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THREE ESSAYS IN CORPORATE FINANCE: PREDATION AND FINANCIAL STRUCTURE; PATENT LITIGATION AND DEEP POCKETS; WHY DO FIRMS GO DARK?

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THREE ESSAYS IN CORPORATE FINANCE: PREDATION AND FINANCIAL STRUCTURE; PATENT LITIGATION AND DEEP POCKETS; WHY DO FIRMS GO DARK?

by

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Dedication

I am dedicating this dissertation to my wife, Anna, for her enduring love and support over the years.

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Supervisor: Sheridan Titman

My doctoral dissertation is composed of three essays in corporate finance. The first essay examines how the financial structure of a firm affects the extent to which it will be subject to predation when there is asymmetric information between firms and investors. Myers and Majluf have shown that a firm may forego a positive net present value investment when financing the project would require it to issue undervalued stock. As I show, in a similar setting where giving up the project benefits competitors, rivals may compete more aggressively in order to lower the prey's stock price.

The second essay investigates whether aggressive patent litigation could in part be driven by the predatory motives of deep pocketed firms. I examine whether the share price reaction to the announcement of patent litigation is related to the relative financial strength of defendant and plaintiff firms, and whether firms that become the target of patent litigation are different from firms that were not sued over the same period. I find that the greater the size of the plaintiff relative to the defendant, the lower the cumulative

abnormal returns (CARs) that accrue to defendants sued by their competitors. This work adds to earlier empirical research on patent litigation as well as the literature on the relationship between product market competition and financial structure.

The third essay (joint work with Nadia Massoud) seeks to answer two important questions. First, why do firms choose to "go dark", i.e. deregister with the Securities and Exchange Commission (SEC) and delist from the major exchanges despite having a large number of outside shareholders? Second, what are the consequences of going dark for shareholders? We find that firms with fewer valuable growth opportunities, greater insider ownership, lower institutional ownership, higher leverage and lower market momentum are more likely to go dark. Furthermore, the cost of complying with the Sarbanes-Oxley Act, as reflected in audit fees, has also been a driving force behind the going dark phenomenon. Finally, shareholders suffer significant negative cumulative abnormal returns upon the announcement of the firms' deregistration.

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Chapter 1: Introduction

1.1 OVERVIEW

My dissertation is composed of three essays in corporate finance. The first essay examines how the financial structure of a firm affects the extent to which it will be subject to predation when there is asymmetric information between firms and investors. Myers and Majluf have shown that a firm may forego a positive net present value investment when financing the project would require it to issue undervalued stock. As I show, in a similar setting where giving up the project benefits competitors, rivals may compete more aggressively in order to lower the prey's stock price.

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going dark phenomenon. Finally, shareholders suffer significant negative cumulative abnormal returns upon the announcement of the firm's deregistration.

1.2 MODELING PREDATION AND FINANCIAL STRUCTURE

Towards the end of the last century, the Microsoft trial and Judge Jackson's verdict generated enormous media attention and created a renewed interest in the economics of predation among antitrust lawyers, corporate executives and policy makers. An issue that surfaced during this antitrust case, and has not received much attention in the earlier literature, is that a predator's actions may have an adverse effect on its rival's stock price and this can in turn affect the prey's ability to compete.[1]

The business press has reported several accusations that dominant firms have taken predatory actions in order to influence the stock price of competitors.[2] A legitimate concern about such claims is that they are typically voiced by the supposed victim of the alleged predatory stock price manipulation, and that they should be treated with skepticism due to the obvious self-interest of the complainant. How could a deep pocketed firm benefit from manipulating a competitor's share price through predation? Could the predator prevent the prey from raising equity to fund new investment? Are certain firms more vulnerable to such predation? The model introduced in my dissertation provides a framework for exploring these issues.

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[1]During its browser war with Microsoft, an often-noted weakness of Netscape was its obligation to meet earnings projections and please Wall Street in general in order to protect its share price.

[2] The Business Week reported on March 6, 2000 ("Call Him the Streetfighter.com", p. 8.): "TheStreet.com's James Cramer is blaming MarketWatch for sinking his company's stock price. [. . .] 'CBS MarketWatch tried to drive our stock down as low as possible and buy us,' Cramer told Business Week. Stock of TheStreet.com, which hit its high of 71 1/4 the day it began trading, closed at a low of 12 1/2 on February 23. Larry Kramer, CEO of MarketWatch, denied trying to drive the stock down." Reuters, September 23, 1999: "Microsoft Corp. President Steve Ballmer Thursday said [. . .] 'There is such an overvaluation of technology stocks, it is absurd.' [. . .] 'I could put our own company and others in that category.' " (Note: Microsoft shares were off $4 at $92.06 in late-afternoon trading and the NASDAQ Composite fell 4.97% on September 23rd and 24th.)

Imperfections in financial contracting have long been proposed as a rational explanation for predatory actions by companies with deep pockets. These explanations grew out of a simplistic "long purse" theory of predatory behavior. Consider an industry with two competing firms where entry barriers are high. If one firm's internal funds and its access to capital markets were limited, then its rival might decide to prey until the financially constrained firm exhausts its funds and exits. The predator may then be able to increase prices and reap monopoly profits in subsequent periods.

Telser (1966) pointed out that in the original long purse theory, predation will not occur in equilibrium because the weaker firm will exit immediately. It is also unclear what prevents the prey from accessing capital markets in the first place. Fudenberg and Tirole (1985) and Bolton and Scharfstein (1990) built models of financial contracting under asymmetric information as a rational explanation to the deep pockets story.[3] The optimal financial contract between the financially constrained firm and the lender alleviates the information asymmetry problem but it also leads to predation. If the predator knows about its competitor's financing arrangement then it may compete more aggressively in order to increase the probability that the prey will break the contract and its funding will be cut. Since contracting parties in capital markets will anticipate such predatory actions, the optimal contract will be different from what it would have been in the absence of predation.

In the model developed in this dissertation, the motivation for predation is quite different from the motivation considered in previous work. Rather than try to cause its rival to default on its obligations, here the predator takes steps to lower the prey's profits and its stock market valuation, limiting the prey's ability to make new investments that

[3] Both FT and BS rely on the models of Gale and Hellwig (1985), Townsend (1979) and Diamond (1984). Gale and Hellwig have shown that in their costly state verification model the optimal contract is standard debt: the debtor either reimburses the contractually fixed amount, or the bank conducts a costly audit and confiscates all profits.

would allow it to compete more effectively. Specifically, I will adopt a framework similar to Myers and Majluf (1984), where the firm must fund investment by issuing equity. Myers and Majluf have shown that firms with undervalued equity may forego positive net present value investments, which can affect the competitive dynamics within an industry. However, most of the long-purse predation literature has focused on debt and debt-like contracts, and the role of equity financing has been largely neglected.[4] My dissertation contributes to the existing literature by examining the relationship between equity financing and predation.

My model is somewhat similar to Rotemberg and Scharfstein (RS, 1990), who examine the relationship between shareholder value maximization and product market competition. In one version of their model lower rival firm profits lead investors to believe that the industry's prospects are dim. In this case firms will compete less aggressively and try to increase rivals' profits in order to increase their own share price. Firms are concerned about their share price because they need to fund positive net present value investment after one period of Cournot competition. Firms with deep pockets can finance all or part of the new project from internal funds and will therefore be less concerned about their current share price. These firms will compete more aggressively than firms with shallow pockets.

Unlike Rotemberg and Scharfstein, I assume that investment by the financially constrained firm has a negative impact on the future profitability of the unconstrained firm. This will encourage the predator to compete more aggressively, in order to prevent the prey from making the investment. The predator's goal is to lower the share price of the prey to the point where losses from selling undervalued equity outweigh the net present value of the new investment. While RS assume that all profits must be paid out as

[4] An exception is Poitevin (1989). In his model, financing by debt instead of equity separates high value entrants from low value ones, but it also exposes them to the threat of predation by the incumbent.

dividends, here predation hurts the shallow pocketed competitor in two ways: it increases the number of shares that must be issued by both lowering the share price and increasing the amount to be raised.

1.3 PATENT LITIGATION AND DEEP POCKETS

The third chapter of my dissertation undertakes an empirical investigation of patent cases filed in U.S. Federal Courts in the 1990s and contributes to the debate over whether patent litigation by deep pocketed firms may have predatory motives. Using a sample of 201 lawsuit announcements reported by the Wall Street Journal I examine whether the magnitude of the share price reaction to the announcement of patent litigation is related to the relative financial strength of defendant and plaintiff firms, and whether firms that become the target of patent litigation are different from firms that were not sued over the same period. Firm size and leverage are used to identify firms with deeper pockets. I find that the greater the size of the plaintiff relative to the defendant, the lower the cumulative abnormal returns (CARs) that accrue to defendants sued by their competitors. Using most measures of firm size, relative size has no effect on the defendant when the plaintiff is not a rival firm. Further, plaintiff leverage is positively related to defendant CARs. The results lend some support to the hypothesis that patent litigation may in part be motivated by predation. This work adds to earlier research on the valuation effects of litigation as well as the empirical literature on the relationship between product market competition and financial structure.

The Bolton and Scharfstein model places no constraints on the type of predatory action or actions that a deep pocketed rival might take, other than the condition that the act of predation is assumed to be unverifiable. (Otherwise predation could be prevented by including a special clause in the financing contract that would let the firm "off the hook" in the event of predation.) The complexities of patent litigation, the anecdotal

evidence reported by the press and the empirical evidence in earlier literature discussed below all raise the possibility that predation may be among the motives behind patent suits.

The notion that patent portfolios and a reputation for aggressive patent litigation may be crucial elements of high tech firms' competitive arsenal is relatively new. Broad, long term cross-licensing used to be popular among technology companies in the 1970s, because the arrangement allowed firms to use each other's technologies. Cross-licensing reduced litigation while compensating innovators for their efforts through a reasonable royalty.[5] Some regard the era as a golden age of innovation, when companies fought their battles in product markets instead of patent courts.

In the early 1980s a number of developments made patent litigation a more attractive competitive strategy. Leading American chipmakers faced increasing competition from Asian rivals allegedly using "ripped off" American technology. The lawsuits (and the mere threat of litigation) served a dual purpose: they helped generate a steady stream of licensing revenue as well as keeping competitors at bay. According to authors Kevin Rivette and David Kline (2000), Texas Instruments and National Semiconductor were both saved from bankruptcy in the early 1990s by aggressive patenting and litigation strategies.

The tough new approach was also helped considerably by the government's changed attitude towards antitrust. The days of trust-busting governments ended when Ronald Reagan's administration came into office. Patents came to be viewed not as legal tools favoring a few monopolists but as powerful incentives for innovation; intellectual property rights have enjoyed increasing legal protection ever since. As part of a new "pro-patent" agenda, the U.S. Court of Appeals for the Federal Circuit was created in

[5] The typical royalty was one percent of the market value of the products made from the patent (according to an article in Forbes ASAP: A Technology Supplement To Forbes Magazine 03/29/1993).

1982 to handle patent appeals. Subsequently, the proportion of patentholders that won their cases doubled to about two out of three plaintiffs according to an April 2001 article in the Economist. Patent protection was extended to new areas such as biotechnology and software in the early 1980s, and opportunities to patent business methods widened substantially by the end of the 1990s.

Critics alleged that the spectacular doubling in the number of patents granted over the last decade of the 20th century was accompanied (and in part caused) by a lowering of standards and a virtual 'land grab' of intellectual property by relatively few powerful firms. Patents awarded for 'one-click shopping' and online reverse auctions were ridiculed in the business press, and the apparent laxity in enforcing the 'non-obvious' standard was criticized by a variety of observers. Also, while fostering innovation had been the most important argument for strengthening patent protection, Bessen and Maskin (2002) found that research and development spending leveled off and possibly declined in the most patent-intensive industries and firms during the period following the pro-patent developments of the early 1980s.

Microsoft's Bill Gates was among the first to fully understand the implications of the new competitive landscape. "If people had understood how patents would be granted when most of today's ideas were invented and had taken out patents, the industry would be at a complete standstill today." Microsoft's management decided to turn the new developments to their advantage. As Gates put it in a memo to employees, "the solution is patenting as much as we can. A future startup with no patents of its own will be forced to pay whatever price the giants choose to impose. That price might be high. Established companies have an interest in excluding future competitors."[6]

[6] Bill Gates was quoted by Lawrence Lessig in his keynote address at OSCON 2002.

Earlier empirical evidence indicates that financial strength may indeed be an important factor in determining the consequences of litigation. A Price Waterhouse study by Bellis and Gustin (1992) found that firms with lower legal costs typically rely more on internal counsel. Earlier, Bartel and Thomas (1987) showed that established firms can rely on costly regulation to keep out new entrants or weaken thinly capitalized rivals.

Bhagat, Brickley and Coles (1994) found that lawsuits imposed costs of financial distress on defendants. They also document that more financially distressed defendants suffer a greater loss in shareholder wealth than their counterparts with healthier balance sheets. Lerner (1995) showed that biotechnology firms with high litigation costs are less likely to apply for patents in patent subclasses where many awards have been granted to firms with low litigation costs. Lanjouw and Lerner (2001) report that larger plaintiffs are more likely to requests preliminary injunction in patent cases. (Preliminary injunctions are considered a very serious threat to defendants because when such requests are granted, the defendant is enjoined from continuing the allegedly infringing activity, effectively depriving the firm from one of its main sources of revenue.)

Anecdotal stories about allegedly predatory patent suits abound, although some of the most often discussed lawsuits are not included among the sample firms in this dissertation due to lack of data. Intel has often been portrayed as a Goliath attempting to squash smaller semiconductor firms through aggressive patent (as well as copyright, trademark and trade secret) litigation. The list of firms sued by Intel is a near complete list of competitors including ULSI Systems, Cyrix, Advanced Micro Devices and Broadcom. George Hwang, cofounder of ULSI Systems, estimated that developing a math coprocessor to compete with Intel had cost his firm $2.5 million, significantly less than the $3.5 million spent on litigation. After five years and several rounds of appeals, Intel's patent infringement claim against ULSI was thrown out in 1994.

Circumstances surrounding certain patent cases suggest that firms with a long purse may well use patent litigation to damage smaller rivals with constrained access to capital markets. Some of the suits are filed right before the initial public offering date of the defendant. Diametrics, Nvidia and Brooktree were all sued by competitors before they went public, and while Nvidia and Brooktree escaped with little apparent harm, the Diametrics IPO had been cancelled. The vast majority of patent suits are settled before they could come to trial, but some cases with alleged predatory motives have dragged on through multiple appeals. Sometimes defendants go under despite their success in both the product market and the court room. Audio semiconductor maker Aureal was sued for patent infringement by Creative Technology, the dominant firm in the sound-card business, in February 1998. Despite the negative publicity and uncertainty generated by the litigation, Aureal continued to report improving sales for several quarters following the suit, but eventually its resources had been stretched to their limits. While the court decided against Creative in December 1999, the decision came too late to save Aureal, which filed for bankruptcy in March 2000. At about the same time Creative's shares reached an all time high near the peak of the "internet bubble." In September 2000 Creative purchased Aureal's remaining assets for $32 million, including a settlement of all outstanding claims between Aureal and Creative.

While my dissertation concentrates on the possibility of predation by deep pocketed rivals, it must be acknowledged that smaller firms or individuals may also be able to abuse patent laws. Large firms that have the financial resources to settle out-of-court and do not want to divert scarce managerial talent from operations may be attractive targets for frivolous patent litigation by smaller firms. Small plaintiffs have little to lose but plenty to gain in the event they win their case or strike a generous settlement. TechSearch, a law firm which bought a microprocessor patent from struggling

International Meta Systems and then proceeded to file a patent infringement lawsuit against Intel is but one example of small outfits allegedly involved in such practices.[7] Such litigation is beyond the scope of my dissertation, however, because data availability limits this enquiry to larger, publicly listed firms.

1.4 WHY DO FIRMS GO DARK?

In recent years there has been an increase in the number of SEC registered and publicly traded firms that "went dark", i.e. deregistered with the SEC despite having a large number of outside shareholders. A number of institutional investors have voiced their concerns about this trend in the business press (See "A Legal Way to Keep Investors in the Dark" and "When Companies 'Go Dark', Investors Can Lose" in the August 4, 2003 and May 24, 2004 issues of the Business Week, respectively). Indeed, 406 firms went dark between January 1, 1996 and May 31, 2004.

Unlike the wave of going private transactions in the 1980s when the mechanism was often a leveraged buyout (LBO) by managers and private equity investors – see Jin and Wang (2002) – firms that go dark exploit Section 12g(5) of the Securities Exchange Act of 1934, as amended in 1964. Under the 1964 amendment a firm with total assets of at least $10 million must continue to be registered under the Securities Exchange Act if it has at least 300 shareholders of record (the threshold is 500 shareholders of record for firms with less than $10 million in assets).[8]

Despite this amendment, companies that have recently gone dark have included United Road Services with over 6,000 beneficial shareowners and $97 million in total

[7] According Mr. Mulloy, Intel's spokesman, "this company [i.e. TechSearch] exists solely for the purpose of purchasing patents and extorting funds from another company." (Source: The Wall Street Journal, 04/16/1999.)

[8] Initial registration under the Exchange Act is triggered when the size of a company exceeds $10 million as measured by total assets and the number of holders of a class of its equity securities reaches 500.

assets and ACAP Corporation with over 500 beneficial share-owners and $146 million in total assets.[9]

Given that the number of beneficial shareholders and total assets of these companies appear to have exceeded the regulatory minimum for public registration, how have they been able to go dark? Why have they chosen to go dark (deregister with the SEC but remain publicly traded over-the-counter on the Pink Sheets)? Moreover, what have been the consequences for shareholders? The main objective of the fourth chapter of my dissertation is to address the above questions, especially in light of the concerns raised about this trend by institutional investors.

