ESSAYS IN MERGERS, ACQUISITIONS, AND ANTITRUST

by

HALEY O'STEEN

(Under the Direction of Stuart Gillan)

ABSTRACT

This dissertation examines the relationship between the market for mergers and acquisitions and the antitrust policy regulating it. The two essays herein address, independently, several aspects of the relationship. I analyze the characteristics of industries that are linked with future merger activity, in Chapter 2. My results provide evidence that merger and acquisition transactions with higher profitability occur in industries where there is a large disparity in size between the largest firm and other firms in the industry. Also, there is a larger quantity of transactions between firms in industries with many medium-sized firms, but smaller firms drive this result. The largest firms in these industries are less likely to merge in the future, and I propose that this is the case because larger firms in these industries decide not to merge to avoid potential costs associated with antitrust challenges. Chapter 300 focuses on analyzing mergers challenged by the U.S. antitrust agencies and the nature of remedies assigned by the agencies. Size and industry type are related to the likelihood of challenge, but measures of market power are linked to the size of the remedy. This dissertation adds to our understanding of the connection between merger activity and antitrust policy.

INDEX WORDS: Mergers, Acquisitions, Antitrust challenge, Market power, Competition, Remedies

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A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2018

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August 2018

DEDICATION

I dedicate my dissertation and all of the work that produced it to my family and many friends who pushed me to persevere, proofread many drafts, and empathized with the plight of a PhD student.

ACKNOWLEDGEMENTS

Unending thanks to Professor Stuart Gillan. His direction fueled my work, and his motivation propelled me through the research and writing processes. Thank you also to my committee members Professor Annette Poulsen and Professor Jeffry Netter who offered valuable insights, a voice of reason, and comedic relief. When there was an obstacle in writing this dissertation, these three provided a way to overcome it.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 PURPOSE OF THE STUDY

This dissertation uncovers some of the links between antitrust policy and mergers and acquisitions. Chapter 2 asks, "Which firms engage in merger activity?" This question has long been studied, and following the theoretical approach of Gorton, Kahl, and Rosen (2009) and using a newer sample of mergers I answer that question while considering how antitrust policy affects the firm's decision to acquire. Firms sometimes avoid merger activity because of the possibility of a future antitrust challenge, so the policies that determine which mergers receive a challenge may also affect merger activity. Chapter 3 studies the determinants of there being an antitrust challenge, namely industry concentration or a price-cost margin, deal size, and whether an acquirer is classified as "high-tech," for an announced merger and the nature of remedies assigned by antitrust agencies after a challenge. I use what I learn about the determinants of challenge in Chapter 3 to inform my analysis in Chapter 2.

1.2 EXPECTED RESULTS

First, I expect to find a link between future merger activity and the structure of the acquiring firm's industry in Chapter 2. Such a finding would be confirmation of the Gorton et al. (2009) results. Second, I expect that variables related to higher probability of antitrust

challenge are less likely to merge in the future, because firms may decide not to merge to avoid the costs associated with antitrust challenges.

In Chapter 3, I expect that mergers with acquirers with higher concentration will be more likely to receive an antitrust challenge. This expectation stems from the fact that the Federal Trade Commission (FTC) and the Department of Justice (DoJ) state that they use industry concentration to evaluate merger deals. I expect that large mergers and those with high-tech acquirers will also be more likely to be challenged, because some critics of the effectiveness of antitrust policy claim the agencies intervene too much and that the agencies will challenge such mergers without grounds that the mergers will harm competition. Using a unique sample of the sizes of required remedies for challenged mergers, I expect to find that remedies are higher for mergers with higher market power as measured by price-cost margin or the Lerner index.

CHAPTER 2

WHO EATS WHOM? MERGERS AND ACQUISITIONS AND ANTITRUST[1]

[1] O'Steen, Haley. To be submitted to *Financial Management*.

Abstract

This paper adds to our understanding of which firms in an industry will acquire when there is a regime shift that leads to increased merger activity in that industry. I posit that managers base their decision to make such acquisitions partially on the potential antitrust outcomes of them. Beginning with the Gorton, Kahl, and Rosen (2009) framework, I show that their hypothesis "eat or be eaten" holds for a set of recent data—firms in industries with many medium-sized firms must acquire to preserve or increase their size after a regime shift alters the industry landscape. I find that a one-percentage-point increase in the percentage of medium-sized firms in an industry is associated with an increase in the likelihood of there being a future merger by 0.29 percentage points. I refine the Gorton et al. (2009) hypothesis by incorporating antitrust considerations; though some firms may wish to acquire, the antitrust costs may be too high to engender merger activity. Therefore, I include determinants of the likelihood of antitrust challenge by U.S. antitrust authorities found in previous literature (O'Steen, 2018). My analysis shows that firms possessing characteristics related to a higher probability of antitrust challenge—high market power, large relative to the industry, and classified as high-tech—are less likely to acquire in the future. To support my claim, I also consider the percentage of potential merger deals that would trigger antitrust scrutiny based on the expected change in the Herfindahl-Hirschman Index (Herfindahl) for any given firm as it relates to the likelihood that there will be future merger activity. I find that firms with a higher percentage of potential mergers that cross the antitrust agencies' Herfindahl threshold are less likely to merge. This result provides further evidence that antitrust considerations affect managers' acquisition decisions.

2.1 INTRODUCTION

The mergers and acquisitions literature studies what drives merger activity in industries. The neoclassical theory of mergers suggests that merger activity in an industry is the result of economy- or industry-wide changes that affect the industry's landscape and cause managers to decide to acquire to adapt to the altered industry. Empirical research shows that merger waves are related to economic shocks or changes in the regulatory environment (Mitchell & Mulherin, 1996; Jovanovic & Rousseau, 2002; Harford, 2005). Gorton, Kahl, and Rosen (GKR) (2009) suggest that when there is such a regime shift, the structure of the industry partially determines which industries will see the most merger activity. Industry structure and firm size relative to the industry also determines which firms do not merge. Though industries with firms of certain relative size will have more merger activity following a regime shift, the size of a firm relative to its industry will also affect how antitrust authorities assess an acquisition the firm plans. The costs to firms of having an antitrust challenge against a merger can be significant, so despite pressure to acquire after a regime shift, potential antitrust costs may deter some firms from pursuing acquisitions. In this paper, I do two things. First, I test the GKR (2009) hypothesis using a recent sample of data. Second, I propose a refinement of their hypothesis. The results of testing this refinement provide insight into which firms in an industry merge after a regime shift and how antitrust policy relates to this.

The GKR (2009) theory states that the distribution of firm size within an industry is an important determinant of merger activity. The prediction is that more mergers will occur in industries where firms are similar in size, but these will be less profitable than in industries where there are one or two dominant firms and many small firms. The rationale

is that in industries with more similar-sized firms, firms will engage in merger activity to defend their market share by increasing their size. This pattern of acquisition behavior gives rise to the name of the theory: "eat or be eaten."

Eat or be eaten is insightful, and GKR.'s (2009) empirical results support their theory for a sample covering 1982-1999. The theory broadly adds to our understanding of merger activity but does not, however, incorporate the antitrust considerations in the firm's decision to acquire. Consider a firm that is deciding whether to acquire another. Managers are weighing the costs and benefits of a transaction, and these costs include those associated with antitrust challenges such as legal fees, reputational losses, breakup fees, and remedies required by the challenging antitrust agency. Though it is difficult to observe mergers that never happen, there is evidence of this kind of behavior. One example of such a deal is that between computer chip manufacturers Lam Research and KLA-Tencor. They announced the $10.6 billion merger in late 2015. The DoJ did not challenge the deal, but there were concerns that antitrust problems would arise. The firms called off the deal a year after its announcement citing antitrust concerns as the reason for ending the partnership (Clark & Minaya, 2016). This shows that if the expected costs associated with an antitrust challenge are sufficiently high, firms will decide not to acquire. Therefore, I extend GKR (2009) to examine who does the eating.

Keeping in mind the opposing considerations of firms to eat or become the eaten and to avoid antitrust costs, I predict, in line with the Gorton et al. (2009) findings that, overall, firms in industries with many medium-sized firms will have a higher likelihood of acquiring in the future. However, because managers consider the antitrust consequences of a merger, firms that possess qualities that may increase the likelihood there is an antitrust

challenge will be deterred from future acquisitions. The same should be true for any possible combination of firms; mergers that are more likely to be challenged should be less likely to occur. Rather than contradicting, this adds to what Gorton et al. (2009) find, and, based on these predictions I develop the following three hypotheses:

> H1: Based on the hypotheses in GKR (2009), (1) following a regime shift, the profitability of acquisitions increases in the ratio of the size of the largest firm in the acquirer's industry to the size of other firms in its industry and (2) following a regime shift, the quantity of mergers increases in the proportion of medium-sized firms in an industry, i.e. eat or be eaten holds for a recent set of data covering 2000-2016 as it does for the 1982-1999 sample used in the GKR (2009) paper,
>
> H2: Following a regime shift, firms with characteristics associated with a higher likelihood of antitrust challenge in industries with many medium-sized firms are less likely to acquire in the future than their counterparts, and
>
> H3: Following a regime shift, potential mergers involving firms in industries with many medium-sized firms will be more likely to occur, and potential mergers with characteristics associated with a higher likelihood of antitrust challenge will be less likely to occur.

To test H1, I replicate the GKR (2009) empirical investigation of eat or be eaten. They use a sample from 1982-1999. I do the same and add the years 2000-2016 to my analysis. The results show that the eat or be eaten theory is applicable for recent years. On average, mergers are more profitable in industries with a significant disparity in size between the largest firms in an industry and other firms, and there is more merger activity

when there are more medium-sized firms. Extending the analysis that examines future merger activity, I include variables that other research shows relate to the likelihood that the U.S. antitrust enforcers challenge a deal—acquirer size and whether the acquirer is high tech—to test H2 (O'Steen, 2018). I find that the largest firms in an industry with many medium-sized firms and high-tech firms have a lower likelihood of merging in the future.

Finally, I take a broader look at the likelihood that there is a merger to test H3. Because this work adopts the idea that some firms will not merge, the problem arises that we cannot know which mergers would have happened but never did. To solve this problem, I examine all potential mergers and, for each one, determine the resulting change in Herfindahl if the merger were to occur noting the Herfindahl changes that would be likely to trigger an antitrust challenge. I find that firms with one percent-point more potential mergers that would be likely to be challenged are about 0.9 percent less likely to merge in the future. Together, the results of this paper provide evidence that industry structure affects the type and quantity of merger activity and that antitrust considerations affect managers' acquisition decisions.

2.2 EAT OR BE EATEN AND WHO EATS

Eat or be eaten frames the empirical research in GKR (2009) and this paper. The theory focuses on merger activity in which some event, or regime shift, triggers firms in an industry to engage in a "race for size" by merging within or across industries. Firms might enter such a race through positioning mergers. These are mergers by which a firm can increase in size and position itself to be a more attractive target of future acquisition. They might also race to increase size through defensive mergers by which a firm can increase in

size and defend the manager from losing private benefits and control in a future acquisition of itself. In the case of positioning, the manager wants to become a takeover target, because the "synergies from efficient mergers are increasing in size (because of economies of scale)." Positioning mergers happen when the manager's focus is on increasing firm value. On the other hand, defensive acquisitions occur when a manager is preventing a potential takeover which could reduce his or her private benefits.

The first hypothesis of the eat or be eaten theory is "following a regime shift, the *profitability* of acquisitions is increasing in the ratio of the size of the largest firm in the acquirer's industry to the size of other firms in its industry, all else equal" (GKR, 2009). GKR's (2009) reasoning is that industries with more disparity in size between the largest and other firms will have more positioning mergers than defensive mergers because defensive mergers are less feasible when there is a dominant firm. Furthermore, positioning mergers should be more profitable since they stem from managers' wish to increase firm value. The second hypothesis is that "following a regime shift, the quantity of mergers is increasing in the proportion of medium-size firms in an industry, all else equal" (GKR, 2009). GKR (2009) suggest this because they show that theoretically, large firms will make unprofitable, defensive acquisitions and small firms will make positioning acquisitions, but medium-sized firms have an incentive to make either defensive or positioning acquisitions. Therefore, medium-sized firms have a larger quantity of possible acquisition opportunities than large or small firms.[2]

[2] Gorton et al. (2009) write, "Large firms have the greatest incentive to make defensive acquisitions, because they are large enough to become immune against being acquired. However, they cannot engage in profitable, positioning acquisitions since any acquisition makes them too large to be acquired. Small firms are too small to be able to use an acquisition to avoid becoming a target of the largest firms. However, they have an incentive to become larger to increase their attractiveness as a target, thereby earning a takeover premium. […] Medium-size firms […] can make and may have an incentive to make either defensive or positioning acquisitions."

Eat or be eaten explains why certain industries have more merger activity, but I dig deeper in this paper to examine which firms are the ones merging in these industries. The theory I test considers the constraints that antitrust law places on firms. There are considerable costs to firms associated with facing antitrust issues for a merger which include but are not limited to legal expenses, potential mandated remedies assigned by the antitrust agencies, and breakup fees. Additionally, a challenge can lengthen the time it takes to complete the merger (Fidrmuc, Roosenboom, & Zhang, 2017). The looming threat of having a deal challenged by the Federal Trade Commission (FTC) or the Department of Justice (DoJ) may be enough to deter some firms from trying to make acquisitions due to these potentially high costs. I hypothesize that this deterrent effect plays a role in which firms acquire, and firms more likely to face a challenge are less likely to acquire.

I rely on previous research to supply the determinants of the likelihood that the FTC or DoJ challenge a merger deal. O'Steen (2018) shows that high industry concentration increases the likelihood of challenge which is in line with the concentration doctrine of antitrust enforcement outlined in the Merger Guidelines (U.S. Dept. of Justice, 2010). The antitrust agencies specify that they use concentration and changes in concentration to evaluate deal competitiveness, so deals that lead to a higher increase in concentration should be more likely to be challenged. In addition to concentration, O'Steen (2018) finds that firm size and whether an acquirer is "high-tech" are strongly associated with the likelihood of a challenge.[3] I test whether expected concentration changes, firm size, and high-tech-ness relate to the likelihood that firms merge.

[3] Though firm size and high-tech-ness do not directly tell about deal competitiveness, some suggest that the antitrust agencies look at these characteristics to evaluate mergers. O'Steen (2018) writes regarding firm size that "commentators have suggested that 'big is bad' rather than 'harm to the consumer is bad' in what some are calling 'hipster antitrust.' Senator Orrin Hatch (R-Utah) calls hipster antitrust the 'progressive

2.3 DATA

2.3.1 Merger Sample

I collect a sample of mergers from 1982-2016. This includes the GKR (2009) sample of 1982-1999. Following GKR (2009), I gather data on the Center for Research in Security Prices database (CRSP)- and Compustat-listed firms and use the Securities Data Corporation's database (SDC) to build a sample of completed, non-financial acquisitions by U.S. firms. I assign each observation a date based on the announcement of the merger. The minimum deal size is $1 million, and the target size must be at least 5% and no more than 150% of the market value of the acquirer. To classify as a merger the transaction value must be for at least 50% of the target, and the acquirer must own at least 90% of the target after deal completion. The resulting sample includes 2,234 mergers. There are 1,303 from 1982-1999 which is consistent with the GKR (2009) sample size. The remaining 931 mergers occur from 2000 to 2016.

To replicate the first part of the GKR (2009) analysis, I look at the profitability of the mergers in my sample. Their model relies on the measurement of profits that shareholders of the acquirer get from the merger event. I calculate the cumulative abnormal returns (CAR) for three days around the announcement including the day prior, the announcement day, and the day after, and this market reaction reflects a firm-value reevaluation in response to new information contained in the merger announcement.[4] The

standard' of antitrust enforcement, suggesting that antitrust enforcers increasingly challenge large deals 'routinely disregarding some of the most basic elements of the consumer welfare standard.'" High-tech firms may also face additional antitrust scrutiny. O'Steen (2018) writes "FTC Chairwoman Edith Ramirez […] acknowledges that antitrust authorities may be likely to hinder innovation in high-tech markets" by challenging high-tech mergers.

[4] I also conduct the analysis using alternative calculations of CARs including the market model and the Fama-French 4-Factor model. I present only the results of using Fama-French 3-Factor CARs in the paper, but results are fundamentally the same for other calculations of returns.

average CAR is similar for the two 1982-1999 samples, 0.010 and 0.011, respectively and similar at 0.010 for the 2000-2016 sample. See Table 2.1 for details.

