2014
Constant	1.4451[a]	1.7212[a]	1.5571[a]	2.0648[a]
	(0.0329)	(0.0506)	(0.0685)	(0.0736)
Log(*Assets*)	-0.1467[a]	-0.1668[a]	-0.1632[a]	-0.2181[a]
	(0.0052)	(0.0109)	(0.0081)	(0.0084)
Log(*Age*)	0.1093[a]	0.0356[a]	0.1287[a]	0.0837[a]
	(0.0056)	(0.0094)	(0.0081)	(0.0087)
Log(*Number of Firms)*	0.0025	0.0037	-0.0104	-0.0169
	(0.0071)	(0.0100)	(0.0127)	(0.0108)
N	195,677	57,689	77,529	60,459
Adjusted R^2	84.64%	90.22%	86.15%	89.66%
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Clustering at Firm Level	Yes	Yes	Yes	Yes

Table 3
Change in the Number of Firms in an Industry and M&A Returns

The table presents results of regressing CARs around merger announcements on the number of public firms in the industry and firm characteristics. The sample consists of mergers and acquisitions transactions over the period 1980-2014 that meet all of the following conditions: (i) percent of ownership by acquirer prior to event is less than 50%; (ii) percent of ownership by acquirer after event is more than 50% or unknown; (iii) both acquirer and target are identified as public firms; (iv) acquirer and target firm have different identifiers; (v) the transaction is completed; (vi) return data around the announcement date is available on CRSP; and (vii) offer price is available on SDC. The cumulative abnormal return (CAR) of the combined firm over a three-day event window [-1, 1] around the merger announcement as calculated as follows:

$$Combined\ CAR_{i,t} = \frac{MV_{A,t+1}+MV_{T,t+1}}{MV_{A,t-1}+MV_{T,t-1}} - 1 - r_{CRSP,t-1,t+1}$$

where t is the announcement date of the transaction, MV_A (MV_T) is the market value of equity of the acquiring (target) firm, and $r_{CRSP,t-1,t+1}$ is the cumulative return on the CRSP value-weighted market portfolio from t-1 to t+1. The cumulative abnormal returns for the target firm (*Target CAR*) and the acquirer (*Acquirer CAR*) are calculated in a similar way. B/M_T (B/M_A) is the book-to-market ratio of the target (acquiring) firm, defined as in Davis, Fama, and French (2000), and winsorized at the 1% and the 99% level. Symbols [a], [b], and [c] indicate significance at 1%, 5%, and 10%, respectively.

Panel A

	Dependent Variable: Combined CARs		
	1980-2014	1980-2000	2001-2014
Constant	0.1484[a]	0.1659[a]	0.2281[a]
	(0.0412)	(0.0446)	(0.0890)
B/M_T	0.0105[b]	0.0089[b]	0.0126[c]
	(0.0044)	(0.0043)	(0.0071)
B/M_A	0.0116[b]	0.0128[b]	0.0110
	(0.0056)	(0.0062)	(0.0109)
$Log(MV_T)$	0.0033[b]	0.0041[a]	0.0022
	(0.0013)	(0.0015)	(0.0015)
$Log(MV_A)$	-0.0075[a]	-0.0069[a]	-0.0078[a]
	(0.0016)	(0.0018)	(0.0029)
Log(Number of Firms)	-0.0139[c]	-0.0224[a]	-0.0341[b]
	(0.0073)	(0.0082)	(0.0155)
N	3,250	1,916	1,334
Adjusted R^2	5.51%	8.03%	3.23%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Panel B

	Dependent Variable: Acquirer CARs		
	1980-2014	1980-2000	2001-2014
Constant	0.0680	0.0753	0.1118
	(0.0361)	(0.0470)	(0.1467)
B/M_T	0.0018	0.0053	-0.0004
	(0.0027)	(0.0036)	(0.0047)
B/M_A	0.0114[b]	0.0076	0.0190[a]
	(0.0052)	(0.0057)	(0.0072)
$Log(MV_T)$	-0.0076[a]	-0.0068[a]	-0.0081[a]
	(0.0017)	(0.0016)	(0.0024)
$Log(MV_A)$	0.0042[a]	0.0033[a]	0.0057[a]
	(0.0013)	(0.0013)	(0.0017)
Log(Number of Firms)	-0.0112[c]	-0.0124	-0.0286
	(0.0065)	(0.0092)	(0.0271)
N	3,250	1,916	1,334
Adjusted R^2	6.38%	7.16%	7.77%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Panel C