We find that firms with fewer valuable growth opportunities, greater insider ownership, lower institutional ownership, higher leverage and lower market momentum are more likely to go dark. Further, the direct costs of complying with the Sarbanes-Oxley Act (SOX) – as reflected in the higher audit fees – also appear to have been a major driving force behind the going dark phenomenon. Our results from a univariate test comparing pre- and post-SOX stock price performance are consistent with SOX driving higher performing firms to go dark. We find that investors suffer significant negative cumulative abnormal returns upon the announcement of deregistration and, post-going dark, are left holding significantly less liquid shares. Our work makes a number of other contributions, including a direct test of the impact of Sarbanes-Oxley using audit fees reported to the SEC, an examination of the incentives created by information asymmetries and conflict of interest between inside and outside shareholders, an analysis of the effects of financial institutions going dark, as well as an analysis of post-deregistration stock price performance and liquidity effects.

[9] For further details of these firms see Nelson *et al* "Petition for Commission Action to Require Exchange Act Registration of Over-the-Counter Equity Securities." a July 2003 petition filed with the SEC for a rule amendment to Section 12g(5) of the Securities Exchange Act (http://www.sec.gov/rules/petitions/petn4-483.htm).

As will be discussed in more detail in Chapter 4, the major mechanism for going dark is an outgrowth of the rapid dematerialization of shares as part of the SEC's effort to increase the efficiency of U.S. stock trading, brokerage and clearing (in particular the move to the three-day settlement of trades to conform with international settlement standards). One of the outcomes of this dematerialization trend is that fewer and fewer shareholders are holding paper share certificates. Instead, they hold their claims in electronic form with street names such as Merrill Lynch and other brokerage firms. As a result, the number of shareholders listed in corporate records as having been issued a paper stock certificate has shrunk.

This is important, because it is the number of shareholders of record, rather than the number of beneficial shareholders, that is used by the SEC to determine whether the number of shareholders is below 300 (or 500 for firms with asset less than $10 million). For example, Merrill Lynch as the holder of the claims of many thousands of small investors would be counted as one certificate holder towards meeting the 300 (500) shareholder threshold.

With respect to both prior and concurrent research our work complements an earlier paper by Bushee and Leuz (2004), henceforth BL. In their paper BL look at firms' registration decisions relating to a 1999 SEC "eligibility rule" requiring firms trading on the OTC Bulletin Board (OTCBB) to make a choice – within a short phase-in period – as to whether to register with the SEC or not. If they chose not to register they had to leave the OTCBB for the Pink Sheets market which was viewed by investors as a less liquid market. Indeed, BL (2004) find significant negative abnormal returns upon removal from the OTCBB.

While BL (2004) analyzed the impact of extending an existing reporting standard to new firms, the introduction of Sarbanes-Oxley, which affected most of our sample

firms, imposed a new, untested standard on firms that have already been registered with the SEC. Consequently, we believe the impact of Sarbanes-Oxley on the decision to deregister deserves separate examination. Moreover, and importantly, ours is the first empirical work to investigate the decision of SEC registered firms to deregister and go dark. Hence, we examine a new set of decisions, namely the decisions of SEC registered firms to deregister from the SEC and "go dark" to investors. These firms could be traded on major exchanges such as the NYSE, AMEX and NASDAQ[10] or on the over-the-counter markets (on the OTCBB or the Pink Sheets). Thus our work complements and adds to prior studies – including BL's analysis of the 1999 change on the OTCBB – which look at how changes in the 1934 Securities Exchange Act alter firm disclosure behavior.

In a related paper Engel, Hayes and Wang (2004) use event study analysis to look at the stock return effects for firms that chose to go private following the passage of the Sarbanes-Oxley Act.[11] They found that firms going private following SOX were smaller firms with greater inside ownership who experienced large positive abnormal returns. Importantly, Engel *et al*'s focus is only on decisions to go private, and not on going dark decisions. As we demonstrate and discuss below, decisions to go dark can have a very different effect on firm returns compared to going private decisions.

The closest related paper to ours is that by Leuz, Triantis and Wang (2004) – henceforth LTW – who in concurrent research have also analyzed the incentives of public firms to deregister. They look at the January 1998 – December 2003 period (whereas we

[10] We identified firms that were listed on one of the major exchanges at the time of the deregistration announcement by searching the CRSP database. There were no NYSE listed firms in our sample.

[11] Engel *et al* (2004) identify a number of factors that impact corporate disclosures post-SOX. First, CEOs and CFOs need to certify financial reports. Second, public companies need external auditor certification of their internal control systems for public reporting. Third, more stringent standards were set for audit committee membership. In addition, the auditing function of external auditors had to be separated from the consulting function.

look at a slightly longer period, from January 1996 to May 2004). Their focus is primarily on the agency effects and corporate governance effects driving a firm's decision to deregister whereas we also investigate one of the direct costs associated with staying registered in the post Sarbanes-Oxley era, namely higher auditing fees and costs.[12] Thus, one important difference in our findings from theirs is that we find that direct regulatory costs (as measured by audit fees) do matter in determining a firm's decision to deregister. That is, we test both regulatory and agency related cost reasons and find both to be important. In their paper, LTW (2004) find agency and associated corporate governance reasons to be important using an unmatched logit approach, where the unmatched sample consists of all those firms that could immediately deregister but choose not to (i.e. firms with fewer than 300 – or 500 – shareholders of record). We find a number of corporate governance agency variables to be important using our matched sample. In addition, we conduct a robustness check using an unmatched sample of all firms with 300 (500) shareholders of record that could, but did not, deregister.

We find that, in addition to auditing costs, the higher the insiders' stake the greater is the probability of a firm deregistering, adding further support to the view that agency conflicts are an important factor impacting the probability of deregistration. Variables that we also find affecting the deregistration decision (not analyzed by LTW) are whether or not the firm is a financial institutions and the firm's q-ratio. The financial institutions variable relates to the special case of regulated firms who have to continue reporting information to regulators (e.g. the Federal Reserve) even if they choose to go dark. This information in many cases (e.g. bank call reports) is also made public. As such, financial institutions reflect a benchmark case of the effects on investors of firms that go dark from the SEC while still indirectly reporting some information to

[12] A factor often mentioned in press and survey reports – see the discussion earlier.

shareholders via regulatory mechanisms. Accordingly, we expect the market response to going dark by financial institutions investors to be less severe in comparison to non-financial firms. Finally, we find important negative return and liquidity effects for stockholders of those firms choosing to deregister.

Chapter 2: Predation and Financial Structure

2.1 OVERVIEW

This essay examines how the financial structure of a firm affects the extent to which it will be subject to predation when there is asymmetric information between firms and investors. Section 2.2 introduces the model and discusses the possibility of predation in a simple, two-state world. The crucial assumption is that an information asymmetry exists between investors and the managements of the two firms, but there is no information asymmetry between the firms. Within the context of the model, the predator preys when industry profits are high, but not when profits are low. Hence, when investors observe that the prey's profits are low, they are unable to decide whether this is the result of a low realization or the consequence of predatory actions by the competing firm. In situations when the predator preys, the prey knows that it is worth more than what its observed profits would suggest and as a result, may pass up the investment rather than issue underpriced stock.

The subsequent section introduces a two period model with a continuum of states in order to demonstrate that the results are not an artifact of the simplified two-state setting. The model is illustrated with a numerical example in Section 2.4. Section 2.5.1 discusses how holding sufficient financial slack may prevent predation, while holding too little slack will only make the predator prey more aggressively. In Section 2.5.2 I examine the impact of allowing the financially constrained firm to signal its value by reducing the size of the project.

2.2 A SIMPLE TWO-STATE MODEL OF PREDATION

Suppose that there are two firms, 1 and 2, competing in an industry over two periods. The firms are risk neutral and the discount rate is zero. Firm 1 is a large firm and has sufficient financial slack to fund all its activities. It is not dependent on equity markets, so it need not be concerned about its stock price. Firm 2 needs to raise outside equity to finance new investment.[13] The value of Firm 2's shares after the first period depends in part on its profits from its existing operations. For simplicity I assume that profits can be either high (Π_H) or low (Π_L). Whether first period profits are Π_H or Π_L depends on the realization of the state variable $j \in \{H,L\}$ at time zero, which is not observable by investors. Second period profits will equal first period profits. This is admittedly an extreme assumption, but it significantly simplifies the analysis, and the results derived assuming positive correlation between current and future profits are qualitatively similar. There is no information asymmetry between the firms, i.e. Firm 1 also observes the state variable. The probability that profits will be Π_H at the end of the first period is $0 < \Pr(H) < 1$.

At the beginning of the second period Firm 2 has an opportunity to invest $I > \Pi_L$ in a new project with value $V > I$. Firm 1 is already present in this market, and if Firm 2 implements the project, then Firm 1's second period profits decline by X. I assume that V, I and X are common knowledge, and the new project and Firm 2's current operations are related. As an example, suppose that Firm 2's existing assets are in the low end microprocessor market. These assets will generate Π_L or Π_H in profits, but the skills acquired while operating these assets also enable Firm 2 to invest I and enter the high end processor market in the future. This assumption is essential because otherwise Firm 2

[13] Equity must be issued because Firm 2 is assumed to have no financial slack: it has no cash on hand and it is assumed to have exhausted its "debt capacity."

could avoid the threat of predation by spinning off the new project, or by selling the new investment opportunity to a firm in an industry where Firm 1 is not present. The model also assumes that managers act in the interest of current shareholders.[14] If, for example, Firm 2 is a young firm where the original founders still hold a suboptimally large ownership stake, then this assumption is not unreasonable.

Consider the case when the realization of the state variable was such that Firm 2's profits are expected to be Π_H. Firm 1 may want to prevent Firm 2 from investing I and entering the new market by taking predatory actions that are unobservable to investors and cause Firm 2's profits drop to Π_L. Suppose that lowering Firm 2's profits to Π_L costs Firm 1 D. The predator is aware that the prey needs to issue equity to finance the investment, and its goal is to prevent the equity issue by lowering the prey's share price.

In order to finance the investment, the prey must raise $I - \Pi_L$ in equity. Suppose that investors believe that Firm 2 issues shares to raise $I - \Pi_L$ and invests in the project only if there was no predation and its second period profits are also expected to equal Π_L. (Later I will argue that these are the only beliefs that can be supported in a pure strategy equilibrium.) When $j = H$ but Firm 2's first period profits are low as a result of predation, the prey's problem is analogous to the underinvestment problem in Myers and Majluf (1984).[15] If Firm 2 decided to implement the project, it would have to issue undervalued equity. Investors value issuing firms as the sum of future profits and the present value of the project: $\Pi_L + V$. In order to be willing to provide $I - \Pi_L$ in funding for the new

[14] This will be the case when managerial share ownership in the company is a non-trivial part of the management's compensation package, and it is not possible to eliminate the information asymmetry problem by forcing the manager to update her portfolio and purchase a pro rata allocation of any new shares issued. Hart (1993) and Dybvig and Zender (1991) demonstrated that such compensation contracts could eliminate the Myers-Majluf underinvestment problem.

[15] The model is actually developed along the lines of a version of the Myers-Majluf model discussed in Daniel and Titman (DT, 1995).

investment, equity investors will want to receive $(I - \Pi_L)/(\Pi_L + V)$ percent of the firm's shares.

If first period profits equal Π_L as a result of predation but the firm still decides to issue, then the original shareholders are left with shares that are worth:

$$\left(1-\frac{I-\Pi_L}{\Pi_L+V}\right)(\Pi_H+V).$$

It is easily seen that given the above beliefs, Firm 2 will be undervalued by investors when Firm 1 preys. Note that Firm 2's shareholders could get $\Pi_H + \Pi_L$ by simply foregoing the investment and the equity issue. For some parameter values investing and issuing undervalued equity will still make the original shareholders of Firm 2 better off than foregoing investment:

Equation 2-1

$$\left(1-\frac{I-\Pi_L}{\Pi_L+V}\right)(\Pi_H+V)>\Pi_H+\Pi_L.$$

For such parameter values Firm 2 will always implement the project, so predatory behavior will be unproductive and consequently there will be no predation. There will not be predation either when the cost of driving down Firm 2's profits from Π_H to Π_L exceeds Firm 1's benefits from preventing the investment, i.e. $X < D$.

The above arguments have eliminated the possibility of predation for certain parameter values. Under what conditions does predation occur in equilibrium? Notice that, given the above beliefs, Firm 2 is no longer better off issuing and investing when:

Equation 2-2

$$\left(1-\frac{I-\Pi_L}{\Pi_L+V}\right)\left(\Pi_H+V\right)\leq \Pi_H+\Pi_L.$$

Proposition 1 *If Equation 2-2 holds with strict inequality and D < X, then Firm 1 preys in equilibrium whenever the realization of the state variable is j = H. In a pure strategy equilibrium Firm 2 forgoes the equity issue and the new project. A mixed strategy equilibrium is also possible for some parameter values where Firm 2 takes the project with probability 1 > δ > 0. If Equation 2-2 holds with equality and D < X, then predation will be one of the possible equilibria for j = H. There will not be predation when the realization of the state variable is j = L.*

Proof: *See Appendix A.*

The market is not entirely fooled by the predator's action, because Firm 1's incentives to prey are known. What investors do not know is whether the observed low profits are the result of predatory behavior, or a decline in profitability due to market conditions. In a pure strategy equilibrium Firm 2's decision to issue equity convinces investors that observed profits equal true profits and there has not been predation.[16] Figure 1 presents an outline of the model when Equation 2-2 holds with strict inequality and $D < X$.

The above discussion assumes that the prey is unable to send a credible signal about the true value of the company.[17] Firm 2's ability to signal that its second period profits will be Π_H instead of Π_L reduces the set of parameters for which predation is possible, but the results remain qualitatively similar. See Appendix B for a brief overview

[16] In a mixed strategy equilibrium where Firm 2 takes the project with probability $1 > \delta > 0$, investors will believe that predation has occurred and true profits are higher than what they observed with probability $\delta / [1 - \Pr(H) + \delta]$.

[17] 11Price setting, project scaling, dividend payments and project delay have all been proposed as mechanisms to signal firm value by Giammarino and Lewis (1988), Krasker (1986), John and Williams (1985) and Choe, Masulis and Nanda (1993), respectively. Section 2.5.2 explores the case when the prey can signal its value by scaling down the project.

of how the above results change when Firm 2 is allowed to signal its true value by burning money.

This simple model does not go into the details of how predation is actually implemented, and it only allows for two possible profit levels for Firm 2. It is also unclear how the cost of predation, D is determined. To address these issues, the following section will develop a more detailed model of predation which allows for a continuum of possible profit levels for the prey. The model will assume that the two firms compete in a Stackelberg game where, in order to lower the prey's profits and perceived value, the predator may choose a production quantity (or capacity) in excess of the quantity that would maximize its first period profits.

2.3 PREDATION IN A TWO-PERIOD STACKELBERG MODEL

2.3.1 The Model

In this version of the model, the two firms compete in a Stackelberg setting over both periods of a two period game. The parameters V, I and X are defined as before and again assumed to be common knowledge. The inverse demand function is $p = a - q_1 - q_2$ in both periods, where p is the price, q_i is the quantity (or capacity) chosen by Firm i and a represents the strength of demand. The "choke price" a is drawn from a distribution $F(a)$ over $[0,A]$ with $A > 0$, at time zero. While A and the distribution $F(a)$ are common knowledge, only the two firms observe the realization of a, investors do not. Still at time $t = 0$, but subsequent to observing a, Firm 1 and then Firm 2 make their output decisions. Firm 2 observes its rival's output choice prior to choosing a production quantity.

For simplicity, I assume that the marginal cost of production is constant and it equals zero. As in the two-state model above, the predatory action is not observable to investors. Just like the Rotemberg and Scharfstein model of shareholder value

maximization and product-market competition, this model also requires the assumption that investors are unable to observe equilibrium prices and quantities. Rotemberg and Scharfstein argue that even though this is unrealistic given that the model deals with a single homogeneous good, a more realistic model with differentiated products and various types of consumers would complicate the analysis without providing additional insight.

Suppose first that the two firms ignore the impact of their first period decision on second period investment. In that case, Firm 1 will produce $q_1^* = a/2$, Firm 2 will produce $q_2^* = a/4$ and the equilibrium price will be $p^* = a/4$ in the first period of the game. Firm 1 and Firm 2's equilibrium profits will be $\Pi_1^* = a^2/8 = \Pi_{SL}$ and $\Pi_2^* = (a/4)^2 = \Pi_{SF}$, respectively. The subscripts *SL* and *SF* stand for Stackelberg leader and Stackelberg follower. If $(a/4)^2 < I$ then Firm 2 will have to raise $I - \Pi_{SF}$ in the equity market. From $I - \Pi_{SF}$ investors can infer the Firm 2's profits in periods 1 and 2, and value shares issued by the firm accordingly. In exchange for providing $I - \Pi_{SF}$ in capital, investors will require shares representing s percent of the firm, where s is:

$$s = \frac{I - \Pi_{SF}}{\Pi_{SF} + V}.$$

2.3.2 The Decision to Prey

Firm 1 has zero funding needs therefore it is not affected by investors' perception of firm value at the end of the first period. It can reduce its rival's first period profits by producing more than the quantity produced by the leading firm in equilibrium in a Stackelberg game. If reducing the prey's current profits lowers the perceived value of its existing assets, then Firm 2 must issue undervalued shares to finance the investment. Predation prevents investment by reducing Firm 2's perceived value to the point where

losses from selling undervalued equity outweigh the net present value of the new investment. Since in this simple two-period setting Firm 1 has no motivation to prey after the first period of the game, it will produce the Stackelberg equilibrium quantity $q_1^* = a/2$ in the second period and the two firms' profits will equal Π_{SL} and Π_{SF} .

Investors' equilibrium beliefs resemble those in the pure strategy equilibrium of the two state model: if Firm 2's period 1 profits equal Π_2 (Π_2 simply stands for Firm 2's observed first period profits) and it issues equity to raise $I - \Pi_2$, then Π_2 must be Firm 2's true profit i.e. there was no predation and the firm observed $a = 4(\Pi_2)^{1/2}$. If Firm 2 had observed $a > 4(\Pi_2)^{1/2}$ and its profits had been lowered by predation, then Firm 2 would not issue. (If Firm 2 issued even when the predator preyed then – since predation is costly – Firm 1 would not have preyed in the first place.) Investors will value Firm 2's shares according to these beliefs.