Another important aspect of the GKR (2009) model is the measurement of largest-firm size in relation to other firms in its industry. This measurement is different from other papers such as Moeller, Schlingemann, and Stulz (2004), which evaluate size in absolute rather than relative terms, but it is necessary to identify characteristics of industry structure. To calculate relative sizes, GKR (2009) develop a relative size ratio that captures the association of size between various firms within Fama-French 48 (FF48) industries. I recreate their ratio—*Log top-123/456 size ratio*—which compares the average size of the first, second, and third largest firms in the acquiring firm's industry to the average size of the fourth, fifth, and sixth largest.[5] The following equation defines the measure:

$$Log\ top-123/456\ size\ ratio_{i,t} = ln\left(\frac{Avg.\ Mkt\ Value\ of\ Three\ Largest\ Firms_{i,t}}{Avg.\ Mkt\ Value\ of\ 2nd\ Three\ Largest\ Firms_{i,t}}\right). \quad (1)$$

This is calculated for the year-end in the year before the deal announcement. Table 2.1 also provides summary statistics for these two measures of relative size in the industry for the identified regime shifts. For 1982-1999, *Log top-123/456 size ratio* has an average of 0.630 and median of 0.384. The average *Log top-123/456 size ratio* for 2000-2016 is 1.241—nearly double that of the older sample—telling us that the largest firms in industries are relatively larger than the second-largest firms.

Throughout the analysis, I use the same variables as in GKR (2009) to control for factors that affect acquisition CAR and merger activity. Definitions of these controls are

[5] Gorton et al. (2009) also use a measure they call *Log top two ratio* which is the natural logarithm of the ratio of the market value of the largest firm to the market value of the second-largest firm. The results they get using these two different measures are the same. I test the robustness of the results using *Log top-two size ratio*, and my results are unchanged. I only report the results using *Log top-123/456 size ratio*.

listed in Appendix A. Since payment type in a transaction can affect CARs (Travlos 1987), I include a variable (*Cash*) that indicates whether the acquirer pays for the transaction in cash. Since the size of both the target and the acquirer can impact the CAR, I include two variables to control for these (Moeller, Schlingemann, & Stulz, 2004). The relative target size (*Ratio*) is the ratio of the amount the acquirer paid for the target and the market size of the acquirer. The natural logarithm of the market value of the acquirer (*Log value*) represents acquirer size. Based on the findings of Fuller, Netter, and Stegemoller (2002) that certain target characteristics impact returns, I control for whether the target is private (*Tgt private*) and whether it is a subsidiary (*Tgt subsidiary*). The variable *Tender offer* shows whether the deal is a tender offer, and I include this because of the Jensen and Ruback (1983) finding that stock return is positive for acquirers in tender offer transactions. Whether the deal is across industries and whether the bidder is a competing bidder is also related to abnormal returns, so I include variables *Cross-industry* and *Competing bid* to control for this (Morck, Shleifer, & Vishny, 1990; Bradley, Desai, & Kim, 1988).

In addition to variables that may affect CARs, I include several others that might impact on merger activity. Controlling for the health of the acquiring firm is important because strong performance may make a transaction more likely (Rau & Vermaelen, 1998; Harford, 2005; Shleifer & Vishny, 2003). I proxy for this using the acquirer's market-to-book ratio (*Market/book*) and the equity-to-asset ratio for an acquirer (*equity/assets*). *EBITDA/sales* proxies for free cash flow. Besides these firm-specific factors, I include year dummy variables to control for other things affecting the entire economy that might change the likelihood of merging and industry dummies to capture time-invariant characteristics of industries.

I include variables related to the likelihood of an antitrust challenge in addition to the variables in GKR (2009) to demonstrate that the expectation of a challenge may influence the manager's decision to merge. O'Steen (2018) shows that for a sample of recent mergers, the transaction value of a deal and whether the acquirer is high tech are related to the likelihood that a merger receives a challenge from the FTC or DoJ. Specifically, larger deals and deals with high-tech acquirers are more likely to face a challenge. Therefore, I include *Deal size* and *High tech*. The average market value of the deal size is approximately $1.7 billion for 1982-1999 and about $1 billion larger for 2000-2016 at $2.7 billion. The designation of "high tech" is based on SDC's definition. SDC indicates whether any firm is high tech, and, broadly, SDC considers certain firms in the biotechnology, computer equipment, electronics, communications, and defense- and government-related technology sectors as high-tech. SDC makes the high-tech classification on a firm-level basis, so not all firms in these sectors are high-tech. Approximately thirty-eight percent of the 1982-1999 merger sample have high-tech acquirers while forty-six percent of the 2000-2016 sample fall in this category.

Table 2.1 summarizes data for years and industries with regime shifts. The first two columns give means and medians for the period covered in GKR (2009). The sample of GKR (2009) and my samples are similar in percentage of all-cash deals (*Cash*). About 32% of the recent-years sample I use are such deals. The average market value of the acquirers in my sample is $1.73 billion which is larger than that in the GKR (2009) sample. Approximately 30% of the sample have a private target (*Tgt. private*) and a subsidiary target (*Tgt. subsidiary*). This percentage is comparable to the corresponding averages in

GKR (2009). Twenty percent of the mergers in the sample occur between different FF48 industries (*Cross-industry*).

The second set of columns in Table 2.1 shows the averages and medians of characteristics of mergers affected by regime shifts or merger waves from 2000 through 2016. Of note is the difference in market value between this and the early set. The average market value of acquirers for the 2000-2016 sample is approximately $2.7 billion—about $1 billion larger than for 1982-1999. This size difference between the sample periods is consistent with size difference reported by Alexandridis, Antypas, and Travlos (2017). There are slightly more cross-industry mergers and tender offers (*Tender offer*) in 2000-2016. Also, the average Herfindahl index (*Industry Herfindahl*) by FF48 industry is higher in the 2000s than in the 1980s and 1990s.

2.3.2 Samples for Testing Likelihood of Future Merger

Replicating the GKR (2009) model to look at determinants of the likelihood that a firm will acquire in the future, I develop a sample of CRSP- and Compustat-listed firms affected by regime shifts for 1982-1999 and 2000-2016. In the early sample, there are 10,243 firms, similar to the number of firms in GKR's (2009) sample. There are 6,487 in the later sample. Table 2.2 describes the details of these samples. To estimate the likelihood that any firm will acquire another in the future, I use the variable *Future merger*, which equals one if a firm *j* in industry *i* announces that it will merge with another firm in year *t* + 1 in any other industry and that merger happens. *Future merger* equals zero, otherwise. The GKR (2009) sample has 9.2% of observations with future mergers. My sample covering the same period has 9.4%. The 2000-2016 sample has slightly more at 11.4%.

I also calculate the market share that any firm holds in its industry for each year. Using that calculation, I find the share of each industry that is small, medium, and large-size firms. I use the GKR (2009) definition of medium-sized, i.e., a firm whose total assets are between 5% and 30% of the total assets of the largest firm in its industry. Therefore, a firm with total assets less than 5% of the total assets of the largest firm is small, and a firm with total assets greater than 30% of the total assets of the largest firm is large. About 86% of my 1982-1999 sample are small. Ten percent are medium-sized, and 3% are large. The newer sample has more medium-sized and large firms but fewer small firms than either sample from 1982-1999.

Control variables include the market value of the firm (*Market value*), the market-to-book ratio (*Market/book*), equity-to-assets (*Equity/assets*), EBITDA-to-sales (*EBITDA/sales*), and the Herfindahl Index for the industry (*Industry Herfindahl*). By nature, some firms are more likely to acquire than others (Rosen, 2005), so I control for that using *Recent acquisition*, which is a dummy variable that equals one if a firm *j* in industry *i* acquired in year *t*.

The average market value for the 1982-1999 sample is $1.23 billion. On average, the 2000-2016 sample is $2.128 billion. *Market/book* is also larger for 2000-2016 than for 1982-1999. The average *Industry Herfindahl* is higher in the later sample. Just under 9% of the 1982-1999 sample have recent acquisitions while 11.8% of the 2000-2016 sample have recent acquisitions.

2.3.3 Regime Shifts

The eat-or-be-eaten theory hinges on an industry regime shift that alters the industry environment making possible future acquisition situations. In the 2009 paper, GKR (2009) identify these shifts in two ways. First, they identify industries where there have been significant changes, for instance in technology or regulation, which come from a list compiled by Viscusi, Harrington, and Vernon (2000). Second, they identify industry-specific merger waves and assume that some regime shift caused it. Harford (2005) supplies the list of merger waves GKR (2009) use. I use the same regime shifts for 1980-1999. Viscusi et al. (2009) identify 29 major, non-financial regulatory or technological changes and Harford (2005) lists 32 industry-specific, non-financial waves.

For the 2000-2016 sample, I identify a series of regime shifts representing major industry changes. The events for this period include industry- or economy-wide regulatory changes and significant merger activity in the industry of an acquirer that merges within two years after the event. I choose regulatory changes from a set of 2,979 laws passed between 2000 and 2016 listed at congress.gov. Most of these laws relate to politics, public lands, and armed forces which would not affect industries in a way that triggers merger activity. I identify 14 regulatory changes among the laws passed during this time which have the Federal Register or other government agencies classify as having "significant" impact in reports of economic analysis of the regulations. These reports also list industries for which a regulation will have a significant economic impact, and I choose industries affected by a regime shift based on those listed in the reports. Merger waves for the sample are significant increases in merger activity in the sample for an industry. The sample has

eight industry-specific merger waves. A list of all regulatory changes and industry merger waves between 1980 and 2015 is in Table 2.3.

All acquirers in the analysis of determinants of CARs and all firms in the analysis of determinants of the likelihood of future acquisition belong to industries that are affected by regime shifts. A merger or firm is considered affected by a regime shift for two years after a regime shift that impacts its FF48 industry (Harford, 2005). For instance, the Telecommunications Act of 1996, which became effective on February 8, 1996, is an example of such a regime shift, and the sample includes acquisitions by telecommunications firms that occur between the effective date and February 8, 1998.[6]

2.4 REPLICATION RESULTS

GKR (2009) test two hypotheses. They are as follow:

> H1(GKR): "Following a regime shift, the profitability of acquisitions is increasing in the ratio of the size of the largest firm in the acquirer's industry to the size of other firms in its industry, all else equal."
>
> H2(GKR): "Following a regime shift, the quantity of mergers is increasing in the proportion of medium-size firms in an industry, all else equal."

The first hypothesis looks at the relationship between relative firm size in an industry and merger profitability. I report my results of testing their theory in Determinants of Acquirer Returns. The second hypothesis address the likelihood that a firm will merge in the future. I report my results of testing their theory under Determinants of Probability of Future Merger.

[6] To test the robustness of my results, I define a firm as affected by a regime shift for three years after the event. This does not substantially change the results.

2.4.1 Determinants of Acquirer Returns

Testing H1(GKR), I use the following specification:

$$CAR_{j,i,t} = \alpha + \beta * Log\ top - 123/456\ size\ ratio_{i,t} + \gamma * controls_{j,i,t} + \varepsilon \quad (2)$$

where *CAR* is the cumulative abnormal return for firm *j*, in FF48 industry *i*, and at time *t*, *Log top-123/456 size ratio* is measured for the end of the year before the merger announcement, for industry *i* in year *t*. In this specification, I include the same control variables as used in GKR (2009) to capture factors that research shows are associated with acquisition CARs. For mergers where the acquiring firm's industry's largest firms are of similar size to the rest of the firms in the industry (low *Log top-123/456 size ratio*), according to the eat or be eaten theory, the profitability of these mergers should be less than the profitability of mergers in industries with more disparity between firm size. The coefficient on *Log top-123/456 size ratio* should be positive.

Table 2.4, Panel A presents the results of regressing the acquirers' CARs on the relative size of the largest firms in a given industry and control variables using FF48 industries to define markets. Each regression controls for clustering at the firm level. Column (1) gives the results of replicating GKR (2009) for the same period (1982-1999). Results are similar between the GKR (2009) study and the one discussed here. The coefficient on *Log top-123/456 size ratio* is positive and significant indicating that mergers following a regime shift in industries where there is more disparity in firm size have higher returns around the announcement of a merger. This outcome tells us that an increase in the size ratio of one standard deviation is associated with a 2.88 percentage-point increase in *CAR* at the time of a merger. When I apply this model to the later set of data—2000-2016—the coefficient in column (5) on *Log top-123/456 size ratio* is again positive but more

highly statistically significant than for the 1982-1999 sample. Increasing *Log top-123/456 size ratio* by one standard deviation increases *CAR* by 1.34 percentage points on average in the 2000-2016 sample. The GKR (2009) model is replicable as well as applicable to recent data.

Results for other variables in columns (1) and (5) are not surprising. The coefficient on the relative target size (*Ratio*) is positive and statistically significant. This tells us that the larger the target is in relation to the acquirer, the more profitable a merger, and this is in line with Moeller et al. (2004). Mergers with private targets have higher CARs, which is like the results of Fuller et al. (2002).

To test the robustness of the GKR (2009) replication, I include the variable *Log top 123/456 sales ratio*. The calculation of it is like that of *Log top 123/456 size ratio* except that it uses acquirer sales rather than market value. It is:

$$Log\ top\ 123/456\ sales\ ratio_{i,t} = ln\left(\frac{Avg.\ Sales\ of\ Three\ Largest\ Firms_{i,t}}{Avg.\ Sales\ of\ 2nd\ Three\ Largest\ Firms_{i,t}}\right). \quad (3)$$

I use this measure because measures of relative sales represent the market share of a firm more directly than does market value. Columns (2) and (6) show that the relationship between this measure of industry structure and announcement returns is still positive and statistically significant for both samples. For an increase in the *Log top 123/456 size ratio* of one standard deviation, *CAR* is on average 1.85 and 2.64 percentage points higher for the 1982-1999 and 2000-2016 samples, respectively.

Market definition changes the calculations of any of the industry-related measures. To test that the definition of markets as FF48 industries is not causing the results in Table 2.4, Panel A, I use an alternate market definition—Hoberg-Phillips (2016) text-based analysis product markets. The Hoberg-Phillips product market data is available for 1997-

2015, so, to allow for comparison with the analysis in Panel A, Panel B shows the results of changing the definition of a market and completing the study for mergers in the 2000s. Results are robust to this change.

2.4.2 Determinants of Probability of Future Merger

The remainder of the paper focuses on what determines the probability that one firm will acquire another. GKR's (2009) second hypothesis states that the likelihood of a merger occurring in the future is increasing in the percentage of medium-sized firms in an industry. They test this by assigning an indicator variable (*Future merger*) to each firm for whether the firm is involved in a merger in the future. Their specification is as follows:

$$Future\ merger_{j,i,t} = f(Pct\ medium - sized\ firms_{i,t}, controls_{j,i,t}). \qquad (4)$$

Future merger is the indicator variable that equals one if a firm *j* in industry *i* and year *t* is involved in a future merger and zero otherwise. *Pct medium-sized firms* is the percentage of total firms in an industry with total assets between 5% and 30% of the total assets of that industry's largest firm.[7] GKR (2009) predict that the coefficient on *Pct medium-sized firms* is positive.

Table 2.5, Panel A shows the results of this estimation. In column (1) the coefficient on *Pct medium-sized firms* is positive and highly statistically significant for the 1982-1999 sample. The marginal effect reported in the table shows that an increase of one percentage point in *Pct medium-sized firms* is associated with an increase in the likelihood of acquisition in the following year of 0.35 percentage points. This evidence aligns with the

[7] Gorton et al. (2009) use this definition of "medium-sized firms" because they believe the range includes firms that are large enough that if they make a major acquisition they deter other firms from acquiring them, but they are small enough that if they make a small acquisition, they become a more attractive target. In other words, medium-sized firms could effectively engage in deterrent or positioning acquisition behavior.

eat or be eaten theory, and the coefficients in column (4) tell a similar story. For the 2000-2016 sample, the coefficient on *Pct medium-sized firms* is statistically as well as economically significant. A one-percentage-point increase in the percentage of medium-sized firms in an industry increases the likelihood of a firm acquiring in the future by 0.29 percentage points.

In columns (2) and (5) of Table 2.5, the regression outcomes for *Pct medium-sized firms* include *High tech*. When a high-tech firm is deciding to merge, it may consider that high-tech firms are more likely to face an antitrust challenge and avoid future antitrust costs by declining to merge at all. If this is the case, the coefficient on *High tech* should be negative. It is also important to consider that the O'Steen (2018) results come from analysis of mergers in the 2000s. Since this period is one of significant technological advance, *High tech* may play a different role during this time, and the antitrust agencies may have alternate ways of judging mergers involving high-tech firms in later years. I propose that the technological advances of the more recent past make it difficult for antitrust agencies to understand how mergers of high-tech firms will impact competition. For that reason, there will be less significance on the coefficient of *High tech* for 1982-1999 than 2000-2016.