	Dependent Variable: Target CARs		
	1980-2014	1980-2000	2001-2014
Constant	0.2529	0.4395[b]	0.0618
	(0.1629)	(0.1853)	(0.3325)
B/M_T	0.0294[b]	0.02845	0.0212
	(0.0132)	(0.0179)	(0.0231)
B/M_A	0.0026	0.0219	-0.0209
	(0.0111)	(0.0178)	(0.0203)
$Log(MV_T)$	-0.0359[a]	-0.0245[a]	-0.0522[a]
	(0.0035)	(0.0045)	(0.0038)
$Log(MV_A)$	0.0273[a]	0.0244[a]	0.0308[a]
	(0.0030)	(0.0033)	(0.0044)
Log(Number of Firms)	0.0214	-0.0368	0.0394
	(0.0237)	(0.0302)	(0.0553)
N	3,250	1,916	1,334
Adjusted R^2	11.83%	8.67%	12.60%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Table 4
Change in the Number of Firms in an Industry and M&A Returns – Related vs. Unrelated Mergers

The table presents the results of estimating CAR around merger announcements as a function of the number of public firms in the industry, as well as bidder-target relatedness, and firm characteristics. Related is a dummy variable that takes on a value of 1 if the bidder and the target belong to the same NAICS 3-digit industry, and zero otherwise. See Table 4 for the description of the sample and variable construction. Symbols [a], [b], and [c] indicate significance at 1%, 5%, and 10%, respectively.

Panel A

	Dependent Variable: Combined Announcement Returns		
	1980-2014	1980-2000	2001-2014
Constant	0.1318[a]	0.1550[a]	0.1745[c]
	(0.0426)	(0.0440)	(0.0941)
B/M_T	0.0102[b]	0.0091[b]	0.0119[c]
	(0.0043)	(0.0043)	(0.0071)
B/M_A	0.0116[b]	0.0127[b]	0.0116
	(0.0056)	(0.0062)	(0.0106)
$Log(MV_T)$	0.0033[a]	0.0044[a]	0.0020
	(0.0013)	(0.0016)	(0.0013)
$Log(MV_A)$	-0.0077[a]	-0.0073[a]	-0.0078[b]
	(0.0016)	(0.0018)	(0.0031)
Log(Number of Firms)	-0.0089	-0.0190[b]	-0.0230
	(0.0077)	(0.0080)	(0.0166)
Related	0.0356[a]	0.0092	0.0881[a]
	(0.0131)	(0.0177)	(0.0269)
Log(Number of Firms) x Related	-0.0079[a]	-0.0034	-0.0169[a]
	(0.0023)	(0.0034)	(0.0053)
N	3,250	1,916	1,334
Adjusted R^2	5.66%	8.20%	3.51%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Panel B

	Dependent Variable: Acquirer Announcement Returns		
	1980-2014	1980-2000	2001-2014
Constant	0.0531	0.0681	0.0663
	(0.0366)	(0.0475)	(0.1503)
B/M_T	0.0016	0.0055	-0.0011
	(0.0027)	(0.0036)	(0.0049)
B/M_A	0.0115[b]	0.0076	0.0195[a]
	(0.0052)	(0.0057)	(0.0069)
$Log(MV_T)$	-0.0075[a]	-0.0067[a]	-0.0082[a]
	(0.0017)	(0.0016)	(0.0022)
$Log(MV_A)$	0.0040[a]	0.0031[b]	0.0056[a]
	(0.0012)	(0.0013)	(0.0017)
Log(Number of Firms)	-0.0067	-0.0102	-0.0187
	(0.0068)	(0.0095)	(0.0281)
Related	0.0314[b]	0.0060	0.0780[a]
	(0.0136)	(0.0177)	(0.0272)
Log(Number of Firms) x Related	-0.0070[a]	-0.0022	-0.0155[a]
	(0.0024)	(0.0031)	(0.0049)
N	3,250	1,916	1,334
Adjusted R^2	6.58%	7.19%	7.37%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Panel C

	Dependent Variable: Target Announcement Returns		
	1980-2014	1980-2000	2001-2014
Constant	0.2635[c]	0.4890[a]	-0.0039
	(0.1577)	(0.1867)	(0.3005)
B/M_T	0.0293[b]	0.0301[c]	0.0211
	(0.0131)	(0.0175)	(0.0233)
B/M_A	0.0027	0.0212	-0.0194
	(0.0110)	(0.0175)	(0.0207)
$Log(MV_T)$	-0.0361[a]	-0.0237[a]	-0.0533[a]
	(0.0035)	(0.0045)	(0.0064)
$Log(MV_A)$	0.0277[a]	0.0241[a]	0.0319[a]
	(0.0033)	(0.0035)	(0.0052)
Log(Number of Firms)	0.0178	-0.0492	0.0489
	(0.0228)	(0.0322)	(0.0472)
Related	-0.0171	-0.1002	0.0873
	(0.0557)	(0.0620)	(0.1348)
Log(Number of Firms) x Related	0.0050	0.0189[c]	-0.0124
	(0.0112)	(0.0113)	(0.0294)
N	3,250	1,916	1,334
Adjusted R^2	11.80%	8.73%	12.60%
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Clustering at Industry Level	Yes	Yes	Yes