Suppose that the predator reduces the prey's profits to $\Pi_2 < \Pi_{SF}$, and the prey still decides to invest and issues stock to raise $I - \Pi_2$. Investors will then believe that Π_2 equals Firm 2's profits in the absence of predation and require

$$s = \frac{I - \Pi_2}{\Pi_2 + V}$$

share of the firm.

How aggressively must Firm 1 prey in order to prevent Firm 2 from investing? Predation must ensure that for the prey's current shareholders, the value of the firm without the new investment is at least as great as the value of their share of the firm subsequent to stock issuance and investment:

Equation 2-3

$$\left(1-\frac{I-\Pi_2}{\Pi_2+V}\right)\left(\Pi_{SF}+V\right)\leq\Pi_{SF}+\Pi_2.$$

How low must Firm 2's profits fall for inequality (2–3) to hold? Solving (2–3) for Π_2 we get:

Equation 2-4

$$\Pi_2\leq\overline{\Pi}_2=\frac{\Pi_{SF}+V-\sqrt{\left(\Pi_{SF}-V\right)^2+4\left(V-I\right)\left(\Pi_{SF}+V\right)}}{2}.$$

Firm 2 will respond to Firm 1's output choice along its Cournot reaction function, producing $R_2(q_1) = (a - q_1)/2$. Producing less or more than R_2 (q_1) will reduce Firm 2's profits and its perceived valuation. When Firm 1 preys and produces $q_1 > a/2$, Firm 2's profits will equal $\Pi_2 = [(a - q_1)/2]^2$. Substituting Π_2, it is easily seen that Equation 2-4 will hold when Firm 1 produces:

Equation 2-5

$$q_1\geq\overline{q}_1=a-2\sqrt{\overline{\Pi}_2}.$$

Differentiating with respect to V and I, it can be shown that $\overline{q}_1$ increases in V and decreases in I. In other words the predator will have to prey more aggressively when the value of the project increases or when the investment required to implement the project decreases. This result is intuitively appealing: the more attractive the investment, the harder it is to prevent it by predation.

In general, one would expect Firm 1 to increase its output above its Stackelberg equilibrium level in period 1 when the gain from predation is greater than the cost. The cost of producing $q_1 > a/2$ is simply the difference between the profits of the leading firm

in a Stackelberg game and those of the predator: $D(a) = (a^2)/8 - q_1\,[(a - q_1)/2]$. Note that $\overline{q}_1$ in Equation 2-5 is itself a function of a, so the relationship between the cost of predation and the realization of a is not straightforward. Although the cost of predation may decrease in a for low values of the demand parameter, ultimately the cost of predation will increase in a because for high realizations of a the predator must reduce Firm 2's profits just to ensure that the prey must raise outside equity in order to fund the project. Predation will not be observed in equilibrium when the realization of a is such that $D(a) > X$, i.e. when the gain from preventing Firm 2's investment, is less than the decline in Firm 1's first period profits caused by the predatory expansion of output.

Firm 1 can reduce the perceived value of Firm 2's assets in place to zero by producing $q_1 = a$ and causing the price and Firm 2's output to drop to zero. If the realization of a falls below a certain level, then even producing $q_1 = a$ and reducing the perceived value of the second company's existing business to zero will not be sufficient to prevent investment. Intuitively, the true value of the company's existing operations is so low relative to the net present value of the project, that current shareholders are better off investing and issuing even when investors believe that the existing assets are worthless. The deep pocketed firm will not prey for such low realizations, since predation would be fruitless.

Lemma 1 *Predation will not be observed when the realization of a is such that* $a < \underline{a}$ *(i.e. the value of Firm 2's existing business is very low).*

Proof: *See Appendix A.*

It is important to note a key implication of no predation for certain values of a (and the corresponding Π_{SF} profits). Suppose the predator preyed at all possible profit levels of Firm 2 (i.e. all realizations of the demand parameter). Investors would always know that the profits they observed were not the true profits but the result of predation,

and they could recover the value of Firm 2 by simply adding back profits lost due to predation. In this model, low realizations may or may not be observed because of predation. This differentiates the model from signal jamming models of predation where observers can recover the original signal from the distorted signal and the players' incentives.

Since the goal of the predator is to deceive investors about the value of the competing firm, predation becomes pointless when investors know that predation must have taken place. The predator must lower the profits of the prey to a level where predation would not occur, in order to keep investors in uncertainty about the value of the prey. In the limited strategy space of the model, Firm 2 can only avoid issuing undervalued equity by not issuing at all, because issuance is interpreted by investors as a signal that there was no predation.[18] Figure 2 contains a simplified outline of the model.

The result in Lemma 1 also suggests that a core business that is not worth much may provide protection from predators, while a valuable core business may make a firm an attractive target. It is possible that small firms do not simply pass below predators' radar screen; it is the low value of their assets in place that makes them less vulnerable.[19]

Proposition 2 summarizes the results from the above discussion.

Proposition 2 *In equilibrium, Firm 1 will prey (will produce at least* $\overline{q}_1$*) in period 1 if and only if i) such predatory action lowers Firm 2's first period profits to a level where predation is not observed, ii)* $a > \underline{a}$*, and iii) the cost of predation, D(a) is less than the benefit X of preventing its competitor from investing. Firm 2 will not issue equity and will not invest when predation has occurred in period 1.*

[18] Section 2.5.2 examines the case when Firm 2 can signal its value by reducing the size of the project.

[19] Consider the following quote from Cusumano and Yoffie (1998), page 140: "In 1994, Netscape came into the world with very little baggage. Its history, revenues and installed base were too meager to give competitors enough of a handhold to bring the company down."

Proof: *See Appendix A.*

The assumption that the net present value of the project and the true value of the firm are unrelated may seem unrealistic, but similar results can be derived even when a positive relationship exists between the two. Assume for example that the present value of the project equals $I + \alpha + \beta\Pi_{SF}$ instead of V , where $\alpha > 0$, $\beta \geq 0$. When $\beta > 0$, the change from the simpler version of the model is twofold: predation lowers the value of Firm 2 in the eyes of investors by both reducing the perceived value of its existing operations to Π_2 and that of its future project to $I + \alpha + \beta\Pi_2$. At the same time, Firm 2's incentives to invest are greater for high realizations of a, since besides increasing profits, high realizations also increase the project's net present value. As it turns out, the latter effect dominates.

The predatory production quantity can be derived analogously to the way we obtained $\overline{q}_1$, by simply substituting $I + \alpha + \beta\Pi_{SF}$ and $I + \alpha + \beta\Pi_2$ for the parameter V (the former represents the project's true present value, while the latter is its value as perceived by investors). The resulting expression increases in β, implying that the greater impact the a demand parameter has on the project's net present value, the more aggressively the predator must prey.

2.4 NUMERICAL EXAMPLE

Consider the numerical example where $I = 100$, $V = 130$, $X = 40$ and $A = 50$. As we will see, in this case there will only be predation if the realization of a falls between 28.932 and 40.046. For some low realizations of a, predation can never achieve its goal. If the realization of the demand parameter is $a = 20$ for example, then Firm 1 would maximize its first period profits by setting its output at $q_1 = 20/2 = 10$.

Firm 2's optimal output choice is given by $R_2(10) = (20 - 10)/2 = 5$ making $\Pi_{SF} = 5(20 - 10 - 5) = 25$. Firm 1 could reduce the profits and perceived value of its

competitor to zero by producing $q_1 = 20$. If Firm 2 decided to issue shares to fund the new investment, investors would demand a 100/130 share of the firm (the firm's perceived value is simply the present value of the project). The original shareholders' holdings will be worth:

$$\left(1-\frac{100}{130}\right)(25+130)=35.769>25$$

so the prey is still better off issuing and investing. It is easily seen that predation will remain fruitless for all $a < \underline{a} = 24.98$.

Suppose that the realization of a is 28. If Firm 1 does not prey and produces 14, then Firm 2's output will be $R_2(14) = 7$ and its profits will equal $\Pi_{SF} = 49$. If Firm 1 increases its output to 23.195, then Firm 2 will reduce its output to $R_2(23.195) = 2.403$. Relative to the "Stackelberg price" $p_S = 7$, the price of the output falls to $p = 28 - 23.195 - 2.403 = 2.403$ and Firm 2's profits drop to $(2.403)^2 = 5.773$.

This reduces the perceived value of Firm 2 to 130 + 5.773 = 135.773: the sum of the project's present value and the future profits investors expect based on current profitability. New investors will then demand (100 − 5.773)/(130 + 5.773) share of the firm, and issuing shares and investing in the new project will no longer make current shareholders better off:

$$\left(1-\frac{100-5.773}{130+5.773}\right)(49+130)=54.733=49+5.773.$$

Note that Firm 1's profits would be 14 × 7 = 98 if it chose its output to maximize current profits, while predation leads to current profits equaling 2.403 × 23.195 = 55.729. The cost of predation, 98 − 55.729 = 42.271 is greater than the amount to be gained from predation, $X = 40$, so Firm 1 will not prey when $a = 28$.

Consider now the case when the realization of a is 36. If Firm 1 does not prey and produces 18, then Firm 2's output will be $R_2(18) = 9$ and its profits will equal $\Pi_{SF} = 81$. If Firm 1 decides to prey and increases its output to 26.566, then Firm 2 will in turn reduce its output to $R_2(26.566) = 4.717$. Relative to the "Stackelberg price" $p_S = 9$, the price of the output falls to $p = 4.717$ and Firm 2's profits drop to $(4.717)^2 = 22.252$. This reduces the perceived value of Firm 2 to 130 + 22.252 = 152.252: the sum of the project's present value and the future profits investors expect based on current profitability. New investors will then demand (100 − 22.252)/(130 + 22.252) share of the firm, and issuing shares and investing in the new project will no longer make current shareholders better off:

$$\left(1-\frac{100-22.252}{130+22.252}\right)(81+130)=103.252=81+22.252.$$

Note that Firm 1's profits would be 18×9 = 162 if it chose its output to maximize current profits, while predation causes first period profits to drop to 4.717×26.566 = 125.315. The cost of predation, 162 − 125.315 = 36.685 is less than the amount to be gained from predation, $X = 40$, so Firm 1 will prey when $a = 36$.

The benefit of deviating from the predatory strategy is less than 40 for realizations when $a_L = 28.932 < a < 40.046 = a_H$, so Firm 1 will prey. There will be no predation when $a \leq 28.932$ or $40.046 \leq a$. Figure 3 illustrates the relationship between the realization of a and predation.

2.5 EXTENSIONS OF THE MODEL

2.5.1 The Role of Financial Slack

First period profits need not be the only source of funding for new investment at the beginning of period two. Firm 2 may also have an amount S of financial slack at the beginning of the game. Assume that Firm 2 observes the realization of a and then –

before the two firms make their output decisions – decides whether to continue to hold slack or make a distribution to shareholders.

The effect of holding slack is twofold: a neutral effect is raising the value of the firm under all realizations of *a*, since the value of *S* does not vary across the state space. Holding *S* as slack will also have an effect similar to reducing *I*: Firm 2 will have to raise less at the end of the first period in order to fund the project. Consider Equation 2-4 and Equation 2-5: the analogous equations when the prey has *S* financial slack are quite similar:

Equation 2-6

$$\Pi_2 \le \overline{\Pi}_2^S = \frac{\Pi_{SF} + V - \sqrt{(\Pi_{SF} - V)^2 + 4(V + S - I)(\Pi_{SF} + S + V)}}{2}.$$

Equation 2-7

$$q_1 \ge \overline{q}_1^S = a - 2\sqrt{\overline{\Pi}_2^S}.$$

Just like in the "no-slack" case, there will be no predation for low realizations of *a*, because the predator would have to reduce the perceived value of its competitor below zero. Examining Equation 2-6 and Equation 2-7, it is easily seen that this will be the case whenever $\underline{a} < \underline{a}^S = 3\sqrt{(V+S)(V/(I-S)-1)} > 0$. Notice that $\underline{a}^S$ is greater than $\underline{a}$ in the previous subsection, i.e. adding slack increases the range of realizations where predation will not be feasible. Lemma 2 and Proposition 3 summarize the results from the above discussion:

Lemma 2 *When Firm 2 holds S in financial slack, predation will not be observed when the realization of a is such that a <* $\underline{a}^S$ *(the value of Firm 2's existing business is very low).*

Proposition 3 *When Firm 2 holds S in financial slack, Firm 1 will prey in equilibrium (will produce at least* $\overline{q}_1^S$*) in period 1 if and only if i) such predatory action lowers Firm*

2's first period profits to a level where predation is not observed, ii) $a > \underline{a}^S$, and iii) the cost of predation, D(a) is less than the benefit X of preventing its competitor from investing. Firm 2 will not issue equity and will not invest when predation has occurred in period 1.

Differentiating with respect to *S*, it can be shown that $\overline{q}_1^S$ increases in the amount of financial slack. For any realization of *a*, the predator will now have to produce more (relative to the no-slack case) in order to sufficiently reduce Firm 2's perceived value. The greater the slack, the more aggressive the predator must become.

There are two possibilities: first, given the realization of *a*, it may still be optimal for Firm 1 to prey even when Firm 2 has *S* in slack. In this case Firm 1 will increase production relative to the no-slack case and Firm 2's profits will be lower. Firm 2 will then prefer to make a distribution to shareholders in order to reduce its financial slack to zero. Distributing all slack to shareholders will make the predator prey less aggressively. In other words Firm 2 will adopt a "puppy dog" strategy in order to reduce competition in its core business.

If *S* is sufficiently large, then predation will not be optimal for Firm 1,[20] and Firm 2 will either not distribute slack or it will distribute a portion of *S* such that the remainder will still deter predation. Of course if Firm 2 had the option of increasing its slack to an arbitrarily large amount at no cost, then it would always start the game with financial slack sufficient to prevent predation. In this case however Firm 2 would not be financially constrained. Although not modeled here, it is probably not unreasonable to assume that – due to information asymmetry and resulting agency problems – investors

[20] $S \geq I$ is the simplest case to consider, but increasing *S* may also prevent predation because both the cost of predation and $\underline{a}^S$ increase in *S*, and both $D(a) > X$ and $a < \underline{a}^S$ prevent predation.

want to limit the amount of financial slack a young firm has, therefore limiting its ability to deter predation.

2.5.2 When the Prey can Signal its Value by Scaling Down the Project

Implicitly I have assumed so far that reducing the scale of the project is not part of the strategy space for Firm 2. If Firm 2 can reduce the size of the project, then it may be able to prevent predation. Firm 2's goal is to use project scaling as a signal and convince investors that the realization of the a demand parameter was in fact high and its next period profits will be high. When predation does occur however, Firm 1 may prey more aggressively to prevent Firm 2 from signaling its value by scaling down the project.[21]

To what extent would Firm 2 have to scale back the project in order to convince investors that its value is high although its current profits are low? Assume that when Firm 2 invests y dollars less, then the payoff from the investment will be reduced by γy dollars. As before, Firm 1's profits will be lower by X if Firm 2 invests I. The net present value of the scaled down project will be $NPV^{SD} = V - \gamma y - I + y = V - I - y\,(\gamma - 1)$.

The payoffs to Firm 2 depend on whether Firm 2 scales down the project or not. Payoffs also differ depending on whether Firm 2's value is high but its current profits have been lowered by predation, or its value is in fact low due to a low realization of a. The payoffs to Firm 2 are the following:

[21] When project details are observable - as it is assumed here, - reducing the size of the project will be a more efficient signal than money burning. Project scaling and money burning both signal the firm's value by lowering its future profits, but the former also reduces the size of the equity issue. A smaller equity issue weakens the incentives of a low valued firm to signal and pretend that its true value is high, because it reduces the amount of overvalued equity that the mimicking firm could issue. (See Daniel and Titman 1995.)

$$P_H^{SD} = \left(1 - \frac{I - \Pi_2 - y}{\Pi_{SF} + V - \gamma y}\right)\left(\Pi_{SF} + V - \gamma y\right)$$

$$P_L^{SD} = \left(1 - \frac{I - \Pi_2 - y}{\Pi_{SF} + V - \gamma y}\right)\left(\Pi_2 + V - \gamma y\right)$$

$$P_H = \left(1 - \frac{I - \Pi_2}{\Pi_2 + V}\right)\left(\Pi_{SF} + V\right)$$

$$P_L = 2\Pi_2 + V - I.$$

Note that the subscripts of payoff P denote whether the value of the demand parameter a is high (H) or low (L), the superscript SD indicates signaling by scaling down, Π_{SF} is again Firm 2's Stackelberg profits for the realization of a observed by the two firms while Π_2 is Firm 2's profit reduced by predation. Note that Firm 2's profits could also equal Π_2 because the realization of a was low and there was no predation.

Incentive compatibility must be satisfied in order for project scaling to be a signal, so one must find a y such that $P_H^{SD} > P_H$ and $P_L^{SD} \leq P_L$. The most efficient signal level is where the second condition holds with equality. We have $P_L^{SD} = P_L$ when:

Equation 2-8

$$y = \frac{\gamma\left(\Pi_{SF} - V\right) - \Pi_2 - V}{2\gamma\left(\gamma - 1\right)} - \frac{\sqrt{\left|\gamma\left(\Pi_{SF} - V\right) - \Pi_2 - V\right|^2 - 4\gamma\left(\gamma - 1\right)\left(I - \Pi_2\right)\left(\Pi_{SF} - \Pi_2\right)}}{2\gamma\left(\gamma - 1\right)}$$

In order for the predator to completely eliminate the new project, it must reduce the prey's current profits to the point where the incentive compatible signal y reduces the net present value of the remaining project to zero or below: $V - I - y(\gamma - 1) \leq 0$. If $\gamma < V/I$,

then the net present value of the project will be positive for any $y < I$. If $\gamma > V/I$ then the scaled-down project's net present value will be non-positive when $y \geq (V - I)/(\gamma - 1)$.