For the early sample, column (2) shows no noteworthy statistical significance. This indicates that whether a firm is high-tech does not matter when making a merger decision for this sample. The result is different for the later sample. The coefficient on *High tech* indicates that a deal with a high-tech acquirer is approximately one-half of a percent less likely to happen than with a different type of acquirer. This is evidence that firms take their "high-tech-ness" into account before deciding to merge, and high-tech firms are less likely to merge in the future.

To test the robustness of the GKR (2009) results to changing the market definition, I use Hoberg-Phillips (2016) text-based analysis product markets instead of FF48 industries. Table 2.5, Panel B shows that for 2000-2015, the results are similar. The coefficient on *Pct medium-sized firms* in any specification remains positive and significant, though the economic significance is not as high as that of the 2000-2016 sample using FF48 market definitions. A one-percentage-point increase in the percentage of medium-sized firms in an industry is associated with a 0.209-percentage-point increase in the likelihood of future merger. The coefficient on the interaction term is negative. Market definition does not drive the statistical results.

2.5 RESULTS: EXTENDING EAT OR BE EATEN

This section presents the results of extending GKR's (2009) eat or be eaten theory to account for antitrust considerations.

2.5.1 Likelihood of Future Merger

In addition to replicating the GKR (2009) test of eat or be eaten, I conduct additional tests to further examine which firms merge when a regime shift leads to merger activity in an industry. I do not disagree with the prediction of GKR (2009) H2 that the quantity of mergers is higher in industries with more medium-sized firms, and indeed, our results are supportive, but in some cases, a firm may not have the luxury of making any acquisition it wants if it is large enough that an acquisition might bring antitrust scrutiny. My hypothesis is that in industries with many medium-sized firms, the largest of those firms will be less likely to acquire if they are among the largest in the industry. To test this, I add an

interaction term to the GKR (2009) model. The term accounts for the percentage of medium-sized firms in an industry and if a firm is large relative to its industry. I call this variable *PctMed × Large* and define it as:

$$PctMed \times Large_{j,i,t} = Pct\ medium - sized\ firms_{i,t} \times Large_{j,i,t}, \quad (5)$$

where *Large* equals 1 if firm *j* holds at least 20% of the market share of its industry *i* and 0 otherwise. I expect to see a negative coefficient on *PctMed × Large*. With my additions and including *High tech*, the regression specification is:

$$Future\ merger_{j,i,t} = f(Pct\ medium - sized\ firms_{i,t}, PctMed \times Large_{j,i,t},$$
$$High\ tech_{j,i,t}, controls_{j,i,t}), \quad (6)$$

where the control variables include those used in the GKR (2009) analysis: *Log value*, *Market/book*, *Equity/assets*, *EBITDA/sales*, *Industry Herfindahl*, *Recent acquisition*, and dummies for year and industry.

The results of tests of my hypothesis are found in columns (3) and (6) of Table 2.5. These two specifications add the dummy variable *Large* and the interaction term *PctMed × Large*. For the period examined by GKR (2009), column (3) shows that *Pct medium-sized firms* is still positively and significantly related to the likelihood of future acquisition. Also, the coefficient on *High tech* still has little statistical significance for 1982-1999. *PctMed × Large* has negligible statistical significance.

Now, see column (6). The results here reflect the GKR (2009) hypothesis that industries with more medium-sized firms will be more likely to engage in merger activity in the future. The coefficient on *Pct medium-sized firms* is positive and statistically significant. Consistent with the finding reported in column (5), we see that for 2000-2016 the coefficient on *High tech* remains negatively related to *Future merger*. The coefficient

on the interaction term is negative and statistically significant. For the sample of recent years, large firms in industries with many medium-sized firms are less likely to acquire another firm in the following year than smaller firms. This supports my hypothesis that larger firms in certain industries tend not to acquire to potentially avoid antitrust problems.

I believe the difference in levels of statistical significance for *PctMed×Large* between the two samples is explainable. Antitrust policy changes over time, and it is likely that firms alter their acquisition behavior in response to these changes. For example, the Horizontal Merger Guidelines were revised at the end of the 1990s in a way that made it more difficult for firms to prove that the efficiencies they claim will make an acquisition beneficial to the market are true efficiencies.[8] This increases the cost of being challenged and might influence firms that expect a higher likelihood of challenge to decide not to acquire in the future. Antitrust policy changes can come in the form of executive branch changes, as well, and the Obama presidential administration (2008-2016) is known as one that tightened regulation, including merger regulation. The late sample includes the Obama administration years, and this is an alternative explanation for the lack of statistical significance on the interaction term for the 1982-1999 sample.

[8] Prior to the publication of the 1997 Horizontal Merger Guidelines, firms did not have to prove the efficiencies they claimed would result from the challenged deal. Because "much of the information relating to efficiencies is uniquely in the possession of the merging firms" and "efficiencies projected reasonably […] by the merging firms may not be realized," the Horizontal Merger Guidelines were changed to reflect that firms "must substantiate efficiency claims so that the Agency [DOJ or FTC] can verify by reasonable means the likelihood and magnitude of each asserted efficiency, how and when each would be achieved (and any costs of doing so), how each would enhance the merged firm's ability and incentive to compete, and why each would be merger-specific." (1997 Horizontal Merger Guidelines, Section 4)

2.5.2 Potential Mergers and Herfindahl Challenge Thresholds

Analysis that hinges on the idea that some mergers do not occur because antitrust costs are prohibitive is inherently challenging. The problem is that we know only which mergers are announced, not the ones that never make it to an announcement. Therefore, we may never observe mergers that remain unannounced because managers are avoiding antitrust problems. To address this, one may consider every potential merger and its expected outcomes.

In the case of the U.S. antitrust authorities, a focal point of the decision to challenge is the expected Herfindahl Index and changes in this index. At any point, a firm could merge with any other firm. I call such a merger a "potential merger." Each potential merger could cause a change in the Herfindahl, and the antitrust authorities would examine this change. The FTC and DoJ define thresholds of changes in the Herfindahl that they use for merger evaluation, so I use the same standards to look at potential mergers. The 2010 Merger Guidelines state that industries with a Herfindahl below 0.15 are considered unconcentrated markets, those with a Herfindahl between 0.15 and 0.25 are moderately concentrated, and those with a Herfindahl above 0.25 are highly concentrated. Mergers resulting in highly concentrated markets and involving an increase in Herfindahl of at least 0.01 are likely to face antitrust scrutiny.[9] For each potential merger, I calculate the resulting Herfindahl and change in Herfindahl. Potential mergers between firms in different Fama-French 48 industries would have a Herfindahl change of zero since a merger like this would not change the industry's concentration. I calculate the change in the Herfindahl for all other potential mergers as the difference between the

[9] Previous versions of the Merger Guidelines have slightly different Herfindahl thresholds. I use those thresholds for appropriate years in the sample.

current Herfindahl and the Herfindahl resulting from removing the individual merging firms' squared market shares and adding the combined firm's squared market share. The following represents the change in the Herfindahl:

$$\Delta HHI = HHI_1 - HHI_0$$

where

$$HHI_0 = \sum_{i=1}^{n} s_i^2$$

and

$$HHI_1 = \sum_{i=1}^{n} s_i^2 - s_{Firm\ 1}^2 - s_{Firm\ 2}^2 + s_{Combined}^2. \quad (7)$$

Here, s_i^2 is the squared market share of the industry held by firm i, Firm 1 and Firm 2 represent the two parties to a potential merger, and $s_{Combined}^2$ is the sum of Firm 1 and Firm 2's market shares squared.

With a measure of the expected change in the Herfindahl, I can determine if there is a connection between the likelihood of merging and the likelihood that there is an antitrust challenge for any firm. I assign a one to each potential merger that exceeds the thresholds for the expected Herfindahl and the expected change in it. Then I create a measure that represents the percentage of potential mergers for a firm that would trigger antitrust challenge based on the Herfindahl thresholds in the Merger Guidelines. I use the following logit specification to examine the link between future merger activity and the likelihood that there is an antitrust challenge:

$$Future\ merger_{j,i,t} = f(High\ \Delta HHI_{j,i,t}, controls) \quad (8)$$

where *High ΔHHI* is the percentage of potential mergers for any firm in the sample that would warrant antitrust scrutiny. I expect to find there is a negative relationship between

Future merger and *High ΔHHI* because firms will avoid future mergers that are likely to face antitrust problems.

Results are in Table 2.6. As in previous analysis, the sample is divided by year: 1982-1999 and 2000-2016. This table uses the Fama-French 48 industries to define markets and calculate the Herfindahl measures, and I use the same controls as in previous tables. In the older sample, the coefficient on *High ΔHHI* is negative and statistically significant. That is, for a given firm, the higher the percentage of potential mergers that have a high likelihood of challenge, the lower the likelihood that the firm will merge in the future. Marginal effects show that a one-percentage-point increase in *High ΔHHI* is associated with a 1.21 percentage-point decrease in the likelihood that there is a future merger for the 1982-1999 sample. While the 2000-2016 sample has negative and significant coefficients like 1982-1999, the marginal effects are smaller. A one-percentage-point increase in High HHI is associated with a 0.87 percentage-point decrease in the likelihood of future merger activity. The difference in magnitude between the two samples may stem from changes in enforcement.

2.6 CONCLUSION

This paper provides evidence that sharpens what we know about which firms in an industry engage in merger activity after a regime shift. First, I follow the work of Gorton et al. (2009) which shows that the structure of an industry affects the acquisition behavior of the firms in that industry. A replication of their empirical analysis on a recent set of data—2000-2006—yields two primary results: (1) the greater the discrepancy in size between the largest firms in an industry and smaller firms, the more profitable are mergers

in that industry after a regime shift, and (2) firms in industries with many medium-sized firms have a higher likelihood of merging in the future.

The latter result provides evidence that industry structure relates to merger activity, but firms do not make the decision to acquire based on industry structure alone. Another consideration is the potential antitrust costs associated with a merger challenge. These costs can be considerable, and if their expected value is too high, firms will decide not to merge to avoid expensive antitrust challenges. I propose that firms with characteristics that increase the likelihood of a merger challenge will be less likely to merge in the future in industries with many medium-sized firms that have been shown to have more merger activity. To test this proposition, I add variables linked to a higher probability of antitrust challenge to my analysis including the concentration threshold the antitrust agencies use to evaluate deals as well as firm size relative to the industry and whether a firm is high-tech (O'Steen, 2018). Indeed, firms in industries with high concentration and large firms are less likely to merge in the future for older (1982-1999) and more recent (2000-2016) data. High-tech firms are less likely to merge in the 2000-2016 sample. These results are evidence that managers take expected antitrust outcomes into consideration when deciding merger activity and determinants of antitrust challenge have a link with merger activity.

Furthermore, firms with a higher likelihood of facing antitrust scrutiny less likely to engage in future merger activity. Using thresholds set by the antitrust agencies of acceptable changes in the Herfindahl Index after a merger, I determine which potential mergers are likely to have an antitrust challenge. Results show that firms with a higher percentage of potential mergers that antitrust enforcers may consider problematic are less likely to merge. This finding indicates that managers make merger decisions based on

expected antitrust outcomes. Previous research suggests that regulation impacts merger activity and this paper illuminates the mechanism.

Table 2.1: Summary Statistics for Merger Samples

This table lists mean and median values of characteristics of non-financial mergers in FF48 industries with regime shifts. The columns for 1982-1999 give the statistics for my dataset during those years that are the same as the years used in Gorton et al. (2009). A merger is affected by a regime shift if the acquirer's FF48 industry had a regime shift in the two years prior to the observation. A list of regime shifts is in Table 2.3. All variables are defined in Appendix A.

	1982-1999		2000-2016	
	Mean	Median	Mean	Median
CAR	0.011	0.003	0.010	0.004
Log 123/456 size ratio	0.630	0.384	1.241	0.986
Log 123/456 sales ratio	0.817	0.465	1.449	1.051
Acquirer high tech	0.376	0.000	0.462	0.000
Cash	0.318	0.000	0.349	0.000
Ratio	0.316	0.000	0.115	0.026
Market value ($ billion)	1.730	0.243	2.731	0.588
Tgt. private	0.305	0.000	0.313	0.000
Tgt. subsidiary	0.306	0.000	0.299	0.000
Cross-industry	0.209	0.000	0.230	0.000
Competing bid	0.016	0.000	0.014	0.000
Tender offer	0.045	0.000	0.051	0.000
Industry Herfindahl	0.032	0.025	0.059	0.047
Observations	1,303		931	

Table 2.2: Summary Statistics for Firms in Industries with Regime Shifts

This table shows mean and median values for firms affected by regime shifts. The columns for 1982-1999 give the statistics for my dataset during these years that are the same as the years used in Gorton et al. (2009). A firm is affected by a regime shift if its FF48 industry had a regime shift in the two years prior to the observation. A list of regime shifts is in Table 2.3. Variable definitions are in Appendix A.

	1982-1999		2000-2016	
	Mean	Median	Mean	Median
Future merger	0.094	0.000	0.117	0.000
Share of industry that is small (size ratio <5%)	0.865	0.882	0.711	0.904
Share of industry that is medium-sized (size ratio between 5% and 30%)	0.107	0.063	0.148	0.051
Share of industry that is large (size ratio >30%)	0.028	0.017	0.141	0.032
Market Value ($ billion)	1.233	0.149	2.128	0.908
Market/book	1.551	1.315	2.162	0.767
Equity/assets	0.308	0.276	0.255	0.108
EBITDA/sales	0.038	0.020	0.061	0.052
Industry Herfindahl	0.076	0.031	0.089	0.007
Recent acquisition	0.088	0.000	0.119	0.000
Observations	10,243		6,487	

Table 2.3: Regime Shifts (1980-2015)

Panel A of this table lists the regulatory changes used to identify industries affected by them. Panel B lists the FF48 industries affected by a merger wave and the year in which the wave began.

Panel A: Regulatory Changes

Year	Event
1980	Motor Carrier Reform Act
1980	Household Goods Transportation Act
1980	Staggers Rail Act
1980	International Air Transportation Competition Act
1980	Deregulation of cable television (FCC)
1980	Deregulation of customer premises equipment and enhanced services (FCC)
1981	Decontrol of crude oil and refined petroleum products (executive order)
1981	Deregulation of radio (FCC)
1982	Bus Regulation Reform Act
1984	Space commercialization
1984	Cable Television Deregulation Act
1984	Shipping Act
1986	Trading of airport landing rights
1987	Sale of Conrail
1987	Elimination of fairness doctrine (FCC)
1988	Proposed rules on natural gas and electricity (FERC)
1988	Proposed rules on price caps (FCC)
1989	Natural Gas Wellhead Decontrol Act of 1989
1992	Cable Television Consumer Protection and Competition Act
1992	Energy Policy Act
1992	FERC Order 636
1993	Negotiated Rates Act
1994	Trucking Industry and Regulatory Reform Act
1995	ICC Termination Act
1996	Telecommunications Act
1996	FERC Order 888
1998	Pharmaceutical Products
1999	FERC Order 2000
2003	Medicare Prescription Drug, Improvement, and Modernization Act
2005	Energy Policy Act of 2005
2007	Energy Independence and Security Act of 2007

2008	Housing and Economic Recovery Act of 2008
2010	Patient Protection and Affordable Care Act
2011	Issuance of National Emissions Standards
2011	Energy Conservation Program
2011	Air Cargo Screening
2012	Adoption of New Healthcare Standards
2013	Drug Quality and Security Act
2014	STELA Reauthorization Act of 2014
2015	Clean Power Plan
2015	Open Internet Order

Table 2.3: Regime Shifts (1980-2015) (cont.)

Panel A of this table lists the regulatory changes used to identify industries affected by them. Panel B lists the FF48 industries affected by a merger wave and the year in which the wave began.

Panel B: Industries with Merger Waves

Year	Industry with Merger Wave
1985	Restaurants, Hotels, Motels
1986	Consumer Goods
1986	Electrical Equipment
1986	Transportation
1986	Business Services
1986	Retail
1987	Entertainment
1987	Communication
1992	Candy & Soda
1995	Chemicals
1996	Personal Services
1996	Healthcare
1996	Machinery
1996	Wholesale
1996	Retail
1996	Restaurants, Hotels, Motels
1997	Communication
1997	Business Supplies
1997	Petroleum and Natural Gas
1997	Transportation
1997	Steel Works
1997	Utilities
1998	Entertainment
1998	Computers
1998	Shipbuilding, Railroad Equipment
1998	Business Services
1998	Pharmaceutical Products
1998	Measuring and Control Equipment
1998	Medical Equipment
1999	Aircraft
1999	Electrical Equipment

1999	Food Products
2001	Business Services
2004	Medical Equipment and Pharmaceuticals
2004	Petroleum and Natural Gas
2005	Utilities
2005	Trading
2006	Business Services
2013	Real Estate
2014	Business Services

Table 2.4: Determinants of Acquirer Announcement CARs

This table displays the OLS regression results for the samples of non-financial mergers for which the acquiring firm's FF48 (Panel A) or Hoberg-Phillips (Panel B) industry is affected by a regime shift. The dependent variable is the merger announcement CAR. Specifications (1), (2), (5), and (6) replicate the results of Gorton et al. (2009) using size- and sales-based measures of industry structure while specifications (3), (4), (7), and (8) include variables related to the likelihood that a merger faces an antitrust challenge following the results of O'Steen (2018). Robust standard errors are used, and robust p-values are in parentheses. Results reflect correction for acquirer cluster effects. Significance levels are represented by *, **, and *** for the 10-, 5- and 1-percent levels, respectively. Each specification includes year and industry dummies. All variables are defined in Appendix A.