Table 5
Number of Firms in an Industry and the Cross-Section of Stock Returns

This table reports alphas for portfolios sorted by the relative change in the number of firms in an industry from year t-2 to year t-1. Portfolio 1 (Low) contains the 10 industries with the smallest relative change in the number of firms, Portfolio 3 (High) contains the 10 industries with the largest relative change in the number of firms, and Portfolio 2 contains the rest of the industries. To calculate returns on year t, we first calculate equally-weighted and value-weighted returns by industry. After these industries are assigned to one of the three portfolios based on the relative change in the number of firms, we calculate equally-weighted industry returns for each portfolio. For value-weighted returns, we aggregate the market value of equity of all firms within an industry and calculate value-weighted industry returns for each of the three portfolios. Using this portfolio formation, we calculate monthly equally-weighted and value-weighted returns from July of year t to June of year t+1. Symbols [a], [b], and [c] indicate significant differences between the high and low portfolios at 1%, 5%, and 10%, respectively.

Panel A: 1972-2014

	Portfolio 1 (Low)	Portfolio 2	Portfolio 3 (High)	Diff (High-Low)
CAPM				
Equally-Weighted Portfolios	0.0031	0.0021	-0.0002	-0.0033
	1.5809	1.4617	-0.0904	-1.3356
Value-Weighted Portfolios	0.0021[c]	0.0002	-0.0017	-0.0038[c]
	1.7071	0.7572	-1.1433	-1.8235
Fama-French 3 Factors				
Equally-Weighted Portfolios	0.0005	-0.0008	-0.0022	-0.0027
	0.3191	-0.8813	-0.9219	-1.0729
Value-Weighted Portfolios	0.0014	-0.0001	-0.0004	-0.0018
	1.1809	-0.2905	-0.2718	-0.8976
Fama-French 3 Factors + Momentum				
Equally-Weighted Portfolios	0.0024	0.0009	0.0000	-0.0024
	1.6066	1.0637	0.0145	-0.9162
Value-Weighted Portfolios	0.0020	-0.0002	0.0008	-0.0012
	1.6185	-1.0095	0.5649	-0.5639

Panel B: 1972-1986

	Portfolio 1 (Low)	Portfolio 2	Portfolio 3 (High)	Diff (High-Low)
CAPM				
Equally-Weighted Portfolios	0.0052	0.0043[c]	0.0056	0.0004
	1.5704	1.6572	0.9148	0.0716
Value-Weighted Portfolios	0.0033[c]	-0.0009[b]	-0.0015	-0.0048
	1.7596	-2.3564	-0.6574	-1.3701
Fama-French 3 Factors				
Equally-Weighted Portfolios	0.0012	0.0001	0.0021	0.0009
	0.5190	0.0578	0.3476	0.1394
Value-Weighted Portfolios	0.0020	-0.0009[b]	-0.0008	-0.0028
	1.0537	-2.2458	-0.3398	-0.7818
Fama-French 3 Factors + Momentum				
Equally-Weighted Portfolios	0.0011	0.0005	0.0027	0.0016
	0.4688	0.4979	0.4319	0.2353
Value-Weighted Portfolios	0.0013	-0.0008[b]	0.0023	0.0010
	0.6732	-2.0632	0.9785	0.2749

Panel C: 1987-2000

	Portfolio 1 (Low)	Portfolio 2	Portfolio 3 (High)	Diff (High-Low)
CAPM				
Equally-Weighted Portfolios	-0.0037	-0.0031	-0.0065[c]	-0.0028
	-1.0240	-1.3452	-1.8661	-0.8814
Value-Weighted Portfolios	-0.0015	0.0010[a]	-0.0006	0.0010
	-0.6224	2.7093	-0.1833	0.2319
Fama-French 3 Factors				
Equally-Weighted Portfolios	-0.0042	-0.0038[a]	-0.0062[b]	-0.0020
	-1.4278	-2.4369	-2.1725	-0.6329
Value-Weighted Portfolios	-0.0024	0.0005[c]	0.0014	0.0038
	-0.9890	1.8747	0.4508	0.9605
Fama-French 3 Factors + Momentum				
Equally-Weighted Portfolios	-0.0011	-0.0007	-0.0019	-0.0008
	-0.3651	-0.5034	-0.6826	-0.2491
Value-Weighted Portfolios	-0.0004	0.0006[b]	0.0026	0.0030
	-0.1569	1.9772	0.8056	0.7169