First, consider the case when $\gamma > V/I$. Firm 1 needs to reduce the first period profits of Firm 2 to the point where:

Equation 2-9

$$y \geq \frac{V - I}{\gamma - 1}$$

in order to ensure that the scaled-down project's net present value equals zero. Substituting Equation 2-8 into Equation 2-9 one finds that Firm 2's profits must be reduced to:

Equation 2-10

$$\Pi_2 \leq \overline{\Pi}_2^{SD} = \frac{(\gamma-1)(\Pi_{SF} + I) - (V - I)}{2(\gamma - 1)}$$

$$- \frac{\sqrt{\left|(\gamma-1)(\Pi_{SF} + I) - (V - I)\right|^2 - 4(\gamma-1)\left|(\gamma-1)I\Pi_{SF} - (V - I)(\gamma(\Pi_{SF} - I) - V)\right|}}{2(\gamma - 1)}$$

Examining Equation 2-10, it is easily seen that $\overline{\Pi}_2^{SD}$ will be negative unless $\gamma \geq \bar{\gamma} = I/(2I - V)$ and $2I - V > 0$. (Notice that $I/(2I-V) > V/I$.) Since the predator cannot reduce the perceived value of the firm below zero, preventing investment through predation will be impossible when scaling down the project is available as a signal, unless returns to scale (i.e. γ) are greater than $\bar{\gamma}$, and the present value V of the project is less than $2I$.

Since $\Pi_2 = [(a - q_1)/2]2$, the predatory output that sufficiently lowers Firm 2's perceived value to prevent investment will be:

$$q_1 \geq \bar{q}_1^{SD} = a - 2\sqrt{\overline{\Pi}_2^{SD}}.$$

Differentiating with respect to γ it can be shown that q_1^{SD} decreases in γ. In other words the greater the returns to scale, the less aggressively the predator must prey. Just like in the case without scaling down, if the realization of a falls below certain level, then even producing $q_1 = a$ and reducing the perceived value of Firm 2 to zero will not be sufficient to prevent investment. The deep pocketed firm will not prey for such low realizations. From Equation 2-10 above it is easy to obtain

$$\underline{a}^{SD} = 3\sqrt{\frac{(V - I)(\gamma I - V)}{\gamma(2I - V) - I}} > 0,$$

the cutoff where the predator would have to reduce the perceived value of the prey below zero in order to prevent investment and so there will be no predation. (Again, note that $\Pi_{SF} = [a/4]^2$.)

Lemma 3 and Proposition 4 summarize the results from the above discussion.

Lemma 3 *If scaling down the project is part of Firm 2's strategy space and $\gamma > V/I$, then predation will not be observed when the realization of a is such that $a < \underline{a}^{SD}$ (the value of Firm 2's existing business is very low). Also, predation cannot prevent investment unless $\gamma >= I/(2I - V)$ and $2I - V > 0$.*

Proposition 4 *If scaling down the project is part of Firm 2's strategy space and $\gamma > V/I$, then Firm 1 will prey in equilibrium (will produce at least $\overline{q}_1^{SD}$) in the first period if and only if i) such predatory action lowers Firm 2's first period profits to a level where predation is not observed, ii) $a > \underline{a}^{SD}$, and ii) D(a) is no greater than the benefit X of preventing its competitor from investing. Firm 2 will not issue equity and will not invest when predation has occurred in period 1.*

Now, consider the case when $\gamma < V/I$. No matter how aggressively the predator preys, the net present value of the project cannot be reduced to zero. Could the predator

prey so aggressively that the incentive compatible signal y increases to I, in effect eliminating the investment? Substituting $y = I$ into Equation 2-9 it can be shown that Firm 2's perceived value would have to be reduced below zero to accomplish this. Predation cannot prevent investment completely when $\gamma < V/I$.

It is quite reasonable to assume however that scaling down the project reduces the loss that Firm 2's new investment causes the predator. Suppose Firm 1's profits in period 2 will be lower by $x(y)$ if Firm 2 invests $I - y$, where $x(0) = X$, $x'(y) < 0$ and $x(I) = 0$. The exact shape of $x(y)$ function depends on how competition is modeled for the industry that Firm 2 enters by investing in the new project. In this setting, the equilibrium may involve predation that is insufficient to prevent Firm 2 from investing, but it forces the shallow pocketed firm to reduce the size of the project in order to signal its quality. Reducing the scale of the project will increase Firm 1's profits in the second period.

2.6 APPLICATIONS OF THE MODEL

2.6.1 Executive Compensation

Consider the situation when Firm 2 has an opportunity to hire a new executive. The reservation wage of the executive equals I^e, while the value of her services to the company equal $V^e > I^e$. Firm 2 has an opportunity to hire the executive at the end of period 1. The large majority of the executive's compensation will consist of Firm 2 stock. Firm 1 – a deep pocketed competitor – is concerned that its profits would be lower by X^e dollars if Firm 2 hires the new executive and starts competing more successfully.

The two firms compete in the same setting as in the earlier section, but now it is the executive to be hired who is unable to observe the realization of the a demand parameter. She assesses the value of Firm 2's shares based on the firm's first period

profits, so Firm 1 may prevent the hiring of the new executive by competing more aggressively and reducing the perceived value of the prey.

What should be emphasized here is that even if there is relatively little benefit to the predator from preventing Firm 2 from hiring key people, the existence of other parties that make their decisions contingent upon the perceived value of the firm will make predation more damaging through a feedback effect.[22] If the predator preys to prevent new investment, it may nevertheless prevent the hiring of the new executive as well. Thus the unconstrained firm does not need to compete more aggressively, but further benefits still accrue to the predator and the prey suffers additional damage.

2.6.2 Mergers and Acquisitions

The model presented here emphasizes the point that share prices have an impact on a firm's ability to invest in a new project. As we have seen above, a firm's market value has an impact on the firm's ability to accomplish other goals as well. If a predator with deep pockets lowers share prices in an industry, then a financially constrained firm in the same industry may have a hard time making a successful takeover bid for a firm that the predator would also like to acquire. Even though their true value may be the same, the predator's cash offer will appear more favorable than the shares offered by its cash-strapped rival.

2.6.3 Innovation

An oft repeated charge against aggressive competitors in high technology industries is that their hardball tactics stifle innovation. This model is similar to other models of predation in the finance literature in that the predator may be able to reduce competition by blocking the prey's access to new financing. A somewhat unique feature

[22] See Subrahmanyam and Titman (2000) for a detailed analysis of how feedback from prices to cash flows increases the potential for stock market manipulation.

of this model however is that a company's existing business becomes a potential victim because the firm has a positive NPV project in another industry or market segment, and it is this new project that threatens an existing monopoly.

It is conceivable that firms with valuable core businesses would adopt a "puppy dog" strategy and try to prevent predation by committing not to implement the future project.[23] This could be achieved by divesting the resources necessary to develop the project in the first place. If firms divest resources vital for innovation in order to avoid predatory action (and these resources are redeployed elsewhere, less efficiently), then the threat of predation indeed reduces innovation.

2.7 CONCLUSION: PREDATION AND FINANCIAL STRUCTURE

I propose a model of predation which relies on the information asymmetry between management and potential equity investors. The underinvestment problem caused by this information asymmetry was analyzed in Myers and Majluf (1984). Under certain conditions predators with deep pockets will benefit from strategically reducing a competitor's share price, in effect inducing a Myers-Majluf type underinvestment problem.

Firms with projects that require relatively little investment and have a large net present value are more difficult to prey on. Sufficiently large financial slack will prevent predation; however the presence of slack which is not sufficiently large will only make the predator prey more aggressively. Hence, financially constrained firms will want to hold a large amount of financial slack or no slack at all. This result has implications for capital structure choice and cause a discontinuity in the firm's capital structure decision.

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[23] In an online chat forum, MIT professor Michael A. Cusumano suggested that aspiring software entrepreneurs should "find a niche in which Microsoft does not compete and is not likely to compete for a few years. This is the only way to avoid becoming roadkill." (Source: "Chat with Michael Cusumano," ABCNEWS.com, 11/12/1998)

Some firms which are vulnerable to predation will follow a "no (or low) leverage" strategy because this strategy will ensure their ability to invest even when their equity is undervalued. Other firms will find that the "no leverage" strategy cannot prevent predation. These firms will increase their leverage in order to make sure that the predator does not prey very aggressively. The "high leverage" strategy will minimize the damage the predator must cause in the prey's core business in order to prevent new investment. If the size of the new investment project can be reduced, then returns to scale will also influence predation. Firms with projects that have smaller returns to scale are less vulnerable. The predator will be unable to prevent projects below a certain returns to scale, and in general the lower the returns to scale, the more aggressively it must prey.

Chapter 3: Patent Litigation and Deep Pockets: Does Size Matter?

3.1 OVERVIEW

This chapter investigates whether aggressive patent litigation could in part be driven by the predatory motives of deep pocketed firms. Section 3.2 below describes the sample and sources of data. The event study evidence from various subsamples is presented in Section 3.3. An analysis of the relationship between the stock market reaction to lawsuit announcements and variables such as leverage and firm size follows in Section 3.4, while Section 3.5 discusses the results of robustness checks. Section 3.6 examines what kind of firm is more likely to become a defendant in a patent lawsuit, using a matched logit approach, and Section 3.7 concludes. Overall, the results support the hypothesis that predation is one of the motivations of firms initiating patent suits.

3.2 SAMPLE AND DATA DESCRIPTION

Patent suit announcements were collected from the Wall Street Journal over the 1990-2001 period using Dow Jones Interactive. Only those lawsuits were included in the sample where data for both the plaintiff and the defendant were available on and before the announcement date from the Center for Research in Security Prices US Stock Database (CRSP) and from Standard & Poor's Compustat. In order to increase accuracy, newswire announcement dates were collected for these 201 patent suits involving 206 plaintiffs and 231 defendants, instead of using the Wall Street Journal announcement date. The first newswire announcement date for each suit was later used as date $t = 0$ in the event study.

Table 1 presents the number of patent suits filed each year that were reported by the Wall Street Journal and involved CRSP and Compustat listed firms. The numbers in

the table certainly do not reflect the reported explosion in patent litigation.[24] Note however, that Bhagat *et al*. identified only 24 patent infringement cases over the 1981-1983 period where data for both plaintiff and defendant firms was available from CRSP and Compustat. This means that the number of high profile patent suits worthy of the Journal's attention that took place between firms represented on both CRSP and Compustat has roughly doubled since the early 1980s.

Several alternative methods have been considered in order to establish whether plaintiffs and defendants involved in a given suit were competitors. Using Compustat's Standard Industrial Classification (SIC) codes proved to be the least accurate approach: as an example consider the case of International Business Machines Corp. which sued Conner Peripherals Inc. in August 1993. Regardless of the number of digits used for matching rival firms, these two companies are not competitors based on their primary SIC codes obtained from Compustat (IBM's SIC code is 7370 while Conner's is 3572). A detailed look at the two firms' main activities however (as described in their 1992 10-K form filed with the U.S. Securities and Exchange Commission) would convince most readers otherwise. Indeed, Hoovers Online lists IBM as one of Conner Peripherals's main competitors. There are of course also examples of non-competing firms belonging to the same SIC classification.

Instead of relying on the inaccurate SIC code based classification, litigants' competitor versus non-competitor status was confirmed using multiple resources. The 'Competition' section in each defendant's and plaintiff's 10-K filings was checked for a list of competitors using the LEXIS-NEXIS Academic Universe. Some firms do not include an explicit list of competitors in their 10-K filings – for these firms I used a list of rivals compiled by Hoover's, Inc. Hoover's lists reflect only the most recent competitive

[24] Among others, the January 20, 1995 issue of the Wall Street Journal discusses how "patent law turns sexy" as a result of "an explosion in the number of patent lawsuits."

environment (i.e. the list of competitors reflects the situation at the time of publication or the year when coverage of the firm was discontinued). In order to account for the impact that a major restructuring may have had on the competitive status of the two litigants, I examined the corporate history provided by Hoover's to see whether any relevant changes had taken place between the date of litigation and the date when the list of competitors was compiled. If for example the division of the plaintiff that competes with the defendant was acquired only after the lawsuit, then the status of the two firms was changed to "non-competitors" accordingly. In some cases information from the lawsuit announcement was also used to make the final call regarding the two firm's status (for example in cases when the Wall Street Journal article mentions that the plaintiff intends to enter the defendant's market or vice versa). Of the 231 defendants, 176 – or 76.2% – have been sued by competitors.

It would be quite natural to expect that all firms involved in patent litigation are competitors. After all, why would these firms be interested in the same technology in the first place if they were not competing in the same market? Note however that the above discussed strengthening of patent protection enabled firms to generate licensing revenue from even those parts of their patent portfolio that were unrelated to their core business. (Such patents may be the by-products of the firms' main research and development activities, or they may be the result of earlier development efforts that the firms no longer intends to pursue etc.) So although the majority of patent cases involve competing firms, this is not necessarily the case.

Patent suits reported by the Wall Street Journal fall into three broad categories. The first type represents initial patent suits filed where the plaintiff or plaintiffs claim that one or more of their patents have been infringed by the defendant or defendants. A different kind of patent suit is when an alleged infringer files first, requesting the court to

declare either that a certain patent is invalid, or that (although the patent itself may be valid) the plaintiff has not infringed on it. These suits are often filed in anticipation of a filing by the patent holder. Finally, a third category consists of follow-on suits of different kinds. The plaintiff could file further suits alleging infringement of additional patents. Defendants often file counter-suits either contesting the patents or charging that the plaintiff firm itself has violated patents belonging to the defendants.

In some cases the counter-suits involve not only patent litigation but also allegations of anti-trust violations. Since the interpretation of preventive lawsuits and follow-on litigation is problematic, I created a sub-sample containing only "pure" patent suits by eliminating all suits where the Wall Street Journal article or the newswire announcement reported earlier litigation between the parties, or where there was litigation between the same parties earlier in the sample. Preventive patent suits were excluded as well, leaving a sample of 147 suits involving 147 plaintiffs and 166 defendants. Note that the typical suit in the sample involves a single plaintiff and one or more defendants; of all 201 suits the large majority – 173 cases in total – involves a single plaintiff pursuing a single defendant.

Daily stock returns for the event study were obtained from CRSP. Prices and the number of shares outstanding data are from CRSP and – in the case of foreign incorporated firms – DataStream. (Of the 437 litigants only 10 were foreign incorporated: three plaintiffs and seven defendants). Compustat was the source of all financial statement data, including total assets (data item 6), net sales (data item 12), research and development expenses (data item 46), common equity (data item 60), balance sheet deferred taxes (data item 74), cash (data item 162) and total debt (data item 181).

The sample firms do not seem to conform to the stereotype that patent litigation is characterized by large bullies suing small defendants. The average size of plaintiff firms

is $19.79 billion as measured by market capitalization, while the average size of defendants equals $20.28 billion. Average sales are $8.65 billion for plaintiffs and $8.03 billion for defendants. The numbers are only slightly different for the above discussed "pure" patent suits, where average plaintiff market capitalization and sales equal $19.9 billion and $7.88 billion respectively, while average defendant market capitalization and sales are $20.4 billion and $6.78 billion. The null hypothesis that the average size of plaintiffs and defendants in the entire sample is equal cannot be rejected using a t-test at any of the customary significance levels, regardless of whether sales or market capitalization is used to measure firm size. I find identical results for "pure" patent suits as well as suits involving a single plaintiff suing a single defendant and cases between rival firms.

The apparent similarity between the average size of defendants and plaintiffs is consistent with the findings of Bhagat *et al.* (1994).[25] This may in part be a consequence of the sample selection process: Bhagat *et al*. also used the Wall Street Journal to identify corporate lawsuits. The Wall Street Journal is unlikely to report litigation involving small firms, so even if defendants are on average smaller than plaintiffs, this is not necessarily reflected in a sample that excludes all small firms.

Note however that average plaintiff is not larger than the average defendant in the sample collected by Lanjouw and Lerner either. Their sample was collected from the Federal Judicial Center's Integrated Database and the PACER databases compiled by the various federal district courts, and it includes privately held firms, so in their study the upward bias in firm size due to data availability was reduced substantially.

[25] The similarity, although not surprising, is nevertheless notable because the BBC sample consists of all corporate lawsuits (not just patent cases) reported in the Wall Street Journal between 1981 and 1983.

3.3 EVENT STUDY EVIDENCE

I use standard event study methodology to measure the abnormal returns accruing to defendants and plaintiffs upon the announcement of patent lawsuit filings. For each filing day t = 0 is defined as the newswire announcement date and day t = –1 as the previous trading day. The primary event window spans these two dates, and results are also reported for a secondary event window spanning days t = –30 through t = –2. Cumulative abnormal returns (CARs) for the event window are calculated using the standard market model. The market model is estimated by ordinary least squares, using the CRSP equally weighted market index and CRSP return data for each litigant from a 255 trading-day estimation period ending 46 trading days before the event date. (Results are essentially the same using the value weighted CRSP index.)

Statistical tests use standardized abnormal returns (SARs) estimating a separate standard error for each security-event and assuming cross-sectional independence. Although SARs are not corrected for serial correlation, Cowan (1993) and Karafiath and Spencer (1991) find that bias in the uncorrected test is small for short (i.e. less than 60 day) event windows.

Ex-ante, the sign of plaintiff abnormal returns is ambiguous. As Bhagat *et al*. (1990) have pointed out the filing of a lawsuit may reveal information both about the injury suffered by the plaintiff and the plaintiff's relative strength versus the defendant. In addition, the filing reveals that bargaining between the parties has failed and costly litigation will ensue. One would expect the mean abnormal return to be positive if the dominant news revealed by the announcements in the sample is that the plaintiff's legal position is unexpectedly strong. If the costs of litigation and/or an unexpectedly large injury to the plaintiff dominate the information content of the announcement, then one would expect on average to observe negative CARs.

Event study findings are summarized in Table 2. Overall, the mean CAR for plaintiff firms is positive and significant for both the primary and secondary event window at 0.60% and 2.43%, respectively. This may be evidence that the impact of patent suits on plaintiffs is different from that of other types of litigation. Bhagat *et al*. (1994) report no significant stock market reaction for plaintiffs in general, but they do report significant positive mean CAR for a rather small subsample of plaintiffs in patent suits. (The 19 firms in their subsample had no other news announced in the five trading days prior and subsequent to the lawsuit.) The evidence seems to confirm the argument by Bhagat *et al*. (1994) that patent suits may not reveal new information regarding the damage suffered by the plaintiff (possibly because the production of potentially infringing products is observable to investors), instead they seem to convey good news regarding the strength of a firm's patent protection.