Panel A: FF48 Market Definitions

	1982-1999				2000-2016			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log top 123/456 size ratio	0.014*		0.009*		0.006**		0.010**	
	(0.068)		(0.071)		(0.031)		(0.029)	
Log top 123/456 sales ratio		0.009*		0.008**		0.012**		0.011**
		(0.059)		(0.048)		(0.037)		(0.042)
High conc. Δ			0.004	0.007*			0.006*	0.008*
			(0.106)	(0.091)			(0.094)	(0.095)
Acq high tech			0.003	0.005			-0.007	-0.002
			(0.434)	(0.386)			(0.178)	(0.216)
Deal size			0.137	0.114			-0.099	0.004
			(0.872)	(0.766)			(0.724)	(0.763)
Cash	-0.006	-0.008	-0.0079	-0.0083	-0.002	-0.005	0.0127	0.0098
	(0.199)	(0.213)	(0.134)	(0.171)	(0.198)	(0.211)	(0.250)	(0.279)
Ratio	0.010**	0.005*	0.009*	0.005	0.003	0.001	0.005	0.001
	(0.045)	(0.087)	(0.051)	(0.103)	(0.503)	(0.492)	(0.476)	(0.421)
Log mkt value	-0.001	-0.011	-0.002*	0.009*	-0.007	-0.015	-0.005*	-0.010*
	(0.191)	(0.138)	(0.065)	(0.084)	(0.240)	(0.234)	(0.091)	(0.089)
Tgt private	0.005**	0.001*	0.003*	0.004*	0.009**	0.006**	0.006*	0.010*
	(0.022)	(0.071)	(0.064)	(0.071)	(0.043)	(0.046)	(0.099)	(0.091)
Tgt subsidiary	0.006**	0.004*	0.004*	0.003*	0.004	0.003	0.002	0.002
	(0.039)	(0.052)	(0.089)	(0.084)	(0.167)	(0.186)	(0.311)	(0.335)
Cross-industry	0.007	0.006	0.011*	0.009	0.002	0.003	0.005	0.007
	(0.105)	(0.122)	(0.094)	(0.111)	(0.243)	(0.259)	(0.229)	(0.274)
Competing bid	-0.029	-0.030	-0.023	-0.022	0.028	0.034	0.019	0.021
	(0.171)	(0.136)	(0.158)	(0.162)	(0.217)	(0.202)	(0.183)	(0.199)
Tender offer	0.012	0.014	0.020	0.018	-0.004	0.002	0.001	0.003
	(0.160)	(0.155)	(0.102)	(0.146)	(0.781)	(0.804)	(0.694)	(0.692)
Industry Herfindahl	-0.007	0.001	-0.004	-0.005	-0.003	-0.003	-0.001	0.002
	(0.203)	(0.351)	(0.485)	(0.378)	(0.276)	(0.332)	(0.400)	(0.411)
Observations	1,303	1,303	1,303	1,303	931	931	931	931
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
R-squared	0.179	0.194	0.181	0.200	0.123	0.128	0.139	0.142

Table 2.4: Determinants of Acquirer Announcement CARs (cont.)

This table displays the OLS regression results for the samples of non-financial mergers for which the acquiring firm's FF48 (Panel A) or Hoberg-Phillips (Panel B) industry is affected by a regime shift. The dependent variable is the merger announcement CAR. Specifications (1), (2), (5), and (6) replicate the results of Gorton et al. (2009) using size- and sales-based measures of industry structure while specifications (3), (4), (7), and (8) include variables related to the likelihood that a merger faces an antitrust challenge following the results of O'Steen (2018). Robust standard errors are used, and robust p-values are in parentheses. Results reflect correction for acquirer cluster effects. Significance levels are represented by *, **, and *** for the 10-, 5- and 1-percent levels, respectively. Each specification includes year and industry dummies. All variables are defined in Appendix A.

Panel B: Hoberg-Phillips Market Definitions

	2000-2015			
	(1)	(2)	(3)	(4)
Log top 123/456 size ratio	0.008*		0.011**	
	(0.054)		(0.034)	
Log top 123/456 sales ratio		0.015***		0.017**
		(0.004)		(0.011)
High conc. Δ			0.004*	0.005*
			(0.071)	(0.083)
Acq high tech			-0.012	-0.005
			(0.223)	(0.259)
Deal size			0.136	0.091
			(0.692)	(0.718)
Cash	-0.003	-0.007	-0.015	-0.012
	(0.128)	(0.157)	(0.169)	(0.197)
Ratio	0.006	0.003	0.003	0.002
	(0.392)	(0.356)	(0.411)	(0.399)
Log mkt value	-0.004	-0.009	-0.005*	-0.008*
	(0.154)	(0.188)	(0.086)	(0.078)
Tgt private	0.012*	0.010*	0.007*	0.012*
	(0.072)	(0.067)	(0.113)	(0.128)
Tgt subsidiary	0.006	0.005	0.002	0.003
	(0.249)	(0.275)	(0.373)	(0.392)
Cross-industry	0.001	0.000	0.002	0.003
	(0.305)	(0.345)	(0.299)	(0.314)
Competing bid	0.017	0.022	0.024	0.025
	(0.235)	(0.219)	(0.227)	(0.254)
Tender offer	0.001	0.004	0.002	0.004
	(0.657)	(0.686)	(0.622)	(0.634)
Industry Herfindahl	-0.005	-0.004	-0.003	-0.001
	(0.202)	(0.214)	(0.350)	(0.321)
Observations	887	887	887	887
Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
R-squared	0.121	0.117	0.134	0.129

Table 2.5: Determinants of Probability of Future Merger

This table displays the logistic regression results for the samples of firm observations for which there is a regime shift. In Panel A, industries are assigned using the FF48 industry definitions. In Panel B, industries are defined using the Hoberg-Phillips (2016) product-market classifications. The dependent variable is Future merger. The marginal effects for Pct medium-sized firms are in italics. I use robust standard errors, and robust p-values are in parentheses. Results reflect correction for firm cluster effects. Significance levels are represented by *, **, and *** for the 10-, 5-, and 1-percent levels respectively. Each specification includes year and industry dummies. All variables are defined in Appendix A.

Panel A: FF48 Market Definitions

	1982-1999			2000-2016		
	(1)	(2)	(3)	(4)	(5)	(6)
Pct medium-sized	4.573**	5.277**	15.399***	1.917**	1.749**	2.020**
firms [5%,30%]	(0.033)	(0.049)	(0.003)	(0.022)	(0.022)	(0.018)
Marginal	*0.354*	*0.331*	*0.342*	*0.287*	*0.284*	*0.246*
Large			0.968			2.107
			(0.799)			(0.467)
PctMed × Large			-5.029			-6.213*
			(0.204)			(0.094)
High tech		11.571	-0.636		-0.804**	-0.683*
		(0.536)	(0.455)		(0.032)	(0.079)
Log value	0.059***	0.052***	0.069***	0.542***	0.569***	0.418***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market/book	-0.0039	-0.002	7.989	0.018	0.022	0.029
	(0.840)	(0.847)	(0.625)	(0.151)	(0.147)	(0.127)
Equity/assets	0.069	0.115	-0.193	0.106	0.194	0.547
	(0.858)	(0.621)	(0.137)	(0.173)	(0.291)	(0.282)
EBITDA/sales	0.101*	0.103	0.125	-0.137	-0.369	-0.328
	(0.078)	(0.134)	(0.336)	(0.241)	(0.187)	(0.198)
Industry	1.761	0.497	0.391	2.849	2.662	2.531
Herfindahl	(0.622)	(0.673)	(0.672)	(0.508)	(0.516)	(0.519)
Recent	1.889***	3.411***	4.022***	0.904**	0.693*	0.991**
acquisition	(0.000)	(0.000)	(0.000)	(0.013)	(0.065)	(0.024)
Observations	10,243	10,243	10,243	6,487	6,487	6,487
Year FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
R-squared	0.0774	0.0735	0.0736	0.0697	0.0681	0.0701

Table 2.5: Determinants of Probability of Future Merger (cont.)

This table displays the logistic regression results for the samples of firm observations for which there is a regime shift. In Panel A, industries are assigned using the FF48 industry definitions. In Panel B, industries are defined using the Hoberg-Phillips (2016) product-market classifications. The dependent variable is Future merger. The marginal effects for Pct medium-sized firms are in italics. I use robust standard errors, and robust p-values are in parentheses. Results reflect correction for acquirer cluster effects. Significance levels are represented by *, **, and *** for the 10-, 5-, and 1-percent levels respectively. Each specification includes year and industry dummies. All variables are defined in Appendix A.

Panel B: Hoberg-Phillips Market Definitions

	2000-2015		
	(1)	(2)	(3)
Pct medium-sized	1.308**	1.119**	1.547**
firms [5%,30%]	(0.036)	(0.034)	(0.029)
Marginal	*0.211*	*0.209*	*0.146*
Large			1.992
			(0.539)
PctMed × Large			-4.228*
			(0.047)
High tech		-1.562**	-1.215*
		(0.021)	(0.054)
Log value	0.429***	0.433***	0.431***
	(0.000)	(0.000)	(0.000)
Market/book	0.011	0.013*	0.017
	(0.196)	(0.098)	(0.127)
Equity/assets	0.0.212	0.243	0.437
	(0.283)	(0.274)	(0.318)
EBITDA/sales	-0.171	-0.249	-0.256
	(0.154)	(0.166)	(0.163)
Industry	2.565	2.433	2.238
Herfindahl	(0.742)	(0.726)	(0.725)
Recent	0.874**	0.719*	0.765*
acquisition	(0.047)	(0.068)	(0.071)
Observations	6,215	6,215	6,215
Year FE	Y	Y	Y
Industry FE	Y	Y	Y
R-squared	0.0625	0.0629	0.0657

Table 2.6: Potential Mergers and Herfindahl Challenge Thresholds

This table displays the logistic regression results for the samples of firm observations for which there is a regime shift. Industries are assigned using the FF48 industry definitions. The dependent variable is Future merger. The marginal effects are in italics. I use robust standard errors, and robust p-values are in parentheses. Results reflect correction for firm cluster effects. Significance levels are represented by *, **, and *** for the 10-, 5-, and 1-percent levels respectively. Each specification includes year and industry dummies. All variables are defined in Appendix A.

FF48 Market Definitions		
	1982-1999	2000-2016
High ΔHHI	2.718***	1.843***
	(0.000)	(0.001)
Marginal	*-1.211*	*-0.874*
Log value	0.244***	0.353***
	(0.000)	(0.000)
Market/book	-0.002	0.009
	(0.752)	(0.179)
Equity/assets	0.164	0.145
	(0.642)	(0.247)
EBITDA/sales	0.093	0.196
	(0.138)	(0.304)
Industry Herfindahl	2.435	3.005
	(0.697)	(0.421)
Recent acquisition	2.106***	1.298***
	(0.000)	(0.000)
Observations	10,243	6,487
Year FE	Y	Y
Industry FE	Y	Y
R-squared	0.1138	0.1041

CHAPTER 3

MERGERS AND ACQUISITIONS, ANTITRUST CHALLENGES, REMEDIES, AND MARKET POWER:

AN EMPIRICAL ANALYSIS[10]

[10] O'Steen, Haley. To be submitted to *Financial Management*.

Abstract

For a recent sample of mergers, I examine the likelihood that the Federal Trade Commission (FTC) or the Department of Justice (DoJ) issue an antitrust challenge against a proposed merger deal. In doing so, I explore the relationship between various proxies for market power and the likelihood of a challenge—the early stage of the antitrust enforcement process—and the nature of remedies assigned by antitrust agencies in the late stage of the antitrust enforcement process. Industry concentration measured by the Herfindahl-Hirschman Index (HHI), a form of which the antitrust agencies use to assess deal competitiveness, is related to the likelihood that there is an antitrust challenge, though results differ based on the definition of a market. Alternative, firm-level measures of market power—price-cost margin (PCM) and the Lerner Index—have only insignificant relationships with the likelihood of challenge. However, the PCM and the Lerner Index have a positive and significant association with remedy size. Other factors alleged to impact antitrust enforcement—deal size and if a merger is high-tech—that are theoretically unrelated to customer protection prove to be strong determinants of the probability of challenge but not of remedy size. These findings together suggest that determinants of antitrust challenge include characteristics both related and unrelated to competitiveness while the final decision of deal anti-competitiveness—the remedy—is more directly related to competitiveness. Also, the results herein help us to understand how U.S. antitrust policy works in the realm of mergers and acquisitions.

3.1 INTRODUCTION

Merger and acquisition activity can have significant impacts on the landscape of an industry. It is also a major event in the life of a firm. However, an antitrust challenge can alter or halt the occurrence of such activity, and the past two decades have brought an increase in the number and size of deals challenged on antitrust grounds. Figure 1 is a visualization of this increase in antitrust case filings by year. Such challenges and the associated remedies imposed by regulators are potentially costly for the firms involved. Thus, it is essential for boards, managers, and shareholders to understand what leads to antitrust challenges and the nature of remedies imposed by antitrust enforcers.

The research in this paper sheds light on antitrust enforcement in the U.S. and the determinants of challenge and the size of remedies. For a set of announced deals between 2008 and 2016, I model the likelihood that antitrust regulators challenge a proposed deal as a function of proxies for the deal's expected market power and other variables not directly related to competition to understand the determinants of a challenge. It is important to recognize expected market power because Section 7 of the Clayton Act prohibits merger and acquisition (M&A) activity that "lessen[s] competition, or tend[s] to create a monopoly" and increases market power. Since antitrust authorities judge M&A deals based on the expected impact on the competitive environment, I focus on the likelihood that the Federal Trade Commission (FTC) or Department of Justice (DoJ) challenge a deal based on measures of the expected market power of the combined entity. Though the goal of antitrust enforcement is to protect competition, some suggest that the antitrust agencies consider factors unrelated to competition when deciding to challenge a merger. In this paper, I examine two such factors—deal size and whether a merger is high-tech—in

addition to measures of market power. I find that concentration, one of the measures of market power, is positively related to the likelihood that an announced merger has an antitrust challenge. Also, large deals and those with high-tech acquirers are more likely to face antitrust scrutiny.

Using the sample of challenged deals in isolation, I also examine the outcomes for firms facing such challenges. From a cost-benefit perspective, if the expected costs of merging are greater than the benefits, firms will forego the transaction. Such costs include those associated with required remedies and termination fees in the rare case that a deal is prohibited. Regarding the former, we know from the Merger Guidelines that the DoJ and FTC decide remedies based on the expected anti-competitiveness of a merger. Indeed, press releases issued by the agencies announcing remedy settlements typically argue that "[the remedies] would resolve the competitive harm alleged in the lawsuit."[11] Therefore, one would expect a transaction viewed as being highly anti-competitive to have a larger required remedy than a minimally anti-competitive transaction would. At the same time, the antitrust agencies have discretionary power to assign remedies, and anecdotal evidence suggests that remedies are ineffectual. I explore these issues empirically by focusing on the magnitude of remedies conditioned on various measures of challenged deals' expected market power. As an added contribution, I develop estimates of the magnitude of these remedies and explore how the magnitude of remedies is related to various measures of challenged deals' expected market power. Results show that non-concentration measures of market power have a strong association with remedy size.

[11] This is the exact language used in many press releases from the FTC or DoJ about merger cases. An example of its use is in the DoJ's press release about divestiture requirements for Entercom's acquisition of CBS Radio (U.S. Department of Justice, Office of Public Affairs, 2017).