Panel D: 2001-2014

	Portfolio 1 (Low)	Portfolio 2	Portfolio 3 (High)	Diff (High-Low)
CAPM				
Equally-Weighted Portfolios	0.0083[a]	0.0058[a]	0.0007	-0.0076[a]
	2.8066	2.5832	0.2282	-3.5580
Value-Weighted Portfolios	0.0044[b]	0.0006	-0.0031	-0.0076[a]
	2.2108	1.4091	-1.4586	-2.5208
Fama-French 3 Factors				
Equally-Weighted Portfolios	0.0052[b]	0.0024[c]	-0.0022	-0.0074[a]
	2.1350	1.6540	-0.8872	-3.4527
Value-Weighted Portfolios	0.0040[b]	0.0004	-0.0026	-0.0066[b]
	2.0345	1.1850	-1.2466	-2.1963
Fama-French 3 Factors + Momentum				
Equally-Weighted Portfolios	0.0059[a]	0.0030[b]	-0.0013	-0.0073[a]
	2.6687	2.3716	-0.5955	-3.3898
Value-Weighted Portfolios	0.0041[b]	0.0003	-0.0022	-0.0062[b]
	2.0766	0.9481	-1.0589	-2.0857

Table 6
Horizontal Merger Investigations

This table reports horizontal mergers investigations conducted by the Federal Trade Commission over the period 1996-2011. HSR second requests are requests in which firms involved in a transaction have to provide additional information to the Federal Trade Commission under the Hart-Scott Rodino Act. Data on total announcements and mega deals comes from Mergerstat. Mega deals are transactions with values of more than $1 billion.

	1996-2003	2004-2011
HSR Second Requests	281	183
HSR Second Requests per Year	35.1	22.9
% of Total Announcements	0.44%	0.24%
% of Mega Deals	26.66%	14.51%

Table 7
Change in the Number of Firms in an Industry and Patent Generation

This table reports coefficients from regressing the number of patents granted to a firm as a function of the number of firms in an industry and other control variables. Patents are obtained from NBER website. The sample includes all the industries where at least one firm is granted a patent in a given year. In Panel A the dependent variable is the log of 1 plus the number of patents that a firm was granted in a given year. In Panel B we scale each patent by the number of citation it received (adjusted for truncation) before converting the number into logs. *Age* is the time (in years) from the firm's CRSP listing date. *Number of Firms* is the total number of public firms in an industry. Industry is defined using a firm's three-digit NAICS code. Standard errors are clustered at the firm level. Symbols [a], [b], and [c] indicate significance at 1%, 5%, and 10%, respectively, and p-values are reported in the parentheses.

Panel A

	Dependent variable: Number of patents			
	1972 - 2006	1972 - 1986	1987 - 2000	2001 - 2006
Constant	-0.444[a]	-0.093	-0.232[a]	-0.079
	0.00	(0.20)	(0.00)	(0.44)
Log(*Assets*)	0.120[a]	0.064[a]	0.092[a]	0.062[a]
	0.00	0.00	0.00	0.00
Log(*Age*)	0.036[a]	0.039[a]	0.029[a]	0.108[a]
	0.00	(0.00)	(0.00)	0.00
Log(*Number of Firms*)	0.017[b]	0.019[c]	0.018[b]	-0.023[c]
	(0.03)	(0.09)	(0.05)	(0.06)
N	141,124	41,867	75,707	27,940
adj. R-sq	81.7%	88.8%	83.7%	88.6%
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Clustering at Firm Level	Yes	Yes	Yes	Yes

Panel B

	Dependent variable: Scaled number of patents			
	1972 - 2006	1972 - 1986	1987 - 2000	2001 - 2006
Constant	-1.581[a]	-0.059	-0.519[a]	-0.881[a]
	0.00	(0.70)	(0.00)	(0.00)
Log(*Assets*)	0.206[a]	0.127[a]	0.187[a]	0.157[a]
	0.00	0.00	0.00	0.00
Log(*Age*)	0.092[a]	0.03	0.077[a]	0.128[b]
	0.00	(0.26)	0.00	(0.02)
Log(*Number of Firms*)	0.025[c]	0.050[b]	0.043[b]	-0.05
	(0.09)	(0.04)	(0.05)	(0.23)
N	141,124	41,867	75,707	27,940
adj. R-sq	72.6%	80.6%	75.3%	72.6%
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Clustering at Firm Level	Yes	Yes	Yes	Yes