Prior expectations regarding the sign of defendant abnormal returns are much clearer than those for plaintiffs. After all it is hard to conceive any reasonable scenario under which the announcement that a firm has been sued for patent infringement constituted good news for investors. The mean CAR for defendant firms is negative and significant (–1.10%) for the two-day primary event window. The lowest CAR among defendants was a 45%market adjusted decline in the value of Penederm's stock when it was sued by its much larger rival, Johnson and Johnson, on July, 24 1996 over a retinoic-acid acne formulation that allegedly infringed on a Johnson & Johnson patent. Note that Johnson & Johnson had 545 times the market capitalization of Penederm, which is the second highest plaintiff versus defendant market capitalization ratio in the sample.

Interestingly, the positive mean plaintiff CAR is significant only for the two-day primary event window in the pre-1996 period, while it is significant only for the longer secondary event window from 1996 through 2001. One possible explanation is that

information about the looming lawsuit leaked out earlier in the period after 1995. This is problematic in that we cannot find a similar pronounced shift in timing for defendant firms. (Although the magnitude of the mean defendant CAR for the primary event period does become slightly smaller over time.) This issue is alleviated by the fact that patent litigation is initiated by the plaintiffs so investors connected to the plaintiff are in a better position to find out about (and trade on) information regarding the stronger than expected legal position of the injured firm. Alternatively, after 1995, a greater number of patent filings may have been preceded by events suggesting that the intellectual property portfolio of the would be plaintiff has become more valuable (announcements of patent awards, FDA approvals etc.).

All statistical tests are repeated for "pure" patent suits, i.e. cases that were not preventive or follow-on suits. The results (see Table 3) are fairly similar to those discussed above. For these firms I have also calculated the mean and median change in the firm's market capitalization over the primary event window. The median decline in the stock market value of defendants was $6.71 million, while the median increase in the value of plaintiff firms was $6.05 million. The mean change is negative for both defendant and plaintiff firms, –$224.18 million and –$218.99 million respectively (for plaintiffs this is the result of negative CARs for some large firms).

3.4 PLAINTIFFS WITH DEEPER POCKETS: CROSS SECTIONAL REGRESSIONS

Next I examined whether the difference in size between the defendant and the plaintiff and other variables proxying for stronger plaintiff finances had a significant impact on the magnitude of the abnormal returns accruing to defendant firms. If predation is among the motives of patent litigation, then one would expect a greater decline in the value of firms that have been sued by a relatively larger firm or a firm with lower leverage. Also, the impact should be greater for firms that were sued by one of their rivals

than firms that have been sued by a non-competing firm. Follow-on suits and preventive suits are excluded from this part of the analysis, since cross sectional variation in defendant CARs may be influenced by factors that would be hard to capture in a simple regression framework.[26] The following model is estimated to examine the hypothesis that the magnitude of defendant CARs is related to the financial strength of the plaintiff:

Equation 3-1

$$\begin{aligned} DABRET_i = {} & a + ß_1 \times SIZER + ß_2 \times SIZERCOMP + ß_3 \times PLEVER \\ & + ß_4 \times PLEVERCOMP + ß_5 \times DLEVER + ß_6 \times INTANGIBLE \end{aligned}$$

The variable DABRET is the cumulative abnormal return to defendant firms over the two-day primary event window. The model is estimated using weighted least squares, where the weights are the reciprocals of the variance of the cumulative abnormal returns. SIZER is the ratio of the size of the plaintiff and the defendant. Size is measured using four different proxies: i) total market capitalization (shares outstanding multiplied by price) 31 trading days before the event date, ii) market value of assets (the book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes),[27] iii) book value of assets and iv) net sales. SIZERCOMP is the slope indicator variable obtained by multiplying SIZER with a dummy variable that equals one when the plaintiff is one of the defendant's competitors and zero otherwise. PLEVER is plaintiff leverage (total debt minus cash and equivalents divided by the market value of assets), while PLEVERCOMP is a slope dummy variable analogous to SIZERCOMP. DLEVER is the leverage ratio of defendants, while INTANGIBLE is a proxy variable for the importance of intellectual property, measured

[26] The relative success of earlier litigation would presumably influence the magnitude of defendant CARs in the case of follow-on suits. In the case of preventive suits it is often unclear which firm initiated the litigation. As mentioned earlier, preventive suits are often (but not always) filed as a defensive measure because the filing of a patent infringement suit is imminent.

[27] All items used to calculate the market value of assets are from the most recent fiscal year-end that precedes the event date by at least 90 days.

by either the ratio of research and development expenses to net sales, or by the Tobin's q-ratio of the defendant firm. (I measure Tobin's q as the market value of assets divided by the book value of assets.)

In addition to the variables in Equation 3-1 above, industry dummy variables are also included in all cross sectional regressions. The industry dummies represent the following industries: Oil And Gas Extraction (two-digit SIC 13), Drugs (three-digit SIC 283), Computer And Office Equipment (three-digit SIC 357), Communications Equipment (three-digit SIC 366), Semiconductors And Related Devices (four-digit SIC 3674), Surgical, Medical, And Dental Instruments (three-digit SIC 384) and Computer Programming, Data Processing (three-digit SIC 737).

Concerns may be raised regarding the mixed use of two-, three- and even four-digit SIC codes in constructing the industry dummy variables. Note however that the lack of a consistent hierarchical structure is one of the most often cited shortcomings of the revised 1987 Standard Industrial Classification system.[28] The lack of a rigorously defined hierarchy across the four-, three-, and two-digit levels (i.e. Industries, Industry Groups and Major Groups) implies that restricting oneself to a certain level of the SIC hierarchy does not ensure consistency, although it may be the only feasible way to proceed in the case of large samples. In the case of relatively small samples it may be more appropriate to carefully identify industry groupings on a subjective basis and across SIC levels if necessary. To alleviate any remaining concerns, I repeated all regressions using dummy variables generated automatically from two-digit SIC codes. The choice of industry dummy variables did not have a significant impact on the results.

Acharya (1988, 1993) and Eckbo, Maksimovic and Williams (1990) argued that traditional event study methods relying on a linear regression of announcement window

[28] See R.R. Schmitt and M. Rossetti (1987) for a brief discussion.

CARs on a set of firm specific variables are misspecified. They view corporate events as voluntary decisions made in response to the arrival of new information. Only the unexpected portion of such information should determine the stock-price reaction. While it has long been recognized that events are not complete surprises, the standard methodology fails to account for the market's assessment of the valuation implications associated with an event, conditional on publicly available information.

Prabhala (1997) examines the relative merits of the conventional approach and conditional methods and finds that in most cases the two approaches lead to equivalent inferences. Conditional methods are superior only when data on "non-event" firms are also available, which is not the case here.

Table 4 presents the first set of estimated coefficients for Equation 3-1. The results are largely consistent with the hypothesis that long purse predation is one of the factors influencing plaintiff firms' propensity to aggressively pursue patent litigation. In the first two columns of Table 4 the relative size of the plaintiff versus the defendant is measured as the ratio of their respective market capitalizations (A), and the market values of their assets (B). The ratio of the size of the litigants does not have a significant impact on the abnormal returns experienced by defendants that were sued by non-competing firms. In contrast, the coefficients for the size ratio interaction dummy are negative and significant at the 5% (A) and 1% (B) level respectively.

When a firm is sued by a rival, the drop in its value will be greater the larger the size of the plaintiff relative to the defendant. It seems that plaintiffs tend to pursue their case more aggressively against competitors than other, noncompeting firms, and their ability to inflict damage on the defendant depends on how much larger they are than their opponents. In other words, size does seem to matter, but only when rivalry provides the incentives.

Plaintiff leverage is positively associated with event period defendant CARs. The coefficient is significant at the 5% level regardless of whether firm size is measured by market capitalization or total market value of assets. Firms that are deeper in debt seem to be less aggressive litigants, as measured by the expected drop in the value of their opponents. Interestingly, the impact of leverage is unaffected by the competitive status of litigants. Again, the results are consistent with the predictions of Bolton and Scharfstein's (1990) theory of predation based on agency problems in financial contracting. On the other hand the results run counter to the limited liability effect proposed by Brander and Lewis (1986) which predicts that firms with higher leverage will compete more aggressively.

The third column in Table 4 shows the results for the specification when firm size is measured by the book value of assets. I find that the size ratio slope dummy coefficient is not statistically significantly different from zero. This is not all that surprising given that the book value of assets is an imprecise measure of firm size, especially for firms that derive a large proportion of their value from intangibles such as intellectual property. Even in this specification the coefficient for plaintiff leverage remains significant at the 5% level.

The last column repeats the regression using sales as a proxy for firm size. While here relatively larger plaintiffs cause lower defendant CARs across both competing and noncompeting defendants, the impact of relative size on rival firms is significantly greater. Just like earlier, plaintiff leverage has a positive effect on the abnormal returns accruing to sued firms.

The variables DLEVER and INTANGIBLE representing defendant leverage and defendants' ratio of research and development expenditures to sales do not have a significant impact on event window returns. The coefficient for the Computer and Office

Equipment dummy variable is negative and significant at the 10% level in regressions B, C and D, while the drug industry dummy is significant and positive in regression D only.

Columns E through H in Table 5 present the results of estimating similar regressions to those in Table 4 using Tobin's q as a measure of the importance of intangible assets instead of the R&D-to-sales ratio. Results are nearly identical to those earlier, except that the new INTANGIBLE variable is negatively related to defendant abnormal returns. Greater reliance on intangible assets may make access to capital more difficult, so the sign of this parameter estimate is consistent with the rest of the findings, but it must be noted that difficulties in financial contracting is not the only possible explanation in this case. A high q-ratio for defendants could simply mean that a greater fraction of a firm's assets derives its value from intellectual property that may not rightfully belong to the firm.

The seemingly minuscule values of the size ratio slope dummy coefficients may lead one to question the economic significance of any difference in size. While the small coefficients do mean that minor differences in size will have virtually no impact, in the sample (and in "real life" as well) the differences in firm size between competing firms can be huge. In the sample used in the regressions in Table 4 the ratio of the market capitalization of plaintiffs to that of defendants (our first measure of the size ratio) has a standard deviation of 74.5, implying that increasing the size ratio by one standard deviation would cause a 4.25% drop in the defendant's share price. The true magnitude of the economic impact of the event is greater than this as long as the event is anticipated to some degree.

3.5 ROBUSTNESS OF THE EVENT STUDY RESULTS

The size of the plaintiff could reasonably be considered as a proxy for the value of the allegedly injured firm's intellectual property. One could argue that the greater the

value of the plaintiff's intangibles, the more the alleged infringer stands to lose in the suit. Note however that if this were the case, the defendant CARs should simply be related to the size of the plaintiff alone, not the relative size of the plaintiff versus the defendant. When repeating the above regressions using measures of plaintiff size instead of size ratio, none of the coefficients remained significant.

The interpretation of the results would be more difficult if differences in size would have the same impact regardless of whether the sued firm is a competitor or not. Fortunately, this is not the case, which makes the economic intuition behind the findings much clearer. It is possible though that there is only limited variation in size ratio within the rather small subsample of non-rival firms involved in patent suits. Lack of variation in the independent variable would reduce the chances of detecting any relationship between the variable and defendant CARs. Note however that the standard deviation of the size ratio variable is actually somewhat greater for the sub-sample containing non-competing firms, regardless of the chosen measure of firm size.

A further question is whether the results are sensitive to changing economic conditions. Does a separate examination of patent suits from the early and the late 1990s yield similar results? The date of Netscape's IPO, August 9, 1995 provides a convenient point in time to split the sample. It is roughly at the midpoint of our 1990-2001 sample period, and the number of firms in the two sub-samples is also roughly equal.

Also, at the time Netscape's IPO seemed to signal the beginning of a new era when small startups had much easier access to capital markets. Inasmuch as smaller firms' access to capital improves, one can expect predation to occur less frequently, since the probability that the predator can significantly damage the prey is also significantly reduced.

Results are presented in Table 6. It is reassuring to find that relative size of rival firms remains important through both periods; however plaintiff leverage seems to have had no effect in the pre-1996 period. Also, there is a surprising increase in the magnitude of the impact of relative size after 1995, suggesting that predation may have actually become more prevalent.

3.6 WHY DO FIRMS GET SUED?

In this section I investigate whether firms that become the target of patent litigation are different from rival firms that were not sued over the same period. Just like earlier in the cross sectional analysis, I exclude defendants involved in preventive and follow-on suits. I match defendants in the sample with a competing firm and then analyze the probability of becoming a defendant using a conditional (also known as fixed-effects) logistic regression.

So called "choice based" samples such as the one used here are characterized by an unequal sampling rate. My sample encompasses all firms that became defendants in patent litigation reported by the Wall Street Journal but it includes only a small fraction of those firms that have not been sued over the same period. As discussed for example by Maddala (1991), a choice based sample in itself does not necessitate the use of the so called conditional (or fixed-effects) logit approach. In fact, only the constant term is affected by the difference in the sampling rates between the two groups. None of the other coefficients and their standard errors will change as a result of the "imbalance" in the sample, and therefore the results of the conventional unconditional logit analysis require no adjustment.

The firms in our control sample however have not been randomly selected: they were matched to defendants based on industry. The issue is not just that of the unequal sampling rate: the matching firms are not representative of the population of firms that

did not get sued; instead they were chosen to be similar to defendants included in the sample. Each defendant and its matching firm represent a group. In this case, the conditional (or fixed-effects) logit is the correct approach, because one must control for the omitted variables that are constant within the group. A logit analysis that does not condition on the groups would suffer from an omitted variable bias; in effect ignoring which sample firms belong in the same group (the mistake is in fact analogous to ignoring the firm specific fixed effect in a panel regression).

In order to create a matching sample for defendants in patent suits, I have identified the most important competitors for each defendant at the time of the lawsuit. Just like earlier, competitors were identified using a combination of sources, including the "Competition" section of each firm's 10-K filing from the fiscal year prior to the lawsuit. The Hoover's Online database was also used extensively to identify competitors, especially in cases when the 10-K filing did not provide a specific list of rival firms. Competitors of the defendant which were themselves defendants in patent litigation in the two years prior or two years subsequent to the Wall Street Journal announcement of the lawsuit were excluded from the pool of potential matching firms. (I have searched the Dow Jones Reuters Factiva database for news releases and articles mentioning the names of rival firms as well as a number of carefully chosen keywords related to patent litigation.)

The matching firm chosen for each defendant was the most important competitor among those rivals that had not been sued for patent infringement over the four year window surrounding the Wall Street Journal announcement date. In the case of firms with multiple divisions, the competitors of the division involved in the lawsuit were chosen over rivals competing with other segments of the firm. In addition, in order to be

included in the matching sample each firm was required to have financial data available from Compustat.

Competitors can be much more reliably identified for firms involved in more recent patent suits, because electronic filings on Edgar can be cross checked against the list of competitors on Hoover's. However, electronic filings are not available for the early 1990s, since companies were phased in to EDGAR filing over a three-year period, ending on May 6, 1996. Also, Hoover's current lists of competing firms are much less helpful when searching for matching firms for defendants in suits that took place several years earlier: restructurings, mergers and bankruptcies etc. significantly alter the competitive landscape over time. The recent history of restructurings and mergers must be taken into account to make sure that the matching firms chosen were in fact competitors when the litigation started. This problem is compounded for the earliest lawsuits in the sample where the participants may have since been involved in multiple restructurings. Given that relevant matching firms cannot be identified with great certainty, defendants involved in pre-1994 patent litigation were excluded from the sample, leaving 112 defendant firms for a total sample of 224 defendants and matching firms.

If the financial resources available to the alleged infringer influence the injured firm's decision to sue, then we would expect that high leverage, small firm size and a limited ability to generate cash flow from operations could increase a potentially infringing firm's probability of being sued.

Leverage was measured as a ratio of total net liabilities to the book value of assets. Liabilities were determined by deducting common equity (Compustat data item 60), deferred taxes (item 74) and cash and marketable securities (item 1) from the book value of assets (item 6). A cash-to-assets ratio was also calculated by dividing cash and marketable securities with the book value of assets. The ratio of research and

development expenses (item 46) to sales (item 12) was calculated as an indicator of the relative magnitude of R&D costs. I used a dummy variable to identify firms with high (i.e. above average) R&D to sales ratio.

Tobin's q traditionally measures the market value of the firm relative to the replacement cost of its assets. A simplified version of the q-ratio was calculated by dividing the market value of assets by their book value. The market value of the firm's assets is defined as book assets less the book value of equity (item 60) plus the market value of equity (shares outstanding times the share price at the end of the fiscal year, i.e. item 25 times item 199). A cash flow variable, which was obtained by dividing operating income after depreciation (item 174) by total assets, is used as a measure of the firm's ability to generate cash internally. Finally, I measured firm age as the time that passed (in years) between the date when the firm first appeared on Center for Research in Security Prices (CRSP) monthly stock database and the lawsuit announcement that appeared in the Wall Street Journal.

Univariate tests (see Table 7) comparing the mean values of variables between defendants and their matching firms reveal that defendants are not statistically significantly different from their matches in terms of size, leverage and q-ratio. I do find however that defendants are significantly younger firms with substantial cash reserves (as a percentage of their assets) but their ability to generate cash internally is limited (i.e. they have a lower cash flow to assets ratio) and their R&D spending is significantly higher in proportion to their sales.

Some firms with high growth opportunities and limited ability to generate cash, for example Google, carry large balances of cash and marketable securities on their balance sheets on a regular basis to ensure that they will be able to exercise their growth options. While defendants do not seem to be smaller or significantly more leveraged than

their matched counterparts, the four statistically significant variables all have signs that are consistent with the hypothesis that younger firms with more limited ability to raise or generate cash are more likely to be sued. This finding is confirmed by the results from conditional logit analysis (see Tables 8 and 9).

The conditional logit results are robust to the use of alternative measures of leverage (for example using market values instead of book values, or using long term debt in lieu of total liabilities). It seems that even though defendants are not smaller in terms of assets and their leverage ratios are not significantly higher than those of the matching firms, due to their inability to generate funds internally these firms could still be considered financially constrained. While the evidence is not conclusive, the univariate and fixed-effect logit results provide some evidence that firms with weaker finances were more likely to become defendants in patent litigation. These results are consistent with earlier research on litigation by Bhagat et al (1994) and Lanjouw and Lerner (2001) which found evidence of injury to defendants with limited financial resources, even though there was no difference between the size of plaintiffs and defendants in their samples.