Another contribution of this paper is a comparison of the use of different measures of market power. For several decades, the merger guidelines published by the FTC and DoJ indicate that when examining deal competitiveness, the focus is on market concentration. The agencies use the Herfindahl-Hirschman Index (HHI) to measure market concentration using internal data gathered in the call for information required of challenged firms at the beginning of an investigation. This has been standard practice since the publication of the 1982 Merger Guidelines.[12] Moreover, the 1992 Merger Guidelines included threshold levels of the HHI and changes in the HHI that the agencies loosely use to evaluate the anti-competitiveness of merger deals. Though not dogmatic in their application of the HHI thresholds, the agencies often cite concentration concerns as their reason for challenging a deal. For instance, the FTC challenged the proposed merger between pharmaceutical companies Mylan Incorporated and Agila Specialties in 2013 based on expected increases in concentration (Clark, 2013). Since the FTC and DoJ use concentration as a basis for issuing an antitrust challenge, I use the HHI, a measure of concentration, as a proxy for market power in my analysis. As additional measures of market power, I use PCM and the Lerner Index, which measure the difference between price and marginal cost. For this reason, they are considered more direct measures of competition in a market than concentration is (Boone, 2008). I find that the measures of market power are relatively uncorrelated.

[12] The Merger Guidelines are an outline, published by the FTC and DoJ, that present the agencies' enforcement policy relating to horizontal mergers and acquisitions. The guidelines give details of the processes and standards by which they analyze mergers. These guidelines are not law but state that "although the guidelines should improve the predictability of the Agenc[ies'] merger enforcement policy, it is not possible to remove the exercise of judgment from the evaluation of mergers under the antitrust laws." The 2010 Merger Guidelines is available at https://www.justice.gov/atr/horizontal-merger-guidelines-0.

Finally, the set of data I use in the analysis in this paper is unlike any published studies of antitrust enforcement. By collecting original case files, I gained access to more data about the details of a given merger, including divestiture sizes and the exact dates of complaint and divestiture filings, than one can glean from the reports about antitrust filings the FTC and DoJ publish yearly. This dataset allows a more detailed examination of both value effects and the size of remedies. The findings from this unique dataset suggest that the empirical link between market power and the probability of a deal receiving an antitrust challenge varies with the specific measure of concentration used. An increase in the probability of challenge is consistent with the agencies' following the market concentration doctrine in practice. Regarding remedies, I find that PCM and the Lerner Index are positively related to divestiture size. This suggests that the agencies use direct indicators of competitiveness than concentration to make the remedy decision.

3.2 BACKGROUND

The role of antitrust agencies is to "identify and challenge competitively harmful mergers while avoiding unnecessary interference with mergers that are either competitively beneficial or neutral" (U.S. Department of Justice, 2010). Underlying this statement from the 2010 Merger Guidelines is the prognosticative nature of evaluating mergers. The agencies note this in the Merger Guidelines stating, "merger analysis is necessarily predictive, requiring an assessment of what will likely happen if a merger proceeds as compared to what will likely happen if it does not." In line with this, research findings indicate that current market power is not predictive of the probability of challenge. Individual market power of the acquirer and target have only a weak relationship with the

likelihood of challenge (Asch, 1975; Eckbo, 1985). For this reason, I do not use individual market power to estimate the probability of a challenge. Instead, I use the expected, future market power of the combined entity.

One problem arises from using concentration to identify anti-competitive behavior. Some argue that anti-competitiveness is too complicated to be recognized by a simple measure of concentration. There is general uncertainty as to what constitutes anti-competitive behavior. A precise definition of it would allow for more specific, defined regulation, which in turn would allow us to estimate probabilities more accurately. Stigler (1966) wrote, "Our difficulty rests on one fundamental fact: we do not have a generally accepted theory […]. If we had such a theory, it would tell us what the determinants […] are." And today, the problem is still present. Published merger guidelines exist, but these are vague, written by the U.S. enforcement agencies—the FTC and DoJ—and are not legally binding.[13]

The empirical literature measuring probabilities related to merger challenges is slim, but various papers study the determinants of antitrust activity. Prior research reports the following determinants of antitrust challenges: size of industry sales increases probability of challenge (Asch & Seneca, 1975), number of rivals decreases probability and concentration ratio in target's industry increases probability (Eckbo, 1985, 1992), Wall

[13] Note this statement from the 1992 Merger Guidelines. "Although the Guidelines should improve the predictability of the Agency's merger enforcement policy, it is not possible to remove the exercise of judgement [sic] from the evaluation of mergers under the antitrust laws. Because the specific standards set forth in the Guidelines must be applied to a broad range of possible factual circumstances, mechanical application of those standards may provide misleading answers to the economic questions raised under the antitrust laws. Moreover, information is often incomplete, and the picture of competitive conditions that develops from historical evidence may provide an incomplete answer to the forward-looking inquiry of the Guidelines. Therefore, the Agency will apply the standards of the Guidelines reasonably and flexibly to the particular facts and circumstances of each proposed merger." (U.S. Department of Justice, 1992)

Street Journal coverage increases probability (Coate, Higgins, & McChesney, 1990), and innovativeness increases probability (Khan, 1999).

This paper is similar in spirit to Kwoka (2015). He focuses on the concentration benchmarks established in the Merger Guidelines and estimates the probability of antitrust challenges dependent on HHI and expected changes in it. Based on aggregate data of mergers between 1999 and 2003 published by the FTC, Kwoka looks at the impact that HHI and the change in HHI have on this probability. Consistent with the implication in the Merger Guidelines that the agencies use these measures to make regulatory decisions, he finds that the likelihood of a challenge is higher when there is higher concentration and when there is a higher change in concentration. More unusually, though, there is a significantly negative coefficient in the interaction term between the two, so when there is both a high HHI and a substantial change in HHI, the likelihood of a challenge decreases. Kwoka, however, uses only highly aggregated data in his analysis, specifically, the number of deals happening in a year, the number of deals within certain HHI ranges, and the number of deals within a range of change in HHI. I provide an in-depth analysis using a more detailed set of challenged deals.

As with this paper, Gao, Peng, and Strong (2017) study the determinants of antitrust case selection for horizontal mergers from 1980 to 2009 with the goal of determining the efficiency of antitrust regulation and enforcement. Over this period, antitrust regulators challenge nine percent (35 deals) of the merger sample faced antitrust challenge. Gao et al. (2017) find that the FTC and DoJ follow the concentration hurdle guidelines in the Merger Guidelines. However, there is no evidence that the agencies enforce antitrust regulations with the goal of protecting the consumer. Instead, rival groups have influence to sway

antitrust intervention, and a challenge is less likely when there is more foreign import competition than less. Using a more recent sample that overlaps that of Gao et al. (2017) for only two years, my findings suggest that the agencies do not follow the concentration guidelines in the Merger Guidelines. Rather than refuting their results, this may be evidence that the Obama administration enforces the guidelines differently than previous presidential administrations.

While the challenge is an interesting aspect of antitrust to study, it is an early stage of the antitrust enforcement process. At this point, the agencies are simply deciding whether to pursue an investigation of an announced merger, and this is far from a final decision about the competitiveness of the merger. A later stage of the process—the assignment of a required remedy—is where the challenging agency makes a final decision about the level of deal anti-competitiveness. Due to the added detail in my hand-collected dataset, I can investigate the nature of these remedies and add to what we know about the antitrust enforcement of mergers and acquisitions.

Previous literature is scant and the results inconclusive. Some research indicates that though the goal of remedies is to eliminate anti-competitive effects, they may not be as effective as intended in practice. A theoretical study, Vasconcelos (2010), approaches remedies as plays in a more dynamic game between merging firms and an antitrust agency. This model implies that antitrust authorities tend to demand divestitures that are greater than necessary to recreate the pre-transaction level of competition. In contrast to Vasconcelos (2010), other scholars and critics of antitrust policy suggest that divestitures are not always stringent enough to reverse monopoly power. Medvedev (2004) provides empirical evidence of this. He concludes that divestitures may be a valuable tool in

proactively curbing monopoly power in proposed mergers, but the antitrust agencies do not use divestitures effectively.

I examine required remedies in a new way. Rather than analyzing their efficiency to correct anti-competitiveness, I study the determinants of remedy size. In this paper, I show that certain measures of market power explain remedy size well.

3.3 DATA

3.3.1 Merger Sample

The base sample is mergers of publicly traded U.S. firms between 2008 and 2016 from the Securities Data Corporation database (SDC). This period is of interest because it spans the Obama administration, which was purportedly particularly tough on anti-competitive behavior. Following the approach of Gorton et al. (2009), I apply several filters to arrive at the final sample. Here, the definition of a merger deal is the purchase of equity of at least 50% of another firm where the bidder owns at least 90% of the target post-purchase. I also exclude deals valued at less than $1 million and those in which the purchase price is less than 5% of the market value of the acquirer. Additionally, both the target and the acquirer must have the requisite data available on Center for Research in Security Prices (CRSP) and Compustat. Following this procedure results in a sample of 291 deals. Of these, there were 62 challenges.

3.3.2 Challenged Merger Deals

When either the FTC or DoJ files a lawsuit to block a merger under Section 7 of the Clayton Act, the challenge becomes official. For each challenge, the FTC and DoJ release the documents related to the case including the official complaint and the final judgment or consent decree. These documents, found in the FTC's Competitive Enforcement Database and the DoJ's Antitrust Case Filings, give details of an antitrust case, the parties to the deal, and decisions made about the case. Fee and Thomas (2004) document that the joint annual report released by the FTC and DoJ provides a more accurate list of challenged deals than do news searches using Factiva. My list of challenged deals with case filings is the same as that used by Fee and Thomas (2004), and I develop my data-set using case documents. By collecting the original case files, I have access to more data about the details of a given merger. Of note, I gather information regarding specific filing and order dates as well as divestiture outcomes. There are 62 such cases between 2008 and 2016. Thus, the unconditional probability of a challenged deal involving a public acquirer during the sample period is 21%.[14]

Of these 62 deals, 43 are now complete; the remaining 19 deals were canceled. Seventeen of these canceled mergers are cases in which the merging parties agreed to drop the deal after the challenge. One such dropped deal was the proposed Staples acquisition

[14] The focus of this paper is on horizontal mergers and acquisitions, and these are the ones most commonly challenged by the FTC or DoJ. However, the agencies cover more antitrust issues than those related to horizontal mergers and acquisitions. Therefore, my process of collecting antitrust-challenge data involves separating the horizontal-merger cases from everything else. In a complaint filing, one can readily recognize the nature of the complaint by seeing the law on which the agency is suing. In the case of horizontal mergers' antitrust problems, the claim is that firms are violating Section 7 of the Clayton Act which prohibits acquisitions of stock or assets where "the effect of such acquisition may be substantially to lessen competition, or to tend to create a monopoly" (15 U.S. Code § 18).

of Office Depot. The firms announced the planned transaction in early 2015, and in December, the FTC filed an official complaint. In March 2016, Staples and Office Depot called off the merger. Of the entire sample, antitrust regulators prohibited only two deals: Aetna/Humana and Anthem/Cigna, both healthcare deals announced in 2015.

3.3.3 Remedies

In addition to the set of mergers, I gather estimates for the magnitude of remedies, when required by the antitrust authorities, which typically involve divestitures. I obtain the size of these divestitures from either SDC or estimated values as reported in the business press. To supplement my use of actual remedy sizes and address any inaccuracies in the press estimates, I also estimate market reactions to the announcements of divestitures.

The FTC and DoJ antitrust cases for horizontal mergers and acquisitions include data on case outcomes. The most common outcome is a settlement between the challenged parties and the antitrust agency, which involves a remedy. Presumably, the size of a remedy should be proportional to the level of a deal's anti-competitiveness since the remedy should eliminate any anti-competitive effects. Cosnita and Tropeano (2006) show that this should be the case; more efficient, i.e., more competitive, merged entities should have smaller asset transfers than less efficient merged entities. In this paper, I find this is the case when I use PCM and the Lerner Index as proxies for competition.

3.3.4 Measuring Market Power

I use five measures to proxy for expected market power: Compustat Herfindahl-Hirschman Index (HHI), Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index,

and a census-based HHI. The Merger Guidelines suggest that the FTC and DoJ rely on standard Herfindahl measures to judge deal competitiveness, so I use several Herfindahl measures in my analysis. The Compustat HHI is simply the HHI calculated using Compustat data, and I define product markets using the Fama-French 48-Industry classifications (FF48). For each acquirer, I calculate its total, squared market share of the FF48 industry classification in which it falls. The Hoberg-Phillips (2010) HHI uses text-based analysis to determine product-market relatedness of firms for every year. Calculation of this version of the HHI is similar to the process used to calculate the Compustat HHI except that I determine the acquirer's squared market share of its respective product market. Product markets evolve, and because an essential part of the process of evaluating competition is defining the product market, the ability for product markets to change year to year offers a distinct advantage to the Hoberg-Phillips HHI over the Compustat HHI.

Measures based on the HHI raise questions because concentration may not be a good proxy for competitiveness. For that reason, PCM, the difference between price and marginal cost as a fraction of price, is as an alternative measure (Boone, 2008). The rationale is that this firm-level measure emphasizes the benefit a firm gets from selling above marginal cost. I calculate PCM using Compustat data following the Ornstein (1975) definition of the measure—

$$(Business\ Receipts - Costs\ of\ Sales\ and\ Operations - Officers'\ Salaries - Pensions - Other\ Employee\ Benefits - Advertising - Interest\ Paid - Depreciation - Rent\ Paid) \div Business\ Receipts.^{15} \quad (9)$$

[15] Compustat variables used for the Ornstein (1975) definition of PCM are as follow: sale, cogs, fatb, stfws, xpr, stkco, dcom, xad, tie, depc, and xrent.

The Lerner Index, commonly used in the literature, measures market power in a manner similar to PCM. I use Grullon, Larkin, and Michaely's (2016) operating profit margin implementation—

$$\frac{Operating\ Income - Depreciation}{Total\ Assets}. \quad (10)$$

The final market power measure I use is the Herfindahl index calculated using census-based data. Keil (2017) compiles data based on concentration data from the U.S. Census Bureau that is intended to take the place of Compustat. He argues that the Compustat HHI is unsuitable for measuring concentration and develops the census-based measure included in my analysis.

3.3.5 Other Determinants of Antitrust Challenge

Although we do not have a clear understanding of how the FTC and DoJ make antitrust decisions in the realm of mergers and acquisitions, we have some idea of factors other than market power that may have a relationship with the probability of challenge.

Current antitrust policy is grounded in the preservation of consumer welfare, but in recent years some commentators have suggested that "big is bad" rather than "harm to the consumer is bad" in what some are calling "hipster antitrust." Senator Orrin Hatch (R-Utah) calls hipster antitrust the "progressive standard" of antitrust enforcement, suggesting that antitrust enforcers increasingly challenge large deals "routinely

disregarding some of the most basic elements of the consumer welfare standard" (CSPAN, 2017).[16] For this reason, I include deal size in my estimations.

FTC Chairwoman Edith Ramirez also offers a glimpse into the inner workings of antitrust policy in her keynote remarks at the 2016 Global Antitrust Enforcement Symposium. She acknowledges that antitrust authorities may be likely to hinder innovation in high-tech markets, because "high tech […] markets may have certain characteristics that have the potential to raise competition concerns" (Ramirez, 2016). Thus, high-tech deals may have a link to the likelihood of antitrust challenge.

3.4 DESCRIPTIVE STATISTICS

3.4.1 Probability of Challenge

Table 3.1 provides insights into characteristics of the set of challenged deals. Challenged deals are larger and have higher market-to-book ratios. The Compustat HHI is lower for challenged deals, but challenged and unchallenged deals have similar Hoberg-Phillips HHIs. The average Hoberg-Phillips HHI values for both challenged and unchallenged deals falls within the agencies' range for being "moderately concentrated." The census HHI is also higher for challenged deals. PCM and the Lerner Index are higher for challenged deals than for unchallenged deals, suggesting that lower market power characterizes challenged deals. Note in Table 3.2 that the correlations between all measures

[16] Sen. Hatch's suggestion is in line with the Gao et al. (2017) findings that the antitrust agencies do not seem to challenge deals with consumer protection in mind.

are relatively low. The highest correlation of 0.2607 is between PCM and the Lerner Index, which is not surprising given the commonalities in these calculations.

The possible range for all measures of HHI is 0.0-1.0. The lower bound of 0.0 indicates a low-concentration industry while the upper bound of 1.0 indicates a highly concentrated industry. The FTC and DoJ use an HHI measurement, but they do not reveal their methods for calculating it. According to the 2010 Merger Guidelines, which reflect the framework the FTC and DoJ use to judge M&A deals, the average Compustat HHI reported in the table for challenged deals is categorized as "unconcentrated" and for unchallenged is categorized as "moderately concentrated." The agencies issue these internal guidelines periodically to assist in making decisions that are in their discretionary realm. However, it is important to note that these guidelines are not legislative rules but simply policy statements.[17]

3.4.2 Remedy Data

In the set of challenged-deals, 19 were canceled or prohibited, 41 were approved subject to structural remedies in the form of divestitures, and two deals required conduct remedies.[18] The case filings contain detailed descriptions of the required divestitures and,

[17] The 2010 Merger Guidelines state that the antitrust agencies use the following three market classifications: Unconcentrated Markets (HHI below .15), Moderately Concentrated Markets (HHI between 0.15 and 0.25), and Highly Concentrated Markets (HHI above 0.25).