3.7 CONCLUSION

My research contributes to the still relatively small empirical literature on product market competition and financial structure using a sample of firms involved in patent litigation. My findings provide additional evidence that leverage affects the way firms compete in product markets, and that firms with higher leverage tend to be less aggressive competitors. In addition to leverage, relative firm size also plays an important role when the litigants are also rivals in the product market: the larger the plaintiff relative to the defendant, the greater the damage suffered by the latter. Unlike some earlier studies, the sample I collected encompasses several industries. Litigants

represented in the sample include pharmaceutical firms such as Glaxo Wellcome, consumer goods companies like Procter and Gamble and technology firms like Intel.

This work also extends earlier research on patent suits. While the role of deep pockets in patent litigation has been investigated before, my work provides a unique insight by separating suits between rivals from litigation between non-competing firms and documenting that plaintiffs' deep pockets primarily affect defendants that are direct competitors. Much of the existing literature relies on samples collected over a short period of time, while the sample here encompasses the twelve years from 1990 to 2001. Unlike Bhagat *et al*. who investigated the role of variables proxying for changes in the costs of financial distress for the defendant, the focus of my work is on the impact of the relative size and leverage of the plaintiff on defendant abnormal returns.

Several innovations in financing litigation have occurred over the past decade, which illustrate the importance of whether or not a firm has deep pockets when it gets involved in patent litigation. In early 1994 the Wall Street Journal reported that American International Group Inc. will start offering insurance policy designed for defendants in patent cases.[29] Patent lawyers increasing acceptance of cases on a contingency basis over the 1990s can also be viewed as an attempt to overcome the "shallow pocket" problem faced by small litigants.

[29] Felsenthal, E., "Business of AIG Will O¤er Insurance Policy For Defendants in Patent Cases," The Wall Street Journal, 01/07/1994, B9.

Chapter 4: Why Do Firms Go Dark?

4.1 OVERVIEW

This chapter (joint work with Nadia Massoud) investigates why firms choose to "go dark" (deregister with the Securities and Exchange Commission (SEC) and delist from the major exchanges) despite having a large number of outside shareholders and what the consequences are for outside shareholders. Section 4.2 discusses potential mechanisms and motivations for firms going dark as well as descriptive statistics regarding their importance. Section 4.3 investigates reasons why firms go dark using first matched and then unmatched logit analysis as a robustness check. As a further robustness test, we also conducted a logit analysis to examine the factors that impact a firm's decision to go dark in comparison to a control group of firms who chose to go private over the same January 1996 to May 2004 period. Section 4.4 examines the adverse impact on shareholders of announcements of planned deregistrations. Section 4.5 examines trading after going dark. In particular, it examines the impact of deregistration on the price and liquidity behavior of going dark stocks as well as on their post-deregistration stock price performance. Section 4.6 concludes and discusses the overall public policy implications of the going dark phenomenon in light of our results. This includes a possible amendment to SEC Rule 12g(5), so as to ameliorate the going dark trend, by replacing shareholders of record with beneficial owners.

4.2 GOING DARK

4.2.1 The Mechanism of Going Dark

Unlike the wave of LBOs in the 1980s and 1990s, which involved raising large amounts of debt to buy out existing stockholders, "going dark" is very different in its

mechanism and leverage implications. A typical example would be a high-tech firm that went public in the 1999-2000 high tech boom and was listed on NASDAQ. For reasons discussed in Section 4.2.2 below, it decides to go dark. This involves a two-step process for a company listed on the NYSE, AMEX or NASDAQ. The first step is to delist from the exchange. This may take up to 21 days, depending on the exchange (e.g. NASDAQ requires a 21 day delisting period). The delisting announcement may also report the reason why the firm is delisting, for example, whether it is delisting because it plans to deregister with the SEC. Once delisted, the firm trades (if at all) over-the-counter on the OTC Bulletin Board or on the Pink Sheets.[30]

The firm may then file a Form 15 with the SEC requesting its deregistration. A full shareholder vote is not required: a firm only needs the approval of its board of directors to deregister with the SEC. In general the deregistration takes up to 90 days to approve. On applying for deregistration the firm no longer has to file public information with the SEC as to its financial condition, i.e. as per 10-Q and 10-K filings, proxy statements, insider stakes, tender offers etc... That is, from an outside investor's perspective the firm has effectively "gone dark" in terms of public information production and disclosure.

It is important to distinguish the voluntary decision to go dark from being involuntarily delisted by an exchange as a result of a firm's inability to comply with one or more of the exchange's listing requirements. Specifically, Macey, O'Hara and Pompilio (2004) and Panchapagesan and Werner (2004) have already examined the impact of involuntary exchange delistings on liquidity, trading costs and volatility.

[30]Since the OTC Bulletin Board requires registration with the SEC (see Bushee and Leuz (2004)), the shares of firms going through the deregistration process are eligible to trade in this market only if they have not yet filed a Form 15 to deregister with the SEC. The OTC market organized by Pink Sheets LLC does not have any registration or disclosure requirements. The Pink Sheets is essentially a quotation service for subscribing market makers offering to trade in OTC issues, not an issuer listing service. Currently there are approximately 3900 issues quoted on the Pink Sheets.

It is also important to distinguish the going dark decision from going private. In going private a firm's insiders commonly repurchase existing shares from a firm's outsiders – often at a premium over current share prices – see, for example, Engel, Hayes, and Wang (2004) and DeAngelo, DeAngelo, and Rice (1984). In the case of going dark, the firm may exploit mechanisms to reduce the number of holders of record below the 300 (500) threshold. These mechanisms include reverse stock splits (exchanging existing shares for a smaller number of new shares, for example in a 1-for-20 split) and limited tender offers (self-tender offers that do not require the firm to repurchase all shares held by outsiders). As a result, surviving outside shareholders are often left with shares in a company, traded on the OTC markets but not reporting to the SEC, that are less liquid than the shares they held when the company was registered with the SEC.

For example, OTCBB traded Keller Manufacturing Company Inc. (Keller) issued a press release on March 8, 2004 announcing that it intends to engage in a going dark transaction by completing a 1-for-500 reverse stock split. The reverse split approach to going dark entails the board setting a sizable split ratio (for example the 1-for-500 split in the case of Keller) in order to reduce the number of shareholders of record to less than 300 (500). As a result of the reverse split, investors holding fewer than 500 pre-reverse split Keller common shares were cashed out (i.e. no fractional shares were issued), the ownership of Keller's officers and directors increased from 41% to 44% and the number of shareholders of record was reduced from 457 to approximately 240, allowing Keller to deregister from the SEC on March 29, 2004.

4.2.2 Reasons for Going Dark

From proxy statements, petitions and press reports, there appear to be two major reasons why firms are choosing to go dark. The first is related to the direct and indirect costs of regulatory compliance following the passage of the Sarbanes-Oxley Act on July

31, 2002. The second relates to a variety of economic incentives, particularly the self-interest of inside shareholders.

4.2.2.1 Sarbanes-Oxley Incentives for Going Dark

The passage of Sarbanes-Oxley imposed a number of indirect and direct costs on publicly registered firms. Indirect costs primarily related to the enhanced responsibility of corporate executives and boards in producing and verifying publicly available information. Direct costs have mostly related to the enhanced and different role played by auditors under Sarbanes-Oxley and the impact on audit costs and fees paid by firms. Specifically, auditors now have to examine whether firms have implemented adequate internal controls to ensure accurate financial reporting and regulatory compliance. In addition, auditors can no longer provide consulting or other ancillary services to the same firm.[31] Such a separation of activities may reduce conflicts of interest, but it has also reduced the potential for cross-subsidization of audit fees by accounting firms in search of additional business such as consulting. Overall, auditors believe that their fees will increase by 25 to 35 percent in the post-Sarbanes-Oxley world (according to the June 3, 2004 issue of the Financial Times). Two surveys by Financial Executives International (FEI)[32] have also suggested that compliance with Sarbanes-Oxley will increase audit fees by 30%.

Nevertheless, while some have questioned the costs of remaining public, others have viewed the passage of the Sarbanes-Oxley Act as being net beneficial for outside investors. For example, a survey conducted by Harris Interactive® (for software maker Movaris) found a majority of investors are looking for good corporate governance and adherence to the Sarbanes-Oxley Act. The survey suggests that 59% of investors believe

[31] This provision was largely in response to the Enron failure and the role played by Arthur Andersen.
[32] FEI surveys are cited in http://www.knowledgestorm.com/info/user_newsletter/022004/Sarbanes-countdown.htm.

that the law will help protect their stock investments. Additionally, 57% would be very unlikely to invest in a company that failed to comply with Sarbanes-Oxley.[33]

Rezaee and Jain (2003) find positive abnormal returns at the time of legislative events leading up to the passage of Sarbanes-Oxley.[34] Thus, whether the Sarbanes-Oxley Act negatively impacted shareholders in general or just inside shareholders, given the trade-off between enhanced corporate governance and higher audit fees, is an empirical question. In particular, outside shareholders may value enhanced governance positively while inside shareholders (such as manager-shareholders) may view enhanced governance negatively. Consequently, the perceived net costs or benefits of Sarbanes-Oxley may be a function of the insider/outsider ownership structure of firms.

In the next sub-section corporate governance and other economic reasons shareholders have for taking the firm dark are briefly outlined. These are also discussed in more detail in Section 4.3.

4.2.2.2 Economic Incentives for Going Dark

A variety of agency, corporate governance and other economic reasons for going dark have been raised in the business press and academic literature. As noted above, insiders and outside shareholders have divergent interests regarding the costs of enhanced corporate governance, restrictions and requirements under Sarbanes-Oxley. In addition, insiders have both the means and the incentives to exploit any asymmetric information advantages they have relative to outside shareholders (see the earlier cited Business Week articles and the petition filed on behalf of institutional investors with the SEC for examples of alleged opportunism by insiders). For example, insiders may believe (or

[33] See the website of the American Institute of Certified Public Accountants for a summary of the enhanced reporting and governance requirements under Sarbanes-Oxley: http://www.aicpa.org/info/sarbanes_oxley_summary.htm.

[34] The Rezaee and Jain (2001) study relates to S&P 500 firms and may not apply to smaller firms.

know) that some of the firm's assets are undervalued and by going dark they can profitably exploit those assets.

A firm may also be taken dark if it has a large free cash flow. That is, following Jensen (1986), a firm which has a large free cash flow faces an agency conflict between its insiders (managers) and stockholders. The agency cost is the greatest when the firm is experiencing simultaneously a low potential for growth (low q) and a high cash flow (see, Lang, Stulz and Walking (1991) and Opler and Titman (1993)). In such a situation, insiders will benefit from going dark by expropriating most of the free cash-flow.

Moreover, in contrast to LBOs, which are viewed as a going private solution to the cash flow problem, going dark makes the cash flow problem even worse for outside shareholders. A key difference between the LBO wave in the 1980s and going dark is that most firms which go dark do not make tender offers to buy-out their shareholders. That is, going dark usually results in stockholders owning shares that are potentially less liquid (since they can be traded, if at all, over-the-counter on the Pink Sheets) and about which little or no public information will be produced. Before a more detailed examination of the importance of these various reasons for going dark, we next discuss our sample in Section 4.2.3 below.

4.2.3 Data Description and Sources

To understand our sample it is important to remember the distinction between delisting from an exchange (which implies that trading in a firm's common stock ceases on that exchange) and deregistration with the SEC (which means that the firm will no longer have to provide financial statements and other public disclosures through mandatory SEC filings).[35] All firms listed on one of the major exchanges or traded on the OTC Bulletin Board are required to be registered with the SEC. (For OTCBB quoted

[35] Firms may, however, provide such information voluntarily.

firms the eligibility rule requiring SEC registration was phased in gradually over the July 1999 to June 2000 period, see BL (2004) for details.) The distinction between delisting and deregistration is important in part because delisting may be the result of any other violation of exchange listing requirements, not just deregistration. A firm that is delisted from an exchange (e.g. because of violating NASDAQ's minimum bid price rule) will not necessarily deregister. However, a firm that decides to end its registration with the SEC while trading on a major exchange or on the OTCBB must delist from the exchange and is deleted from the OTCBB in the case of Bulletin Board quoted firms. A number of these firms then find their shares moved to the Pink Sheets. By moving to the Pink Sheets a firm can continue to be traded, while not only avoiding stock exchange listing fees,[36] but also the costs of complying with SEC requirements (i.e. going dark).

Deregistering firms were first identified by searching the SEC's EDGAR database[37] for firms which filed a Form 15 to deregister all classes of their public securities over the January 1996 – May 2004 period.[38] We excluded firms which filed a Form 15 to deregister only their preferred stock or publicly traded bonds.

The dates of deregistration announcements were identified as follows. In a number of cases firms filed a Form 8 with the SEC with an attached (and dated) public announcement of their planned deregistration. In some cases other SEC filings (for example proxy statements) contained the announcement. For those firms which did not file information regarding the deregistration announcement with the SEC, we searched

[36] There are no fees for companies to be quoted on the OTCBB. NASD Rule 2460 explicitly prohibits any payment by issuers or their affiliates and promoters, directly or indirectly, to market makers for publishing quotations.

[37] EDGAR, the Electronic Data Gathering, Analysis, and Retrieval system, performs automated collection, validation, indexing, acceptance, and forwarding of submissions by companies and others who are required by law to file forms with the U.S. Securities and Exchange Commission.

[38] Not all SEC filings are available on EDGAR. Companies were phased in to EDGAR filing over a three-year period, ending May 6, 1996. Since we use EDGAR data quite extensively, our sample does not include firms that went dark before 1996.

press releases and newswire announcements using the Factiva database as well as checking news releases posted on the firms' web sites. We analyzed three possible deregistration event dates: the filing date, the announcement date and the earliest of either the filing date or the announcement date. Firms which filed to deregister as a result of a merger, bankruptcy or liquidation were dropped from the sample.[39]

After this procedure our total sample consisted of 406 firms, which could be subdivided into two distinct sub-samples (see Figure 4). The first sub-sample includes deregistering firms that were – at the time of the deregistration announcement – listed on one of the major exchanges such as the NYSE, AMEX or NASDAQ and delisted voluntarily. Over the January 1996 - May 2004 period there were 47 such firms. To make sure whether delisting from the exchange was voluntary, we collected the delisting codes from CRSP.[40] Our second sub-sample of 359 firms contains those companies that announced their planned deregistration while trading over-the-counter either on the OTCBB or Pink Sheets.[41]

The logit analysis in Section 4.3 below requires the availability of both financial statement information and share price data. Accounting information was obtained from Compustat as well as directly from Edgar electronic filings with the SEC. Datastream was our primary source of stock return and volume data. Closing bid and closing ask price data were provided by Pink Sheets LLC.

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[39] Press releases were the most important source of information regarding the reason for deregistration. Also, each Form 15 contains the number of holders of record for the security. In the case of mergers firms typically report 1 as the number of holders of record. We excluded all firms with 1 holder of record and carefully examined all other firms to make sure that they have not deregistered as a result of merger.

[40] Delisting codes 520, 570 and 573 identify voluntarily delisting firms in the CRSP data files. When the CRSP delisting information contradicted the data gathered from delisting announcements, we used Factiva to find a third source to confirm whether the delisting was voluntary or involuntary.

[41] Since the broker has to pay for quoting a company's shares for trading over-the-counter while the issuer pays for listing on the major exchange some public companies will not be traded at all if the issuer views exchange fees and benefits as relatively small or the broker, in the case of over-the-counter markets, views the cost of making markets in the company's shares as too high.

As a further screening of the deregistering sample (406 firms), we excluded foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations,[42] firms for which accounting or stock price data was not available and firms which were not publicly traded – either on a major exchange or over-the-counter – at the time of the announcement. After such screening we end up with a total deregistering sample of 261 firms. Table 10 shows the breakdown of the going dark sample in each year between January 1996 and May 2004. As can be seen, the number of firms going dark has grown dramatically over time. The increase is the highest after SOX with 101 firms deregistering in 2003 compared to 44 in 2002. To better understand the type of firms in our going dark sample we provide two examples.

Isomet Corporation, one of the firms in our first (exchange traded) sub-sample, was still listed on the NASDAQ when it announced, on February 14, 2003, that it would take steps to voluntarily delist and deregister its common stock in order to "avoid costly SEC filing requirements," according to the press release issued by the firm. After the firm deregistered with the SEC (and thus became ineligible for trading on the NASDAQ), trading in the company's shares continued on the Pink Sheets Electronic Quotation Service. On the day of the deregistration announcement Isomet shares closed at $0.85, down 52 cents from $1.37 the day before.

SEMX Corporation on the other hand is included in our second sub-sample (firms deregistering while trading in the OTCBB or the Pink Sheets market). Beginning April 1996, the company's common stock traded on the NASDAQ National Market. On March 3, 2003, SEMX issued a press release announcing that as of March 10 it would be delisted from the NASDAQ. Subsequently, SEMX began trading on the Over-the-Counter Bulletin Board. Then, on May 21, 2003, SEMX Corporation announced plans to

[42] A shell corporation is a corporation without any business activities.

go dark by filing a Form 15 with the Securities and Exchange Commission to deregister its common stock and suspend its reporting obligations under the Securities and Exchange Act of 1934. Upon filing of the Form 15, the Company's obligation to file with the SEC certain reports and forms, including Forms 10-K, 10-Q and 8-K, immediately ceased. In addition, SEMX common stock was no longer eligible for quotation on the OTC Bulletin Board, and over-the-counter trading in the company's stock moved to the Pink Sheets. On May 21 the company's stock closed at $0.10, but after the news about the voluntary deregistration broke it fell to $0.09 on May 22 and dropped to a 52 week low of $0.05 on May 30.

In this study we use both a matched-firm and unmatched-firm logit analysis to investigate the underlying reasons why firms go dark. The results of this logit analysis are discussed in the next section.

4.3 LOGIT ANALYSIS OF THE FIRM'S DECISION TO GO DARK

The question analyzed in this section is what factors prompt a firm’s decision to go dark? In the case of the wave of going private transactions in the 1980s, Jensen's (1986) free cash flow hypothesis was often suggested as the most plausible explanation. Moreover, studies by Lehn and Poulsen (1989) and Opler and Titman (1993) tended to support the free cash flow hypothesis. While one might expect to find similar results for firms that went dark, two important differences should be noted. First, besides free cash flow and other agency related variables, the decision of firms to go dark may have been also affected by their costs of regulatory compliance. Second, it must be emphasized that while going dark may be motivated by some of the same factors as LBOs and MBOs, the final results for outside shareholders differ dramatically. This is because rather than resolving the agency problems of free cash flow, going dark actually exacerbates them.

4.3.1 Matched Logit Analysis: Model and Variables

To examine this question we first use a matched logit analysis – matched on asset size, SIC code and the market in which the firm's equity is traded[43] – to identify the relative importance of different factors driving the going dark decision. We believe that a priori the matched approach has at least three advantages over the unmatched approach. First, the unmatched sample (see later in Section 4.3.3) has a large proportion of firms that trade on major exchanges rather than over-the-counter. In particular, only 11.5% of the firms in the unmatched control sample traded over-the-counter, as opposed to 52.5% of the firms that went dark.[44] Second, a further imbalance exists in the unmatched sample between going dark financial institutions (21.5% of the total sample) and financial institutions with under 300 (500) holders of record that chose not to go dark (9.8% of the total sample). This difference is statistically significant, see Table 15. This difference is important since, as our results show, going dark financial institutions' returns and liquidity behave very differently from those of non-financial firms. Third, a firm can deregister, even if it has more than 300 shareholders of record, by engaging in a reverse stock split or a limited self-tender offer.[45]

As explained earlier (in Section 3.6), "choice based" samples such as ours are characterized by unequal sampling rates. Our sample encompasses all firms that went dark but it includes only a small fraction of the large majority that chose to stay registered with the SEC. A choice based sample in itself would not necessitate the use of the so called conditional (or fixed-effects) logit approach. The firms in our control sample

[43]We distinguished between two types of equity markets: major organized exchanges (NYSE, AMEX and NASDAQ) and over-the-counter markets (the OTCBB and the Pink Sheets).
[44] The 52.5% reflects the percentage of going dark firms traded on OTC at the end of the last fiscal year prior deregistration.
[45] Note that a limited share repurchase still leaves the non-repurchased shareholders exposed to the effect of the deregistration decision.

however have not been randomly selected: they were matched to deregistering firms based on firm characteristics such as size and industry. The issue is not just that of unequal sampling rates: the matching firms are not representative of the population of firms that did not go dark; instead they were chosen to be similar to deregistering firms. Each going dark firm and its matching firm(s) represent a group, and in this case, the conditional (or fixed-effects) logit is the correct approach, because one must control for the omitted variables that are constant within the group.

While the SEC has authority over a broad range of corporate activities, state corporate law and a company's articles of incorporation and by-laws govern reverse stock splits.[46] Depending on the state of incorporation and its articles of incorporation and by-laws, a company's board of directors may be able declare a reverse stock split without a vote by shareholders. The earlier discussed reverse stock split by Keller Manufacturing is one example where the board, under Indiana law, was not required to seek shareholder approval. Smaller firms, which seem to be the primary candidates for going dark, tend to have high insider ownership, implying that a reverse stock split may be a feasible strategy even when a shareholder vote is required.

Nevertheless, in Section 4.3.3 below, we also analyze an unmatched sample, as a robustness check, where all firms in the unmatched sample are firms with fewer than 300 (500) shareholders of record who could deregister but chose to remain registered. We match by size since, a priori, we expect smaller firms to have a greater incentive to deregister than larger firms. Larger firms may be reluctant to deregister for a number of reasons including the need to retain public visibility so as to attract sufficient external financing in the future. Matching by firm size and four (or two) digit SIC code has become common practice in the literature (an example is Lehn and Poulsen (1989)).

[46] See the SEC's website for further details: http://www.sec.gov/answers/reversesplit.htm

In our matched logit tests we controlled for the possibility that matched firms with fewer than 300 holders of record that did not deregister (of the same asset size and industry) behaved differently from firms with over 300 shareholders of record that did not deregister, by using a dummy variable to identify this effect in the matched logit analysis. As a robustness test, we conducted an unmatched logit analysis (in section 3.3) of the case where the non-deregistering sample consists of all firms that had fewer than 300 (500) shareholders of record and chose not to deregister.

As discussed above, our sample of going dark firms are all firms that deregistered over the January 1996 to May 2004 period. We constructed our matched holdout sample in a manner similar to Lehn and Poulsen (1989), selecting non-deregistering firms that had similar asset size, SIC codes and were traded on the same equity market as the going dark firms. The dependent variable is binary: 0 if the firm did not deregister and 1 if it did. Specifically, the matching firms are chosen based on three criteria: (i) its 4 digit SIC code, (ii) its average asset size over the 3 years prior to a going dark announcement by the sample firm and (iii) the market for the firm's common equity at the end of the last fiscal year prior to deregistration.

Where possible, we also chose a matching firm close in "age" to the firm under consideration by comparing the date the matched firm became public with that of the going dark firm. This information was obtained from the CRSP and the EDGAR databases. When we could not find a 4 digit SIC match directly we checked the Hoover's Online database.[47] Hoover's publishes an industry directory for each firm which lists all 4-digit SIC codes related to a firm's operations. In addition, the Hoover's database includes the names of the firm's major competitors. On a few occasions when it was

[47] Hoover's is an online database providing comprehensive company and industry information that can be accessed at: http://www.hoovers.com/.

difficult to choose between matching firms, we included both firms in the matching sample.

In total we have 281 matching firms and 261 going dark firms for a combined sample of 542 firms. Table 11, Panel 1, provides full details of the construction and source of our dependent and explanatory variables in the logit model.

Our choice of explanatory variables was predicated on our seeking to distinguish economic reasons (including agency conflicts of interest between inside and outside shareholders) from auditing cost incentives to go dark. With respect to economic incentives, the q-ratio measures the firm's potential growth options. Firms with a high q-ratio may prefer to stay public since they are better able to raise additional external financing in capital markets. Alternatively, insiders may wish to take high q-ratio firms dark so as to be better able to expropriate the implied growth options inherent in a high q-ratio.[48] That is, having a higher q-ratio may either increase or decrease a firm's probability of going dark.

Insider ownership stakes – the percentage of voting common equity controlled by managers and directors of the company – may also be expected to influence the going dark decision for both corporate governance cost and cash flow expropriation reasons. The insider ownership variable reflects the relative controlling decision power (as to whether to go dark) of the firm's stockholding officers/directors.[49] The more concentrated that power, the easier it is to ensure sufficient votes to take a firm dark.

According to the extant literature, the larger is a firm's cash flow, the stronger the incentive to take that firm private (Jensen (1986) and Lehn and Poulsen (1989)).

[48] It is also plausible that going dark is the result of a bad realization of the firm's investment opportunity set and the q-ratio in part controls for this.

[49] Engel *et al* (2004) considered a similar measure. An alternative measure for controlling power of insiders is blockholders' ownership, considered by LTW (2004). This measure includes both insiders and outsiders with ownership stakes larger than 5%. Hence the blockholder variable will tend to overestimate the voting power of insiders and underestimate that of outsiders.

However, as noted earlier, unlike in the LBO wave of the 1980s, where an LBO and its related debt burden were viewed as ways to discipline managers and reduce agency problems, firms that go dark can capture significant amounts of cash flow for insiders such as stockholder-managers. In our tests, we not only analyze the separate effects of cash flow, the q-ratio and insider ownership stakes but also the explanatory power of cash flow when it is interacted with each of these variables. Specifically, firms with limited (low q) growth opportunities may have a stronger incentive to go dark if the potential gain from cash flow expropriation by insiders is greater. Therefore, the propensity to go dark may be greater among firms with both low q-ratios and high free cash flows (see, for example, Opler and Titman (1993) and Lang, Stulz and Walking (1991)). The interaction of cash flow with insider ownership examines the possibility that firms with high free cash flow and high insider ownership have a greater incentive to take the firm dark so as to expropriate the free cash flow.[50]

The ratio of intangible assets to total assets (the intangible asset ratio) is a measure of the degree of asymmetric information between insiders and outsiders, regarding the value of the firm's assets.[51] In particular, insiders may be better able to correctly value and exploit such assets compared to outsiders. Consequently, insiders may seek to utilize their private information advantage by going dark (and transferring wealth from outside equity holders to insider equity holders).

[50] This interaction variable is highly correlated with the free cash flow variable (correlation of 0.767). To address this issue, we dropped the free cash flow variable from the logit model when we introduced the cash flow-insider ownership interaction variable.

[51] Compustat describes intangible assets as including for example: unamortized research and development, blueprints or building designs, client lists, computer software patent costs, contract rights, costs associated with approved patents, copyrights, design costs and etc… See the Compustat Manual for a complete list of intangible assets.

Audit fees reflect some of the most obvious and measurable costs of compliance under the (revised) corporate governance requirements post-Sarbanes-Oxley.[52] We considered two measures of audit fees: the ratio of audit fees to the market value of the firm's equity and the natural log of audit fees. The audit fee, which is usually available from the proxy statement of the firm filed with the SEC, is obtained from the Audit Analytics data base (a recent addition to the databases available from Wharton Research Data Services). As noted above in Section 2.2.1, the audit-related costs of Sarbanes-Oxley compliance were mentioned in the business press as a reason for firms' choosing to go dark. A financial institution (FI) dummy is also introduced to measure the different incentives regulated financial institutions, such as banks, have to go dark versus non-financial firms (this variable is omitted in the case of the industry and size matched control sample).

Firms may be more reluctant to go dark following a period of either strong positive stock price performance (or momentum) or high liquidity, since they would have to give up the new security issue benefits related to a relatively high valuation or market liquidity. Companies with low liquidity or poor recent return performance on the other hand may view their equity as undervalued by the market and may see less benefit in staying a publicly registered firm. We examine the impact of momentum and trading volume on the probability of deregistration by including pre-deregistration trading volume and market-adjusted[53] buy and hold returns in our logit model. Following

[52] We recognize that there are other Sarbanes-Oxley related factors that had an impact on the going dark decision but, unlike audit fees, those factors are difficult to measure accurately and may even be unobservable. Also, it is not unreasonable to assume that most Sarbanes-Oxley related costs are highly correlated with audit fees.

[53] We also considered an alternative measure of momentum by including, in the logit test, the pre-deregistration buy and hold raw returns. The results are essentially the same. Trading volume is defined as the ratio of daily average of trading volume to outstanding shares.

Loughran and Ritter (1996), we define buy and hold market-adjusted returns for the *j*th firm in our sample as:

$$BHMAR_{j,T_{-150},T_{-31}} = \left[\prod_{t=T_{-150}}^{T_{-31}}\left(1+R_{jt}\right)\right] - \left[\prod_{t=T_{-150}}^{T_{-31}}\left(1+R_{mt}\right)\right],$$

where T_{-150} and T_{-31} are the first and the last trading day included in the holding period we use to calculate buy and hold returns (i.e. 150 and 31 trading days prior to the deregistration announcement, respectively), R_{jt} is the daily return for sample firm j on date t, and R_{mt} is the return on the Russell 2000 Index on the same date. We chose the Russell 2000 because the firms covered are relatively small.[54]

The average daily volume or turnover is also measured from 150 to 31 trading days prior to the deregistration announcement (over a 120 trading day window). The leverage[55] variable is motivated by earlier results from the disclosure literature. Palepu (1987), Healy and Palepu (1990), and DeAngelo, DeAngelo, and Skinner (1996) find that highly leveraged firms are more likely to make strategic decisions (here the decision to go dark) to conserve cash. Finally, the log of the firm's assets is introduced to control for any remaining size effects on the decision to go dark.

Table 12 shows descriptive statistics of our sample including the number of observations, means, standard deviations, minimum and maximum values of the logit model variables. Notice that for the audit fee variables we have only 310 observations out of 542 going dark and matched firms. The disclosure of audit fees in proxy statements became mandatory only after February 5, 2001. The introduction of the audit fee

[54] Our results are robust to the use of the Russell 3000.

[55] Since our sample includes financial institutions, we considered the common measure of leverage as a ratio of total liabilities over assets. We also considered an alternative measure of leverage after we excluded financial institutions from our sample which is the ratio of total debt to assets. Overall, it generates similar model results.

variables eliminated those firms from our sample that went dark before they had to file a proxy statement under the new SEC rules.[56]

4.3.2 The Matched Logit Results

Table 13 shows t-test statistics for differences in means for our logit model variables between going dark firms and their matched firms, Table 14 presents the coefficient score results of the logit analysis together with the odds ratio (economic importance) for each of the explanatory variables described above. In Table 14, we examine five models, starting with a set of variables for which observations are available for the entire sample (i.e. 542 observations), and then introducing additional variables successively. Each decline in sample size, from one model to the next, reflects the reduction in the number of available observations resulting from the inclusion of an additional explanatory variable and the availability of information on that explanatory variable.

As can be seen from the results for models 1 through 4 in Table 14, firms with a high q-ratio have lower incentives to go dark. This suggests that staying registered allows relatively profitable firms the benefit of continued access to external equity funding so as to finance their profitable (high q-ratio) investments.

Free cash flow appears to have offered much less of an incentive to go dark, in comparison to the incentive to go private during the LBO wave of the 1980s. Specifically, it is statistically insignificant throughout the models tested in Table 14. The primary reason for this is that on average the cash flow of going dark firms has been low (see Table 12) over our sample period. Indeed, for 120 firms out of 261 in the

[56] On November 21, 2000 the SEC issued a "Revision of the Commission's Auditor Independence Requirements" (release number 33-7919, effective date: February 5, 2001), which states that "registrants must comply with the new proxy and information statement disclosure requirements for all proxy and information statements filed with the Commission after the effective date." (See http://www.sec.gov/rules/final/33-7919.htm for further details.)

deregistering sample, cash flow was actually negative in the year prior to deregistration. Consequently, there may have been a different impact of cash flow on the going dark decision emanating from positive relative to negative cash flow firms. To further examine the cash flow effect and following Opler and Titman (1993), we created an interactive dummy variable for the firm's cash flow and its q-ratio. This dummy variable takes a value of 1 if the cash flow is positive (>0) and the q-ratio of the firm is less than 1 (q-ratio<1), i.e., it has few future growth opportunities. For all other firms this variable takes a value of zero. As can be seen from Table 14 this interactive dummy variable is positive and significant (at the 5% level) in model 5, implying that positive cash flow firms with low q-ratios (low growth opportunities) are more likely to go dark. However, it is not statistically significant in the other models.

As expected, the insider ownership variable, measured by the percentage holding of voting common shares by all directors and officers as a group, is significantly positive at the 1% level for most relevant models (significant at 5% for model 5). As noted earlier, the greater the insider versus outsider stock ownership the more powerful are inside stockholders and stockholder managers relative to outsiders, i.e, their votes and private incentives are likely to predominate over outside shareholders in a going dark decision. The interactive variable of insider ownership with cash flow appears to be less important in explaining the going dark trend.

A common reason given for firms seeking to go dark has been increased audit costs related, in part, to the passage of Sarbanes-Oxley. To examine this we used the dollar value of the annual audit fee paid by the firm before deregistration divided by the firm's market value of equity (MVE).[57] Consistent with the arguments made in the press and in public petitions to the SEC, the audit fee/MVE ratio –which is reflective of the

[57] Using the log of audit fees as an alternative measure leaves our results unchanged.

direct costs of remaining registered—has a positive and significant (at the 5% level) effect on the probability of going dark.[58] Importantly, we find that in addition to the economic and agency related incentives to go dark, audit costs have also been an important factor underlying the deregistration decision.

As implied by the disclosure literature, highly levered firms are more likely to go dark. As can be seen, with the exception of model 5, the leverage variable is positive and significant at 1% in Table 14. As expected, a positive share price momentum reduces the probability of going dark. In addition, the volume (turnover) variable is negative and is significant at the 1% level in models 4 and 5.

The size variable (log of assets) is statistically significant and negative in all models.[59] The coefficients for the intangible assets ratio were statistically insignificant. Finally, a dummy variable that reflected whether the matched firms had fewer than 300 (500) stockholders of record was examined. If the matching firm had stockholders of record below 300 (500) the dummy variable was set equal to 1 for both the matching and sample firm otherwise it was equal to 0. The variable was not statistically significant in any of our matched logit tests.[60]

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[58] Indeed we find considerable variability in both absolute and relative audit costs. For example, Soligen Technologies, with a total market capitalization of $4,441,440, paid $44,549 in audit fees in the fiscal year ended on March 31, 2001. Teltone Corp, with total market capitalization of $823,920 was billed a more modest $27,769.5 for the audit of its annual financial statements for the fiscal year ended June 30, 2002. While Soligen's audit fees were 1% of the market value of its equity, for Teltone the cost was higher in percentage terms, amounting to 3.4% of its market capitalization. Variation in audit fees paid by companies is well documented in the accounting literature. In a survey article for the CPA Journal, Turpin (1995) notes that audit fees vary according to client attributes associated with audit effort and audit risk. Besides client size, complexity and industry have a significant impact on audit costs. While large diversified companies tend to pay higher fees, firms in heavily regulated industries incur lower audit costs.

[59] It should be noted that the asset size variable controls for size effects after taking account of firm matching. The asset-size variable more completely reflects the size effect in the *unmatched* sample logit tests (see Table 16 later).

[60] In order to save space, the results are omitted from Table 14.

Overall, our results suggest that the main factors impacting a firm's decision to go dark are its q-ratio, its insider ownership concentration, leverage, trading volume, momentum and its audit fees.