[18] The two deals in the sample for which there are conduct remedies rather than divestiture remedies are the acquisition of Coca-Cola Enterprises by The Coca-Cola Company announced in 2010 and the acquisition of DataQuick Information Systems, Inc. by CoreLogic, Inc. announced in 2013. The remedy announcement from the FTC for the Coca-Cola deal states, "The Federal Trade Commission […] announced that it will require The Coca-Cola Company to restrict its access to confidential competitive business information of rival Dr. Pepper Snapple Group as a condition for completing Coca-Cola's proposed $12.3 billion acquisition of its largest North American bottler [(Coca-Cola Enterprises)], which also distributes Dr. Pepper Snapple carbonated soft drinks." The FTC announced the following statement regarding the remedy for the CoreLogic deal: "To preserve competition that would be lost due to the acquisition, the FTC's final order

in some instances, specify the required purchaser of the divestiture. I match the details of the divested assets to SDC data and retrieve the value of the divestiture. This value is the measurement of the remedy, and there are 27 such values in my sample. In the 14 instances where SDC does not give the value of the divestiture, I use analysts' estimates of the value to represent the actual remedy value. For the two challenged deals with behavioral remedies—those with boundaries for a combined firm's future behavior or property rights—it is difficult to assign an exact value to these remedies.

Given that nearly one-third of the sample divestiture sizes are estimates, to add to the analysis, I use the market response to divestiture announcements to estimate the impact of divestitures. I do this by measuring the cumulative abnormal return (CARs) for the acquirers. AR_{ijt} is the abnormal return around the announcement of divestitures. I calculate the actual return using both the market model and the Fama-French 3-factor model. The CAR is as follows:

$$CAR_{i,j,t} = \sum AR_{i,j,t} \tag{11}$$

with an event window of (-1, 2) and an estimation window of 120 days. Alternate specifications of the event and estimation windows do not substantively change the results in this analysis.

On average, the divestiture size is 1.805% of the size of the transaction, and the maximum divestiture size for the sample is 9.195%.

requires CoreLogic to license to Renwood RealtyTrac LLC national assessor and recorder bulk data as well as several ancillary data sets that DataQuick provides to its customers."

3.5 MULTIVARIATE ANALYSIS

3.5.1 Estimating Probability of Challenge

To address the first question in this paper—what is the likelihood that a deal faces an antitrust challenge given the various measures of market power—I run basic logit and linear probability regressions represented by

$$Challenge_{i,j,t} = \alpha + \beta_1 * MktPwr\ measure_{i,t} + \beta_2 * Transaction\ value_{i,j,t}$$

$$+\gamma * controls_{i,j,t} + \varepsilon. \quad (12)$$

Challenge is the indicator that equals one if a deal faces an antitrust challenge from the FTC or DoJ and equals zero otherwise. *MktPwr measure* represents any of the measures of market power in this paper: Compustat HHI, Hoberg-Phillips HHI, PCM, the Lerner Index, and the census-based HHI. The variable *Transaction value* is deal value in millions of dollars. Controls include the number of legal advisors to the acquirer, an indicator for whether the target is a subsidiary, an indicator for whether SDC classified the acquirer as belonging to a high-technology (high-tech) industry, and an indicator for deals in which payment is at least 90% cash. I include the number of legal advisors because firms are more likely to have more legal advisors in the presence of legal problems such as an antitrust challenge. Whether or not the target is a subsidiary has an impact on the CAR of a deal (Fuller, Netter, & Stegemoller 2002). The high-tech dummy controls for differences of firm structure between high- and low-technology companies. Finally, payment type is related to the CAR of a deal. In some specifications, these regressions also include year fixed effects.

I begin with a logit model. Panel A of Table 3.3 presents the results of this analysis. The table indicates that in a logit specification, the Compustat HHI is associated with a

decrease in the probability of challenge. If the Compustat HHI is an accurate measure of market power, this result is consistent with a negative association between market power and the likelihood of challenge. In the logit framework, both the Hoberg-Phillips HHI and Lerner Index have statistically significant, positive relationships with the probability of challenge. This is the relationship I anticipate given the stated goals of the antitrust agencies. There is still little significance for the PCM or the census-based HHI. Across the board, antitrust regulators are more likely to challenge larger deals regardless of the market-power proxy. This could be an indication that the FTC and DoJ tend to challenge based on deal size rather than anti-competitiveness, and this idea lines up with the Watts and Zimmerman (1978) conclusion that larger firms tend to attract more government interference. Year fixed effects have little impact on outcomes.

The increased probability of challenge associated with deals where the acquirer is in a high-tech industry suggests that the antitrust agencies may be identifying deals where the acquiring firm is on the cusp of a technological advantage. In this case, such deals may have low market power in the year following the antitrust challenge, but the FTC or DoJ recognizes its potential for monopoly power in the longer term.

Due to potential problems with interpreting coefficients using the logit model, I estimate linear probability specifications as an alternative and report the results in Table 3.3, Panel B. The results show negative and significant coefficients on the Compustat HHI but low significance on the Hoberg-Phillips HHI or the PCM. A first interpretation may be that a negative coefficient on the Compustat HHI is surprising given that the Merger Guidelines state that the FTC and DoJ use the Herfindahl Index in the decision-making

process. However, this may indicate that the agencies use their discretionary powers more than the arbitrary boundaries in the Merger Guidelines.

In the antitrust realm for mergers and acquisitions, the definition of what constitutes a market is vital in the identification of anti-competitive behavior. The fact that there is little significance on the Hoberg-Phillips HHI suggests that its use of alternative product market definitions does not help identify deals that will face antitrust challenges. Additionally, PCM, a more direct measure of competition than the Compustat HHI, tells us very little about the mechanism for determining potential challenged deals.

The coefficients on *Transaction value* and *High-tech acquirer* are highly significant across all linear probability specifications. *Transaction value* is positively related to the probability of challenge, suggesting that deal size is important in the agencies' decisions to identify potentially anti-competitive deals. A one-percentage-point increase in the value of a transactions translates to an increase in probability of challenge of about 0.08 percentage points. This makes sense because transaction value is easily measured and may offer a yardstick to evaluate deals quickly and easily before a challenge. The same may be true of deals with *High-tech acquirer* = 1, which is also positively related to the probability of challenge. An announced merger with a high-tech acquirer is approximately 8% to 10% more likely to be challenged than a merger a low-tech acquirer. These patterns persist with and without year fixed effects.

3.5.2 Divestiture Size Results

I also analyze the relationship between market power and required remedies for challenged deals. Using a hand-collected set of divestiture sizes, I construct a relative divestiture size measure. This is the ratio of the divestiture size to the value of the deal, and I call this *Divestiture ratio*. The divestiture ratio is the dependent variable in the analysis reported in Table 3.4, Panel A which is modeled by:

$$Divestiture\ ratio_{i,j,t} = \alpha + \beta_1 * MktPwr\ measure_{i,t}$$

$$+\beta_2 * Log\ transaction\ value_{i,j,t} + \gamma * controls_{i,j,t} + \varepsilon. \qquad (13)$$

As in the analysis of the probability of challenge, *MktPwr measure* represents any of the five measures of market power: Compustat HHI, Hoberg-Phillips HHI, PCM, the Lerner Index, and census HHI. *Transaction value* represents deal size. *Controls* includes the number of legal advisors to the acquirer, an indicator for whether the target is a subsidiary, an indicator for whether SDC classifies the acquirer as a high-technology firm, and an indicator for deals in which payment is at least 90% cash. All specifications include year fixed effects.

On the market power measures in Table 3.4, Panel A, only the measures of margin—PCM and the Lerner Index—show statistical significance in the divestiture ratio regressions. In contrast to the analysis of antitrust challenge in which the natural logarithm of the transaction value and the high-tech dummy had significant, positive relationships with the likelihood of challenge, these variables load significantly only when using the Lerner Index.

Challenged mergers canceled before finalization of the case are excluded in the sample used in Table 3.4, Panel A. If deal cancelation signifies that managers foresee antitrust costs to be too great—so great that they are willing to incur termination fees—then these excluded deals are important to examine. They represent a set of deals that may be so costly to pursue that managers decline to face the antitrust ramifications. The termination fees can be considered a lower bound of remedy size, since, presumably, managers prefer to pay them than to take on future remedies. The analysis in Table 3.4, Panel B is similar to that in Table 3.4, Panel A, but it includes the previously excluded deals where *Remedy ratio* is the ratio of the divestiture size or termination fee to the size of the transaction. Panel B shows a similar relationship between a measure of remedy size and market power measures, size of the deal, and high-techness to that in Panel A. With canceled, challenged mergers, PCM and the Lerner Index are significantly related to the relative size of the remedy. Deal size and whether there is a high-tech acquirer also have a significant link to the size of the remedy.

Taken in conjunction with the results discussed under the section Estimating the Probability of Challenge, this is evidence that the antitrust agencies challenge deals based on easily measurable characteristics but remedy those deals based on other considerations. Expected market power, as measured by more direct measures of competition than HHI, such as the PCM and Lerner Index, may be an example of another consideration. A more pessimistic explanation is that firms involved in larger deals can afford better lobbying or legal resources that allow them to avoid substantial remedies.

3.5.3 Divestiture Announcement CAR Results

Because my sample does not include divestiture size for every challenged deal, I also use the market reaction to announcements of divestitures as an alternative to the divestiture ratio. For deals where the remedy requires divestitures, there are two notable dates. The first is the date when the FTC or DoJ announces requirements of divestitures because the respective agency and the firms involved have reached a settlement. The second date is when the case is officially finalized and the final order is issued. I estimate the CARs for these dates and regress them on the measures of market power.

Table 3.5 reports the results using market-model and Fama-French 3-factor estimation. Panel A provides results for the date of the divestiture announcement and Panel B for the final order. In Panel A, there is a differing association between cumulative returns around divestiture announcements and both the Compustat HHI and the Lerner Index. Deals with higher Compustat HHIs exhibit lower CARs when the divestiture is first announced but deals with higher Lerner Indices have higher CARs at that time. There is also a positive relationship between the divestiture announcement CARs and the census-based HHI, shown in columns (1) – (3) using the market model to calculate CARs. There is little evidence in Table 3.5, Panel B to show that market power, however measured, is significantly associated with acquirer returns at the announcement of completion of the antitrust case.

In further tests to identify any patterns related to high versus low divestiture size, I examine median breakpoints for divestiture sizes and market responses. I assign divestiture ratios, CARs for divestiture announcements, and CARs for final order dates to two groups:

above the median and below. I regress this new dummy variable—*Below median*—on the market power measures as:

$$Below\ median_{i,j,t} = \alpha + \beta_1 * MktPwr\ measure_{i,t} + \beta_2 * Ln\ transaction\ value_{i,j,t} + \gamma * controls_{i,j,t} + \varepsilon. \quad (14)$$

Below median equals one if a value falls below the median. *MktPwr measure*, *Transaction value*, and *controls* represent the same variables as in previous analysis.

The results in Table 3.6 Panel A report regression results when *Below median* is an indicator variable for the below-median divestiture ratios. The market-power measures do not load significantly, but there is some significance between *Below median* and the natural logarithm of the transaction value and the high-tech dummy. The greater the transaction value, the more likely a deal is to have an above-median divestiture ratio. Specifically, a one-percentage-point increase in deal size is associated with approximately a 0.40-percentage-point decrease in the likelihood of having a relatively small required divestiture. Similarly, deals with high-tech acquirers are more likely to have above-median divestiture ratios. Based on this finding, large, high-tech deals are more likely to have higher divestiture requirements relative to the deal size.

Panels B and C show results for market reactions to divestiture announcements and final orders, respectively. Using median breaks for returns at these events, I find that there is little information in measures of market power, deal size, or technology classification.[19]

[19] Dividing the sample into tercile splits instead of median splits yields no significant findings.

3.5.4 Multinomial Logit

A stated goal of the antitrust agencies about mergers is to "deter or counteract the competitive effects of concern." Remedies counteract anti-competitive effects and are measurable, but how can we evaluate mergers that never occur because of deterrence? While this is a challenge, a first step is to start with the set of announced mergers, then track the ultimate outcomes. We can view deals canceled after an antitrust challenge as situations in which the parties concluded that the antitrust costs of merging were too high. In this way, these cancelled deals have a very high expected remedy. Thus, in the entire sample of mergers and acquisitions there are three categories of transactions: unchallenged deals, i.e., no remedy is required, deals that are challenged and ultimately completed, i.e., the benefits of the merger outweigh the cost of the remedy, and deals that are challenged but not consummated, i.e., the remedy is too costly. In a multinomial logit framework, I assess the different possible outcomes in relation to the five measures of market power used in this paper and controls. I model this by:

$$Deal\ status_{i,j,t} = \alpha + \beta_1 * MktPwr\ measure_{i,j,t} + \beta_2 * Log\ transaction\ value_{i,j,t} + \gamma * controls_{i,j,t} + \varepsilon. \quad (15)$$

Deal status is an indicator for the three possible categories into which any deal observation may fall—unchallenged, challenged-completed, and challenged-uncompleted deals. *MktPwr measure* represents any of the five measures of market power: Compustat HHI, Hoberg-Phillips HHI, PCM, the Lerner Index, and the census-based HHI. *Transaction value* represents deal size. *Controls* includes the number of legal advisors to the acquirer,

an indicator for whether SDC classifies the acquirer as a high-tech firm, and an indicator for deals in which payment is at least 90% cash.

Table 3.7 presents the results of this analysis. Unchallenged deals are the baseline in the regression. The relative probability of a challenge for a deal that is eventually completed is significantly lower for those with higher expected Compustat HHIs. This is consistent with the Compustat HHI result in the Estimating the Probability of Challenge section regarding the probability of challenge. This is not the case for any of the other measures of market power. Again, we see that the likelihood of challenge is higher for larger transactions where a one-percentage-point increase in transaction value is associated with at least a 0.30-percentage-point increase in likelihood of challenge and completion relative to unchallenged.

Whether the acquirer is high tech is not related to the relative probability of challenge and subsequent deal cancellation, though classification as high tech is related to the relative probability of challenge and deal completion. A deal with a high-tech acquirer is more likely to end up challenged and completed than unchallenged, but the job of antitrust enforcement is complicated when it comes to high-tech deals. On the one hand, the uncertainty of the future of technology makes it impossible for the antitrust authorities to see how anti-competitive a deal may be. On the other hand, the authorities do not want to impede technological progress (Cass, 2013). It is possible that high-tech acquirers, recognizing the opposing forces facing antitrust authorities, expect the FTC or DoJ to err on the side of allowing technology to progress while maintaining the power to deter very anti-competitive deals.

Included among controls in earlier sections of the paper is the natural logarithm of an acquirer's market capitalization. In other analyses, there was no statistical loading on the variable. However, this reversed in the multinomial logit regressions. Table 3.7 shows the relative probability of a challenged deal being dropped is significantly lower for deals with higher acquirer market capitalization. This is an indication that the antitrust authorities choose to challenge M&A deals based on the sizes of firms involved. If this is the case, deals challenged on size alone will not be as anti-competitive as small-firm deals challenged because they are in clear violation of antitrust regulation. Therefore, deals with smaller acquirers may be more likely to cancel after an antitrust challenge.

3.6 CONCLUSION

While there is a broad sense of what antitrust agencies focus on when analyzing mergers—potential market power—there is a lack of clear decision rules for the process. This ambiguity makes an empirical exploration of what explains their decision to challenge a merger difficult in some ways. Regulatory challenges to mergers on antitrust grounds are costly for firms, yet there is little systematic evidence in the literature to indicate what drives such challenges or the resulting costs. This paper explores these and related issues using a unique, hand-collected dataset on deal challenges and remedies from FTC and DoJ filings. The results in this paper begin to shed light on the inner workings of U.S. antitrust enforcement in recent years.

The expectation under the current antitrust policy is that enforcing agencies identify anti-competitive deals by a process involving foresight of the resulting changes in market

power. I use five measures including various calculations of concentration and price-cost margin to proxy for market power in analysis of two stages of antitrust enforcement—the antitrust challenge and the issuance of the remedy to offset anti-competitive effects. I find that the HHI with Hoberg-Phillips product markets defining industries has a positive link with the decision to challenge at the first stage. At the challenge stage, measures that do not inform us about the competitive nature of a potential merger have descriptive power. A one-percentage-point increase in deal size is associated with a 0.08 percentage-point increase in the likelihood that a merger faces an antitrust challenge, and mergers with high-tech acquirers are approximately 9% more likely to face a challenge. Differentiating between challenged deals that are completed and those that are dropped, I find that large deals are more likely to be challenged than unchallenged, overall. Mergers with high-tech acquirers are more likely to be challenged and end up completed than to be unchallenged, but they are not more likely to be challenged but canceled before the end stage of the antitrust process.

Examination of the remedies required of parties to challenged mergers yields more insight into the M&A antitrust process. In the late stage of the antitrust enforcement process, the antitrust agencies define remedies required of the merging parties to correct anti-competitive problems with a proposed deal. Using divestiture value to proxy for remedy size, I find that mergers in which the acquirer has a larger PCM or Lerner Index have relatively larger remedies, but the value of a transaction and whether the acquirer is high-tech are statistically unrelated to remedy size.

Together, the finding for the challenge and remedy stages of the antitrust enforcement process indicate that the antitrust agencies use may use industry concentration

and obvious firm characteristics in the decision to challenge, but they look more directly at competition when deciding the level of anti-competitiveness at the second stage.

As yet, we understand little about specifically how the FTC and DoJ issue merger-related challenges or remedies. This paper takes the first step at empirically examining how various measures of market power are associated with the likelihood of a deal challenge, and it shows the results of unique analysis involving the size of remedies assigned to correct anti-competitive merger behavior.

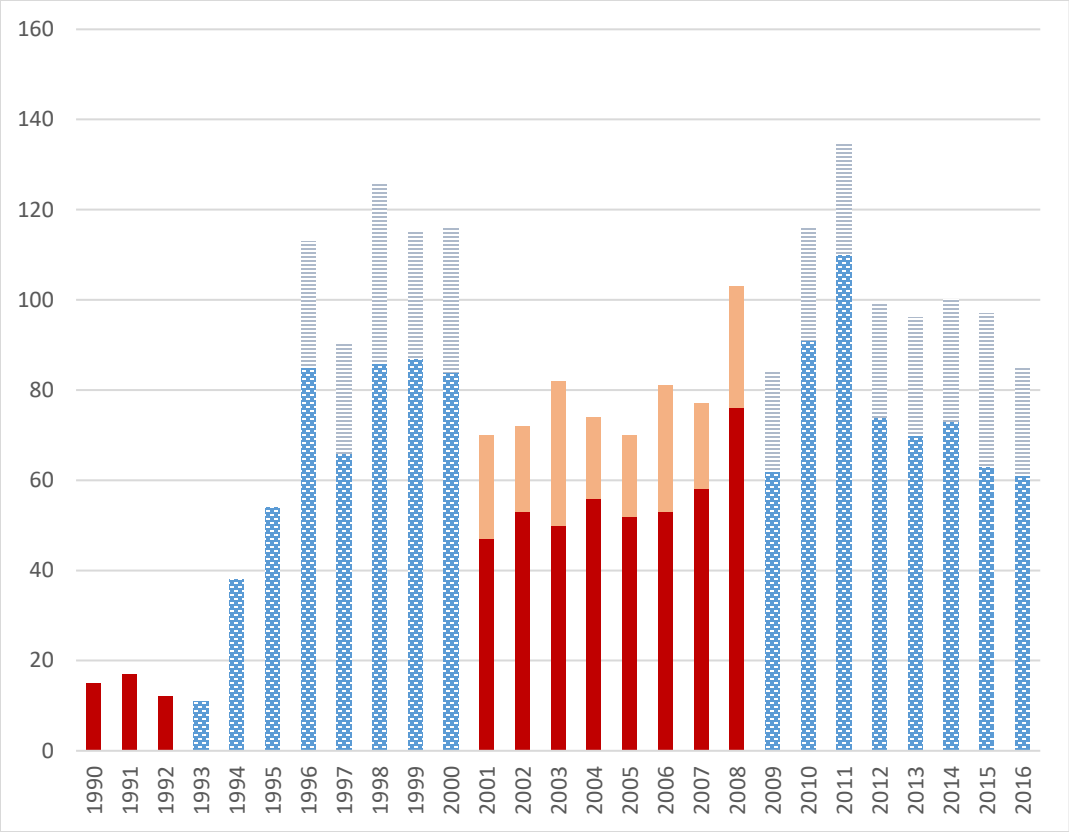

Figure 3.1: Number of Antitrust Case Filings (1990-2016)

This figure shows the number of antitrust case filings between 1990 and 2016. Republican presidential administrations are represented with solid bars and Democrat administrations are represented with patterned bars. Bottom bars represent the number of case filings by the Department of Justice, and top bars represent the number of case filing by the Federal Trade Commission starting in 1996.

Table 3.1: Merger Descriptive Statistics

This table provides details of the sample of deals in this paper. Divided into challenged and unchallenged deals, these are announced 2008 or later and completed 2016 or earlier. Values represent the numbers for the year of a given transaction for public acquirers. Transaction Value is the deal value in millions of dollars. Compustat HHI, Hoberg-Phillips HHI, Price-cost margin (PCM), Lerner Index, and Census HHI represent each of the measures of market power used in this paper.

		Transaction Value (mil)	Compustat HHI	Hoberg-Phillips HHI	PCM	Lerner Index	Census HHI
Challenged	*Average*	$5,311.82	0.0033	0.2083	0.2710	0.0866	0.0838
	Std Dev	$11,641.51	0.0204	0.1908	0.3722	0.0438	0.1680
	Min	$8.70	0.0000	0.0374	-0.7195	0.0245	0.0003
	Max	$68,000.00	0.1293	0.8024	1.0002	0.2313	1.0000
	n=	61	61	61	59	55	61
Unchallenged	*Average*	$130.44	0.1722	0.2115	-0.3271	-0.0162	0.0440
	Std Dev	$195.83	0.1676	0.2130	5.0692	0.2773	0.0501
	Min	$5.00	0.0131	0.0156	-64.1415	-2.4788	0.0010
	Max	$949.34	1.0000	1.0000	9.7665	0.5186	0.4262
	n=	272	263	272	251	230	225

Table 3.2: Market Power Correlations

This table displays the correlation coefficients between the measures of market power used in this paper: Compustat HHI, Hoberg-Phillips HHI, Price-cost margin (PCM), Lerner Index, and Census HHI.

	1	*2*	*3*	*4*	*5*
1. Compustat HHI	1.0000				
2. Hoberg-Phillips HHI	0.1686	1.0000			
3. PCM	0.0211	0.0584	1.0000		
4. Lerner Index	-0.0438	0.0329	0.2607	1.0000	
5. Census HHI	0.0275	0.0604	-0.0165	0.0294	1.0000

Table 3.3: Probability of Challenge

This table presents coefficients for Logit regressions. The dependent variable is whether a deal is challenged by antitrust authorities (challenged equals one if a deal was challenged, zero otherwise.) Transaction value is the deal value in millions of dollars. High-tech acquirer is a dummy which equals one if the acquirer is classified as a high-tech firm by SDC. Also included are controls: number of legal advisors, dummies for subsidiary targets, and payment in at least 90% cash. Values in parentheses are standard errors. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. N= observations values are given by # unchallenged and # challenged. Variables are defined in Appendix B.

Panel A: Logit

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Compustat HHI	-72.1777*** (23.7439)					-107.3505*** (36.4667)				
Hoberg-Phillips HHI		3.079** (1.4917)					7.1621*** (2.4312)			
PCM			0.2461 (0.4939)					1.2439 (1.1755)		
Lerner Index				12.0564*** (4.4575)					12.1290** (4.9358)	
Census HHI					1.0368 (0.2998)					-2.4172 (3.7485)
Log transaction vale	0.9125*** (0.3178)	1.4452*** (0.3054)	1.2891*** (0.2324)	1.1952** (0.2339)	1.3500*** (0.2998)	1.4401*** (0.5127)	1.9396*** (0.4487)	1.3430*** (0.3271)	1.2942*** (0.2709)	1.4602*** (0.2892)
Marginal	*0.1203*	*0.1488*	*0.0826*	*0.0881*	*0.0830*	*0.0977*	*0.1340*	*0.0836*	*0.0714*	*0.0865*
High-tech acquirer	1.7899* (0.3165)	1.6386 (0.6592)	1.2186** (0.5181)	1.1054** (0.5242)	0.1649** (0.6615)	3.6951** (1.7239)	2.6127*** (0.9456)	1.8638** (0.7722)	1.7295*** (0.6390)	2.4464*** (0.7530)
Marginal	*0.2976*	*0.2647*	*0.1040*	*0.1186*	*0.0258*	*0.2581*	*0.2590*	*0.0968*	*0.1038*	*0.0203*
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	Y	Y	Y	Y	Y
Pseudo R-squared	0.7566	0.5423	0.5347	0.5375	0.5508	0.8101	0.6678	0.6017	0.5594	0.5668
Chi-squared	150.06	91.48	131.08	120.01	94.46	149.64	104.19	94.81	108.21	108.89
# Unchallenged	173	187	180	150	163	173	187	180	150	163
# Challenged	61	61	59	51	54	61	61	59	51	54

Table 3.3: Probability of Challenge (cont.)

This table presents coefficients for basic linear probability regressions. The dependent variable is whether a deal is challenged by antitrust authorities (challenged equals one if a deal was challenged, zero otherwise.) Transaction value is the deal value in millions of dollars. High-tech acquirer is a dummy which equals one if the acquirer is classified as high-technology by SDC. Also included are controls: number of legal advisors, dummies for subsidiary targets, and payment in at least 90% cash. Values in parentheses are standard errors. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. N= observations values are given by # unchallenged and # challenged. Variables are defined in Appendix B.

Panel B: Linear Probability

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Compustat HHI	-0.7559*** (0.1324)					-0.7123*** (0.1343)				
Hoberg-Phillips HHI		0.1652* (0.0911)					0.1769*** (0.0914)			
PCM			0.0030* (0.0041)					0.0023 (0.0041)		
Lerner Index				-0.0419 (0.0940)					-0.0868 (0.0934)	
Census HHI					0.1501 (0.3562)					0.1610 (0.3462)
Log transaction value	0.0635*** (0.0097)	0.0774*** (0.0101)	0.0845*** (0.0103)	0.0919*** (0.0128)	0.0829*** (0.0112)	0.0652*** (0.0098)	0.0777*** (0.0100)	0.0817*** (0.0104)	0.0908*** (0.0131)	0.0822*** (0.0112)
High-tech acquirer	0.0747** (0.0387)	0.0954** (0.0407)	0.0864** (0.0427)	0.1110** (0.0506)	0.1042** (0.0524)	0.0836** (0.0385)	0.1023** (0.0402)	0.0963** (0.0417)	0.1270** (0.0497)	0.1196*** (0.0165)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	N	N	N	N	N	Y	Y	Y	Y	Y
Adj. R-Squared	0.3950	0.3556	0.4167	0.3925	0.4122	0.4055	0.3789	0.4472	0.4245	0.4513
F-stat	26.35	23.71	29.33	22.54	26.24	14.24	13.56	14.75	11.54	13.69
# Unchallenged	173	187	180	150	163	173	187	180	150	163
# Challenged	61	61	59	51	54	61	61	59	51	54

Table 3.4: Divestiture Ratio Regressions

This table shows results of regressing the divestiture ratio (divestiture size divided by deal size) on measures of market power: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, and payment in at least 90% cash. Values in parentheses are standard errors. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel A: Dependent Variable—Divestiture Ratio

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	-1.0645				
	(2.2988)				
Hoberg-Phillips HHI		0.5034			
		(0.4436)			
PCM			0.4472***		
			(0.1434)		
Lerner Index				8.1247***	
				(1.9876)	
Census HHI					-0.1913
					(1.1572)
Log transaction value	-0.0306	0.0318	0.0181	0.2498***	-0.0140
	(0.0431)	(0.0596)	(0.0374)	(0.0801)	(0.0467)
High-tech acquirer	0.0440	0.0683	0.0089	0.6079***	0.0668
	(0.1249)	(0.1226)	(0.1027)	(0.2124)	(0.1368)
Log acq market cap	0.0263	0.0569*	0.0131	0.1389***	0.0390
	(0.0261)	(0.0306)	(0.0231)	(0.0321)	(0.0279)
Controls	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Adj. R-squared	0.1621	0.1082	0.3899	0.5495	0.3883
F-stat	1.47	1.31	2.63	3.99	0.3104
# Challenged	42	43	43	37	31

Table 3.4: Divestiture Ratio Regressions (cont.)

This table shows results of regressing the divestiture ratio (divestiture size divided by deal size) on measures of market power: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, and payment in at least 90% cash. Values in parentheses are standard errors. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel B: Dependent Variable—Divestiture Ratio, Including Break-up Fees

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	-1.6185				
	(2.7459)				
Hoberg-Phillips HHI		0.5253			
		(0.4089)			
PCM			0.5997***		
			(0.2077)		
Lerner Index				7.3685***	
				(2.0381)	
Census HHI					0.2324
					(1.3903)
Log transaction value	-0.0352	0.0407	0.0741*	0.2617***	0.0083
	(0.0411)	(0.0643)	(0.0408)	(0.0824)	(0.0475)
High-tech acquirer	0.0680	0.0827	0.0105	0.7164***	0.0549
	(0.1276)	(0.1346)	(0.1173)	(0.2234)	(0.1402)
Log acq market cap	0.0278	0.0603*	0.0234	0.2004***	0.0518*
	(0.0270)	(0.0359)	(0.0306)	(0.0498)	(0.0292)
Controls	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Adj. R-squared	0.1742	0.1161	0.4003	0.5817	0.3976
F-stat	1.52	1.37	2.93	4.15	0.58
# Challenged	57	58	58	52	46

Table 3.5: Divestiture Announcement and Final Order CARs

This table presents the results of regression the CARs at the divestiture announcement on the market power measures: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. CARs are measured for time (-1,2). For each date, CARs are estimated using the market model and the Fama-French 3-factor model. Transaction value is the deal value in millions of dollars. Standard errors are in parentheses. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel A: Divestiture Announcement CARs

	CAR at Divestiture Announcement (MM)					*CAR at Divestiture Announcement (FF)*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Compustat HHI	-0.5600**					-0.5230**				
	(0.2718)					(0.2631)				
Hoberg-Phillips HHI		0.0382					0.0357			
		(0.0341)					(0.0329)			
PCM			0.0187					0.0148		
			(0.0193)					(0.0188)		
Lerner Index				0.3413**					0.3157**	
				(0.1602)					(0.1556)	
Census HHI					0.1106*					0.1080*
					(0.0609)					(0.0587)
Log transaction value	-0.0011	0.0006	-0.0002	0.0053	-0.0008	-0.0013	0.0004	-0.0005	0.0047	-0.0009
	(0.0045)	(0.0048)	(0.0047)	(0.053)	(0.0033)	(0.0043)	(0.0047)	(0.0046)	(0.0051)	(0.0032)
High-tech acquirer	-0.0226*	-0.0162	-0.0178	-0.0083	-0.0006	-0.0234*	-0.0176	-0.0187	-0.0103	-0.0027
	(0.0137)	(0.0137)	(0.0140)	(0.0136)	(0.0100)	(0.0132)	(0.0132)	(0.0136)	(0.0131)	(0.0097)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adj. R-squared	0.042	0.1535	0.1678	0.0341	0.3444	0.0204	0.1231	0.1476	0.0192	0.3782
F-stat	0.87	0.56	0.53	0.9	2.58	0.94	0.64	0.58	0.94	2.82
# Challenged	42	43	43	37	34	42	43	43	37	34

Table 3.5: Divestiture Announcement and Final Order CARs (cont.)

This table presents the results of regression the CARs at the final order on the five market power measures: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. CARs are measured for time (-1,2). For each date, CARs are estimated using the market model and the Fama-French 3-factor model. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, high-tech acquirers, and payment in at least 90% cash. Standard errors are in parentheses. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel B: Final Order CARs

	CAR at Final Order (MM)					*CAR at Final Order (FF)*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*
Compustat HHI	-0.2111 (0.2906)					-0.2259 (0.2906)				
Hoberg-Phillips HHI		0.0004 (0.0357)					0.0041 (0.0357)			
PCM			-0.0154 (0.0212)					-0.0134 (0.0213		
Lerner Index				-0.0057 (0.1754)					0.0398 (0.1755)	
Census HHI					0.0492 (0.0816)					0.0699 (0.0827)
Log transaction value	-0.0043 (0.0048)	-0.0042 (0.0050)	-0.0048 (0.0047)	-0.0045 (0.0058)	-0.0068 (0.0044)	-0.0038 (0.0048)	-0.0035 (0.0050)	-0.0042 (0.0047)	-0.0032 (0.0057)	-0.0066 (0.0045)
High-tech acquirer	0.0031 (0.0148)	0.0057 (0.0141)	0.0071 (0.0141)	0.0050 (0.0148)	-0.0099 (0.0135)	0.0049 (0.0148)	0.0076 (0.0142)	0.0089 (0.0141)	0.0079 (0.0148)	-0.0082 (0.0136)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adj. R-squared	0.1867	0.179	0.1966	0.171	0.4054	0.1923	0.182	0.1948	0.1748	0.3962
F-stat	1.71	1.69	1.78	1.64	3.05	1.74	1.71	1.77	1.65	2.97
# Challenged	42	43	43	37	31	42	43	43	37	31

Table 3.6: Below-Median Divestiture Ratio and Market Response

This table reports the logit regressions of variables for divestiture ratio, divestiture announcement CARs, and final order CARs that fall below the median, on measures of market power: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, high-tech acquirers, and payment in at least 90% cash. A below-median value is represented by one and an above-median by zero. Standard errors are in parentheses. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel A: Below-Median Divestiture Ratio

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	-3.9127				
	(5.4699)				
Hoberg-Phillips HHI		3.1285			
		(2.3749)			
PCM			-0.8193		
			(1.2015)		
Lerner Index				-0.0756	
				(4.4649)	
Census HHI					-1.6548
					(5.1112)
Log transaction value	-0.4900*	-0.4611*	-0.4160*	-0.2773	-0.3571
	(0.2894)	(0.2942)	(0.2502)	(0.2606)	(0.2582)
Marginal	*-0.0436*	*-0.0521*	*-0.0499*	*-0.0483*	*-0.0414*
High-tech acquirer	-2.3358*	-2.5022**	-1.8859*	-2.2820*	-2.1238*
	(1.1995)	(1.2264)	(1.1627)	(1.2606)	(1.1368)
Marginal	*-0.0628*	*-0.0584*	*-0.0515*	*-0.0529*	*-0.0611*
Controls	Y	Y	Y	Y	Y
Pseudo R-squared	0.2858	0.3217	0.2861	0.3044	0.2792
Chi-squared	11.24	12.65	11.25	11.29	10.68
# Challenged	42	43	43	37	31

Panel B: Below-Median CAR (Divestiture Announcement)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	-11.7678				
	(6.8911)				
Hoberg-Phillips HHI		-2.0786			
		(2.2425)			
PCM			-2.2705*		
			(1.3910)		
Lerner Index				-3.0848	
				(5.4407)	
Census HHI					-6.5434
					(5.6546)
Log transaction value	-0.4189	-0.1679	-0.2232	-0.1043	-0.2500
	(0.3386)	(0.2476)	(0.2942)	(0.2460)	(0.3001)
Marginal	*-0.0024*	*-0.0066*	*-0.0037*	*-0.0031*	*-0.0052*
High-tech acquirer	-0.5963	0.1074	0.6009	-0.4416	0.0220
	(1.0112)	(0.9957)	(1.0444)	(0.9787)	(0.1074)
Marginal	*-0.0107*	*0.0023*	*0.0051*	*-0.0098*	*0.0018*
Controls	Y	Y	Y	Y	Y
Pseudo R-squared	0.2782	0.2048	0.2825	0.1855	0.3138
Chi-squared	11.23	8.27	11.41	6.96	12.08
# Challenged	42	43	43	37	31

Table 3.6: Below-Median Divestiture Ratio and Market Response (cont.)

This table reports the logit regressions of variables for divestiture ratio, divestiture announcement CARs, and final order CARs that fall below the median, on measures of market power: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, high-tech acquirers, and payment in at least 90% cash. A below-median value is represented by 1 and an above-median by 0. Standard errors are in parentheses. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Panel C: Below-Median CAR (Final Order)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	3.6371 (5.3882)				
Hoberg-Phillips HHI		-5.1593* (2.9605)			
PCM			-0.5397 (0.8006)		
Lerner Index				-6.1998 (5.3704)	
Census HHI					-9.2259* (5.3700)
Log transaction value	-0.1183 (0.2601)	-0.0650 (0.2515)	-0.0324 (0.2379)	0.1341 (0.2790)	0.0599 (0.2694)
Marginal	*-0.0113*	*-0.0099*	*-0.0056*	*0.0005*	*0.0017*
High-tech acquirer	0.0094 (1.0088)	0.7862 (1.0700)	0.4727 (1.0352)	-0.4057 (1.1261)	0.2906 (1.0308)
Marginal	*0.0219*	*0.0144*	*0.0194*	*-0.0026*	*0.0127*
Controls	Y	Y	Y	Y	Y
Pseudo R-squared	0.1756	0.2652	0.1762	0.2856	0.2463
Chi-squared	7.28	10.99	7.3	11.04	9.89
# Challenged	42	43	43	37	31

Table 3.7: Multinomial Logit

This table reports results of multinomial logit regressions of deal status (unchallenged, challenged and completed, challenged and dropped) on the measures of market power: Compustat HHI, Hoberg-Phillips HHI, price-cost margin (PCM), the Lerner Index, and the census-based HHI. Transaction value is the deal value in millions of dollars. Also included are controls: number of legal advisors, dummies for subsidiary targets, high-tech acquirers, and payment in at least 90% cash. The baseline is unchallenged deals. Standard errors are in parentheses. Significance at the 1-, 5-, and 10-percent levels are annotated by ***, **, and *, respectively. Variables are defined in Appendix B.

Multinomial Logit—Unchallenged Deals Baseline

	Challenged—Completed					*Challenged—Dropped*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
Compustat HHI	-5.2930**					-5.6824				
	(2.6585)					(5.9597)				
Hoberg-Phillips HHI		0.919					-11.1644			
		(0.9486)					(8.2367)			
PCM			0.0219					1.9997		
			(0.0956)					(2.4133)		
Lerner Index				-0.5815					8.6636	
				(1.1096)					(13.1130)	
Census HHI					0.9067					0.9067
					(2.6687)					(2.6687)
Log value of transaction	0.2643**	0.31551**	0.2936**	0.3051**	0.3524***	2.0836***	2.6188**	2.0260***	1.9031***	2.3607***
	(0.1224)	(0.1270)	(0.1221)	(0.1395)	(0.1342)	(0.6814)	(1.0601)	(0.6107)	(0.5630)	(0.7856)
High-tech acquirer	0.8961**	1.1142**	1.0217**	1.1267*	1.0134***	0.0854	0.7250	-0.2982	0.0338	0.8668
	(0.4350)	(0.4352)	(0.0821)	(0.1435)	(0.4480)	(1.3487)	(1.5642)	(1.3345)	(1.2831)	(1.4573)
Log acquirer mkt cap	0.1242	0.1299	0.1406*	0.1565*	0.0765	-1.1254***	-1.3638**	-1.0123***	-0.9500***	-1.2008***
	(0.0814)	(0.0825)	(0.0821)	(0.0866)	(0.0847)	(0.4273)	(0.6161)	(0.3280)	(0.2910)	(0.4344)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pseudo R-squared	0.401	0.285	0.3794	0.3906	0.3948	0.401	0.285	0.3794	0.3906	0.3906
Chi-squared	112.72	65.64	105.31	99.26	104.52	112.72	65.64	105.31	99.26	104.52
N	247	247	238	229	216	247	247	238	229	216

CHAPTER 4

CONCLUSIONS

The research in this dissertation expands what we know about merger activity, U.S. antitrust policy, and the link between the two. In Chapter 2, following the work of Gorton et al. (2009), I show that the results they find are similar for a more recent set of data covering the 2000s through 2016. Announcement CARs are approximately 1.5 percentage points higher in industries where the ratio of the average size of the three largest firms to the average size of the second three largest firms is one standard deviation larger. Additionally, firms with one percentage point more medium-sized industries are associated with approximately a 0.3 percentage-point increase in the likelihood of acquiring in the future. However, I pose that while firm size relative to the industry impacts merger activity, size and other variables influence the likelihood that there will be an antitrust challenge, and firms may choose not to merge to avoid costs associated with a potential challenge. Therefore, in Chapter 3, I study the determinants of challenge. In this chapter, I show that the Herfindahl-Hirschman Index calculated using the Hoberg-Phillips text-based analysis definitions of product market, deal size, and whether the acquiring firm is "high-tech" are positively related to the likelihood of challenge. An increase in the value of transaction of one percentage point is associated with approximately a 7.7 percentage-point increase in the likelihood of challenge and deals with high-tech acquirers are approximately 10.0 percentage points more likely to face an antitrust challenge. I also find that at the stage of the antitrust

process in which the antitrust agencies determine the size of remedies required of parties to a merger, firms with higher price-cost margin or a higher Lerner Index have larger required remedies. However, deal size and whether the acquirer is high-tech do not have a significant relationship with the remedy size.

In Chapter 2, I extend the Gorton et al. (2009) analysis by incorporating the factors found in Chapter 3 to be related to the likelihood that the U.S. antitrust agencies challenge a merger. I find that the largest firms in industries with many medium-sized firms are less likely to merge in the sample of recent mergers (2000-2016) but not for the sample covering 1982-1999. The results may be different between the samples because of major changes made to antitrust policy at the end of the 1990s which made it more difficult to claim that a merger is efficient and competitive. Additionally, deals that would result in a high change in concentration are 0.87% less likely to merge in the future. Mergers with high-tech acquirers are 0.5% less likely to merge in the future. Together, the results in Chapter 2 are consistent with the proposition that managers weigh industry structure as well as antitrust considerations when deciding to acquire.

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APPENDIX A

Variable Definitions

This table lists the variables used in the analyses in Chapter 2 and their definitions.

Variable	Definition
Acq high tech	Dummy variable that equals one if the acquirer's industry is classified as high tech in SDC, zero otherwise.
CAR	The cumulative abnormal return of an acquirer for the merger announcement, the day before, and the day after.
Cash	Dummy variable that equals one if the deal was an all-cash transaction, zero otherwise.
Competing bid	Dummy variable that equals one if a merger has one or more competing bidders, zero otherwise.
Conc Δ	The expected change in concentration for a potential merger.
Cross-industry	Dummy variable that equals one if a merger occurred between firms in different FF48 industries, zero otherwise.
CRSP	Center for Research in Security Prices.
Deal size	The transaction value of a merger deal relative to the size of the acquirer.
Defensive merger	Mergers that occur when a manager is preventing a potential takeover which could reduce his or her private benefits.
DoJ	Department of Justice. An antitrust enforcing body in the U.S.
EBITDA/sales	A firm's EBITDA-to-sales ratio.
Equity/assets	A firm's equity-to-assets ratio.
FF48	Fama-French 48 industries.
FTC	Federal Trade Commission. An antitrust enforcing body in the U.S.
Future merger	Dummy variable that equals one if firm j announces an acquisition in the following year (t + 1), zero otherwise.
GKR	Gorton, Kahl, Rosen (2009).
Herfindahl	See Herfindahl-Hirschman Index.
Herfindahl-Hirschman Index	The sum of squared market shares of each firm competing in a market.
HHI	See Herfindahl-Hirschman Index.

High conc Δ	Dummy variable that equals one if a potential merger has a high expected change in concentration (according to the Merger Guidelines), zero otherwise.
High tech	Dummy variable that equals one if SDC classifies a firm as being in a high-technology industry.
High ΔHHI	The percentage of potential mergers for any firm in the sample that would result in a change in HHI great enough to warrant antitrust scrutiny based on the HHI change thresholds in the Horizontal Merger Guidelines.
Horizontal Merger Guidelines	An outline of the enforcement policy of the DoJ and the FTC concerning horizontal acquisitions and mergers.
Industry Herfindahl	An industry's Herfindahl index for year t.
Large	Dummy variable that equals one if a firm has a market share of 20% or greater, zero otherwise.
Log top-123/456 sales ratio	Natural logarithm of the ratio of the average sales of the three largest firms to the second-three-largest firms in the industry of the acquirer.
Log top-123/456 size ratio	Natural logarithm of the ratio of the average market size of the three largest firms to the second-three-largest firms in the industry of the acquirer.
Log value	Natural logarithm of the acquirer's equity market value.
Market value ($ billion)	The market value of a firm in billions of dollars.
Market/book	A firm's market-to-book ratio.
Med dummy	Dummy variable that equals one if at least one party to a potential merger has more than the median number of medium-sized firms in its industry, zero otherwise.
Merger Guidelines	See Horizontal Merger Guidelines.
Merger wave	Significant increases in merger activity in the sample for an industry.
Pct large	The share of an industry in a given year that is made up of large firms. Gorton et al. (2009) define large firms as those whose total assets are greater than 30% of the total assets of the largest firm in the industry.
Pct medium-sized	The share of an industry in a given year that is made up of medium-sized firms. Gorton et al. (2009) define medium-sized firms as those whose total assets fall between 5% and 30% of the total assets of the largest firm in the industry.
Pct small	The share of an industry in a given year that is made up of small firms. Gorton et al. (2009) define small firms as those whose total assets are less than 5% of the total assets of the largest firm in the industry.
PctMed x Large	Interaction term between the variables Pct medium-sized and Large.

Positioning merger	Mergers by which a firm can increase in size and position itself to be a more attractive target of future acquisition.
Potential merger	A hypothetical merger between any two firms.
Ratio	Ratio of the price paid for the target to the market value of the acquirer.
Recent acquisition	Dummy variable that equals one if firm j announced a deal in year t and the deal was completed, zero otherwise.
Regime shift	Regulatory or technological industry change.
SDC	Securities Data Company.
Tech dummy	Dummy variable that equals one if both parties to a potential merger classify as high tech, zero otherwise.
Tender offer	Dummy variable that equals one if a merger is a tender offer, zero otherwise.
Tgt private	Dummy variable that equals one if the target in a merger is private, zero otherwise.
Tgt subsidiary	Dummy variable that equals one if the target in a merger is a subsidiary, zero otherwise.

APPENDIX B

Variable Definitions

This table lists the variables used in the analyses in Chapter 3 and their definitions.

Variable	Definition
AR	Abnormal return for the acquirer.
Below median	Indicator that equals one if a CAR is less than the median CAR value.
CAR	Cumulative abnormal return for the acquirer.
Census HHI	Herfindahl-Hirschman Index calculated using concentration data from the U.S. census.
Challenged	Indicator that equals one if a deal was challenged, zero otherwise.
Clayton Act (Section 7)	Prohibits mergers and acquisitions that may reduce competition or tend to create a monopoly.
Compustat HHI	Herfindahl-Hirschman Index calculated using Compustat.
Controls	Includes number of legal advisors to the acquirer, an indicator for whether the target is a subsidiary, and an indicator for deals for which payment is at least 90% cash.
CRSP	Center for Research in Security Prices.
Deal status	Equals zero if a deal is unchallenged, one if a deal is challenged and eventually completed, and two if a deal is challenged but is never completed.
Divestiture announcement CAR	Cumulative abnormal return for the acquirer at the time of the divestiture announcement.
Divestiture ratio	The ratio of divestiture size to deal size.
DoJ	Department of Justice. An antitrust enforcing body in the U.S.
FF48	Fama-French 48 industries.
Final order CAR	Cumulative abnormal return for the acquirer at the time of issuance of a final order.
FTC	Federal Trade Commission. An antitrust enforcing body in the U.S.
Herfindahl	See Herfindahl-Hirschman Index.
Herfindahl-Hirschman Index	The sum of squared market shares of each firm competing in a market.
HHI	See Herfindahl-Hirschman Index.
High-tech acquirer	Dummy variable that equals one if an acquirer is classified as "high-tech" in SDC.

Hoberg-Phillips HHI	Herfindahl-Hirschman Index calculated using the Hoberg-Phillips (2010) product-market relatedness data.
Horizontal Merger Guidelines	An outline of the enforcement policy of the DoJ and the FTC concerning horizontal acquisitions and mergers.
Lerner Index	(Operating Income - Depreciation) / Total Assets.
Log acq market cap	Natural logarithm of the market capitalization of the acquirer.
Log transaction value	Natural logarithm of the value of transaction.
M&A	Merger and acquisition.
Merger Guidelines	See Horizontal Merger Guidelines.
MktPwr measure	One of the five estimations of market power: Compustat HHI, Hoberg-Phillips HHI, Price-cost margin (PCM), Lerner index, or Census HHI.
PCM	See price-cost margin.
Price-cost margin	Difference between price and marginal cost as a fraction of price.
Remedy	Relief for antitrust violation required by the FTC or DoJ.
Remedy ratio	The ratio of the divestiture size or termination fee to the size of the transaction.
SDC	Securities Data Company.
Transaction value (mil)	Size of the transaction in millions of dollars.