4.3.3 Unmatched Logit Tests

Section 4.3.2 examined the factors driving the deregistration decision for a sample matched by asset size, equity market and industry. It could be argued that all firms with fewer than 300 (500) shareholders of record could go dark and thus should be the appropriate hold-out sample in a logit analysis.[61] For completeness and as a robustness check we also constructed an unmatched sample by using all firms available on EDGAR with stockholders of record below 300 (500) over the 1996-2004 period (we refer to it as the unmatched control group). For the firms with holders of record greater or equal to 300 and less than 500, we only included firms with assets below $10 million in the past 3 years. We also excluded foreign firms, shell corporations, bankrupt firms and firms in their first year of registering with SEC (because they are not eligible to deregister). There are 1,860 such firms. Note that a firm could go dark during any year, as long as its holders of record satisfied the 300 (500) criteria. As a result, our sample may include some firms more than once. Overall, there are 7,114 firm-years in the sample. However, as discussed earlier, we believe that the matched approach has certain advantages over the unmatched approach in analyzing the going dark decision.

The summary statistics of the unmatched control group and the t-statistics for differences in means between the going dark sample and unmatched control group are presented in Table 15. Table 16 presents the coefficient score results and the elasticities (economic importance) of the logit analysis using the same explanatory variables discussed in Section 4.3.1. Comparing the results in Table 16 (the logit results using the

[61] See also LTW (2004).

unmatched control group) with those in Table 14 (the logit results using the matched control group), with the exception of the momentum we find similar results to the matched logit. In particular, both the audit cost and insider ownership variables remain statistically significant.

4.3.4 Additional Robustness Checks

4.3.4.1 Going Private Transactions versus Going Dark

Our next robustness check was to examine the factors that impact a firm's decision to go dark in comparison to a control group of firms who chose to go private over the same January 1996 May 2004 period. As discussed above, going private often involves a different mechanism (buyout of all outside shareholders) than going dark where insiders deregister a firm while often leaving outside shareholders in place. Engel et al (2004) and LTW (2004) examine going private decisions. We identified firms that went private over the sample period, following Engel et al (2004) by collecting those firms that filed a Schedule 13E3 with the SEC regarding a going private transaction and subsequently filed a Form 15, showing that the going private transaction was completed. Note that this approach essentially follows the SEC's definition of going private and is different from the approach sometimes used which defines going private transactions to include only LBOs, MBOs and similar transactions.[62] We check each sample firm to make sure that the deregistration was related to the earlier Schedule 13E3 filing (i.e. we exclude firms where the going private transaction was not completed but the firm ended up deregistering for some other reason), and we also excluded all firms that filed a Schedule 13E3 in order to go dark following a reverse stock split or self-tender offer.

[62] Refer to the following SEC web page for further details on how the SEC defines a going private transaction: http://www.sec.gov/answers/gopriv.htm

In our study we use the same set of explanatory variables used in our logit test above for deregistration to examine the factors impacting the going dark decision versus the going private decision using logit analysis. Table 15 shows the summary statistics for the going private control group and t-statistics for differences in means between the going dark sample and the going private control group. In comparison to firms that went private, we find the going dark firms are generally smaller in size, have a higher leverage ratio and are more likely to be financial institutions. The logit results are shown in Table 17. As a further robustness check, we repeated our test including only LBOs, MBOs and similar transactions in our sample (i.e. excluding mergers between parents and subsidiaries), and we found that our results remained essentially unchanged.

4.3.4.2 Exchange Listing: Voluntary Delisting and Deregistration

It might be argued that the firms that voluntarily delisted and deregistered from the major exchanges, i.e., the 47 firms denoted as sample 1 in Figure 4, may have had different incentives to go dark from those that deregister while trading over-the-counter on the Bulletin Board and/or the Pink Sheets. For example, firms listed on a major exchange can reduce their public firm compliance costs by first delisting and then deregistering. In particular, listing on a major exchange requires a fee to be paid by the firm to the exchange. By contrast a firm listed on the Pink Sheets does not have to be registered and listing fees are paid by broker/dealers with inventories of the firm's shares. To test whether major exchange listed deregistering firms had different incentives to voluntarily delist and go dark relative to the other firms in our sample, we introduced a dummy variable (equal to 1) if the firm going dark was NYSE, AMEX or NASDAQ traded and simultaneously voluntarily delisted and deregistered and 0 otherwise.[63] We

[63] It is important to note that we are only looking at voluntary delistings (and deregistrations) as opposed to involuntary delistings.

then add this dummy variable to the right hand side of model 5 in Table 14 and re-estimated the matched logit model. The exchange traded dummy variable was insignificant at the 10% level.

4.3.4.3 The Sarbanes-Oxley Act

It might be argued that the Sarbanes-Oxley Act's passage in July 2002 may have altered the importance of the various incentives for going dark. To examine this question we split our sample into firms going dark pre-Sarbanes Oxley (January 1, 1996 to July 30, 2002) and those post-Sarbanes-Oxley (July 31, 2002 to May 30, 2004). Table 18 presents mean values of the explanatory variables for going dark firms before and after the passage of Sarbanes-Oxley and corresponding t-statistics for differences in means for the period from January 1996 to May 2004. The number of firms in our sample that went dark prior to Sarbanes-Oxley was 92, compared to the 169 that went dark after the Act's passage. As can be seen from Table 18, there appears to have been no significant difference in the characteristics of pre- and post- Sarbanes-Oxley firms except for insider's ownership, market momentum and volume. The insider ownership variable is larger post-SOX than pre-SOX. The significantly higher post-SOX stock price performance is consistent with SOX encouraging higher performing firms to go dark.

4.3.4.4 Institutional Ownership

To examine the effects of institutional ownership (see also LTW 2004), we collected institutional ownership data from the Thompson Financial database. There were institutional ownership data for 99 of the going dark firms and 124 of the matched firms. We collected these data from the quarter before the firm went dark. We found

institutional ownership to be negative and significant at the 1% level, with our prior results remaining generally unchanged.[64]

4.3.4.5 Other Variables

We also examined a variety of other variables that may have impacted a firm's decision to go dark. Among these were some motivated by the earlier going private/LBO literature. Perhaps because many of these firms are quite young (e.g. a firm conducting an IPO in 2000 and going dark in 2002), past growth in sales revenue was found to be insignificant. This variable had been found to be an important factor by Lehn and Poulsen (1989) in explaining LBOs in the 1980s. We also examined the ratio of R&D expenditures to sales as an alternative measure for the asymmetric information advantage of insiders, but we did not find it to be statistically significant. In addition, we used capital expenditure growth as a proxy for financing needs. Specifically, Lang and Lundholm (1993) have shown that the costs and benefits of disclosure are affected by financing needs, however we found that a proxy for financing needs (capital expenditures) has no impact on firms' decisions to go dark. According to the Economist (Sarbanes-Oxley: A price worth paying?, May 19, 2005) some firms try to switch auditors in an effort to reduce audit costs. We included a dummy variable indicating whether there was a switch in auditors over a one-year and/or two-year period prior going dark, but we did not find either significant.

We also investigated the impact of executive compensation and cash bonuses. A Business Week article (May 24, 2004) argued that highly paid executives[65] may enrich themselves after going dark since they will no longer be required to disclose executive

[64] We added the institutional ownership variable to the existing set of explanatory variables in Table 14, model 5.

[65] In 2003, the year prior to going dark, the compensation (salary and cash bonus) of Niagara Corp's CEO increased to $880,000 from $680,000 in 2002 and $480,000 in 2001.

pay. We collected the annual salary and cash bonuses from the proxy statement with SEC filing. Our measure of compensation growth, the percentage increase in combined annual salary and cash bonus over the year preceding deregistration, collected from the proxy statement, did not have a significant impact on the probability of going dark.

4.4 THE IMPACT OF DEREGISTRATION ANNOUNCEMENTS ON STOCKHOLDERS

4.4.1 Announcement Effects

In this section we examine the impact of deregistration announcements on stockholders. Over the period from January 1996 to May 2004 we identified 238 firms with stock price data available on Datastream as announcing planned deregistrations that were unrelated to bankruptcies, liquidations or mergers. This compromises 188 non-financial firms and 50 financial firms.[66] We analyzed two event windows. The date of the announcement (the event date) is day 0 and the numbers in the parentheses identify the starting and ending date of each event window relative to the event date. The first window, (0,+1) attempts to capture the immediate impact of the deregistration announcement, and includes both the actual announcement date and – since announcements are often made after the close of the day's trading – the following trading day. The window (0,+5) recognizes the potentially slow public diffusion of these announcements due to the relatively small size of some of these firms. Because of the large number of results we focus our discussion primarily on the (0,1) day announcement effects. Panels 1a, 1b and 1c of Table 19 show the effects of respectively: the announcement effect taking the earliest of the public announcement and filing as the event, the effect of taking the announcement date only and the effect of taking the filing date only. As can be seen from Table 19, for non-financial firms announcing their

[66] The sample size is different from that in the logit analysis, because the additional requirement of the availability of Datastream stock price data eliminated 24 firms from the original 261 firm sample.

intention to deregister the cumulative average abnormal return (CAAR) is significantly negative at the 1% level or better, and is large in absolute terms for all event windows.[67] For example, Table 19 shows that the (0,1) window mean cumulative abnormal returns were –12.03% (Panel 1a), –10.99% (Panel 1b) and –10.33% (Panel 1c). These results indicate that, on average, stockholders suffered large and significant wealth losses from firms' decisions to go dark, confirming the concerns expressed by investors in the business press.[68]

However, investors may not be affected in the same way by all deregistration decisions. For firms which announced their deregistration while still trading on a major exchange, the joint impact of the loss of disclosure and additional liquidity and oversight provided by the exchange may be greater than the announcement effect for firms which are trading over-the-counter. Panel 2 of Table 19 shows that the magnitude of the impact is greater for exchange listed deregistering firms (panel 2a) relative to the OTC traded sub-sample (panel 2b).[69] For example, the mean cumulative abnormal return is –16.74% for the (0,1) exchange listed event window compared to –10.84% for the OTC sub-sample. Note, however, that the difference in mean abnormal returns is not statistically significant at the 10% level (the t-statistic is 1.17).[70]

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[67] We use standardized abnormal returns following Patell (1976). The Patell test standardizes the event-date prediction error for each stock by its standard deviation.

[68] See the article, "When Companies 'Go Dark', Investors Can Lose" in the May 24, 2004 issue of the Business Week.

[69] These findings are consistent with our earlier logit analysis (see Section 4.3). Small firms are affected more by compliance costs (as measured by audit fees), therefore they are more likely to deregister. But the market reaction is less severe than it is for larger firms since the audit cost savings are relatively greater for smaller firms. We find that the ratio of audit fees to assets is significantly higher for firms below median size than for larger firms. A univariate test confirms this result at the 1% level, with a t-statistic equal to 5.4.

[70] This result is different from that in Leuz et al. (2004) who report that firms with a low (below one dollar) stock price suffer a larger negative share price reaction compared to firms with stock prices above one dollar. Note, however, that the two approaches are not equivalent, since some exchange listed firms may have a share-price lower than a dollar (which may lead to delisting, although delisting is sometimes avoided through a reverse stock split) and a number of firms with a share price above a dollar are traded on the OTC Bulletin Board and the Pink Sheets.

Panel 3 examines the impact of deregistration before and after the enactment of the Sarbanes-Oxley Act on July 31, 2002 for non-financial firms. Investors appear to react as negatively to deregistration announcements after the enactment as they did before July 31, 2002.[71] This finding is consistent with outside investors balancing their corporate governance control losses related to a post-Sarbanes-Oxley deregistration, against the savings in higher auditing and other compliance costs related to the Act. That is, on a net benefit/cost basis, outside investors did not view the overall effects of deregistrations as being worse post- versus pre-Sarbanes-Oxley. Of course, for inside shareholders (as was discussed earlier) the weakening of corporate governance control and the lowering of auditing/compliance costs were both potential benefits.

Banks and other financial institutions[72] have to continue to provide accounting and other disclosures to the Federal Deposit Insurance Corporation (FDIC), the Federal Reserve, the OCC and the OTS and other regulators through call reports and other regulatory filings post- going dark. Moreover, they continue to be examined (audited) by bank regulators. For example, Madison Bancshares Group, Ltd, a bank holding company filed a Form 15 to deregister on March 7, 2003, but Madison Bank's financial statements (call reports) continue to be available through the FDIC website, and its holding company's financial statements are available from the Federal Reserve. Moreover, it continues to be examined by bank regulators. It may be no accident that when Madison Bancshares announced its decision to deregister on February 28, 2003, its share price barely moved. From Panel 4 of Table 19 it is evident that the negative impact for financial institutions in our sample is very different from that for non-financial institutions. Indeed, the –1.67% cumulative abnormal return for the (0,1) event window is

[71] Using the (0,1) window the immediate announcement effect was greater *post*-SOX. However, over the larger (0,5) window these results were reversed, and neither is statistically significant.
[72] We have 50 financial institutions in our sample, the majority of which (32 firms) are banks or thrift institutions.

not significantly different from zero. Also, the difference between financial institutions' mean cumulative abnormal returns and those of non-financial firms is statistically significant at the 1% level for the (0,1) event window.

The results in Table 19, Panel 5 examine the relative impact on investors of firms that neither repurchased shares nor implemented a reverse split versus those that did. These results show that the effects of a repurchase or reverse split in Panel 5b induce a similar reaction by investors to firms that do not take such actions.

4.4.2 Disentangling the Deregistration and Delisting Announcement Effect: A Robustness Check and Natural Experiment

One possibility is that the delisting announcement effect may add noise to our measurement of the deregistration announcement effect. As a robustness check on the deregistration versus delisting effect we took the sub-sample of firms trading on the OTCBB prior to the passage of the 1999 regulation requiring firms trading on the OTCBB to register with the SEC. Firms that were traded on the OTCBB, prior to 1999, could deregister without delisting from the Bulletin Board (see BL (2004)). We also added firms traded on the Pink Sheets at the time of their deregistration announcement. Essentially this sub-sample provides a natural experiment relating to the size of the pure deregistration effect (absent delisting noise) in the OTC markets. We identified 40 such non-financial firms. As shown in Table 19, Panel 6 their average cumulative abnormal return over the (0,1) window period was –6.7%, which is significantly different from zero at 1% level. Also, this is not significantly different from the abnormal returns for all deregistering Pink Sheet and OTCBB firms (–10.84%, see Panel 2b).

4.5 THE MARKET AFTER GOING DARK

4.5.1 The Impact of Deregistration on Liquidity

As described above (see Section 4.4), a firm that goes dark without repurchasing shares is expected to impose a significant value loss on existing stockholders. Indeed, our cumulative abnormal return tests in the previous section suggest a substantial loss of value. In this section, we examine one potential source of value loss, namely the reduction in liquidity resulting from the decision to go dark. Specifically, once a firm deregisters, its stock is no longer eligible for trading on any of the major exchanges or even the OTC Bulletin Board. Registration with the SEC, however, is not a requirement for firms quoted or traded on the Pink Sheets.

To analyze the liquidity loss we compare various measures of liquidity before and after deregistration. To do this, we compare liquidity measures in the pre-deregistration period ($t_0 - 90$ to $t_0 - 31$) with liquidity measures for the post-deregistration period ($t_0 + 31$ to $t_0 + 90$), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on the liquidity of trading, we excluded 30 days before and after the deregistration date. Figure 5 shows those different time periods.

Following Macey, O'Hara and Pompilio (2004) and BL (2004) we used five measures of market liquidity, namely dollar spread, percentage spread, volatility of rate of return, volume (turnover) and the number of days on which a trade occurs in a stock.[73] The bid-ask spread data were collected from two sources, either from CRSP (for the pre-deregistration period of sub-sample 1, the exchange listed deregistering firms) or the Pink

[73] LTW (2004) analyze only two measures of liquidity –mean daily turnover and percentage of days traded prior to deregistration. Using a regression approach they find a significant fall in the liquidity of deregistering firms. An important issue with the LTW regression is that they pick a sample period ending 6 days prior to the deregistration (the pre-deregistration period) and starting 6 days after (the *post*-deregistration period). Given the very short window there is a possibility that the actual change in liquidity due to deregistration is contaminated, in part, by the deregistration announcement. As noted above, we control for this by looking at period ending 30 days prior to deregistration and starting 30 days after.

Sheets. The return data, volume data and trading days were collected from Datastream. We include only a sub-sample of going dark firms that have data from these different sources and have data for the period before and after the deregistration. Dollar spreads are defined as (closing ask price – closing bid price). Percentage spreads are calculated as (closing ask price – closing bid price) / (midpoint of closing ask and bid prices) × 100. Volatility is calculated as the standard deviation of daily returns of the stocks in the relevant sample or sub-sample period. Volume (turnover) is measured as the percentage average daily volume to total outstanding shares. Trading days is measured as the number of days a stock is traded during the pre- and post-deregistration period. We use a difference in means test to evaluate the effects on liquidity of deregistration. The difference in means test is a two-sided test that assumes unequal variances. The results, presented in Table 20, provide information on mean spreads, volume, volatility and trading days for different sub-samples.

As can be seen from Table 20 panel 1, three out of five measures of liquidity suggest that on average the stocks that go dark become significantly less liquid. For example, the mean of the percentage bid-ask spread increased from 33.976% to 51.353%, the mean volatility of daily returns increased from 11.400% to 19.055% and the number of trading days decreased from 27.192 days to 19.557 days. On the other hand, the dollar spread and volume traded were little affected for the whole sample, with no statistically significant difference before and after filing Form 15. Our findings for percentage and dollar spread, volume and volatility are qualitatively similar to those in Macey, O'Hara and Pompilio (2004) for the non-bankrupt stocks of their involuntary delisting sample.

In general the studies of deregistering non-financial firms in the different sub-samples (Panels 2 to 4 of Table 20) become less liquid. In particular, in panel 2 of Table 20 we show the mean liquidity impact on firms deregistering while trading on a major

exchange. In this case four out of five measures of liquidity show a significant worsening post-deregistration. In Table 20 panel 3 we show the liquidity effects on non-financial OTC firms. The major difference between the exchange listed and OTC listed firms is the size and significance of the different liquidity measures. For example, in percentage terms, while the percentage spread, volatility and trading days for exchange listed firms moved in an adverse direction by 159%, 113% and 33%, respectively, the percentage spread, volatility and trading days for OTC listed firms moved in an adverse direction by 40%, 63% and 25%, respectively. Panel 4 of Table 20 summarizes the liquidity effects of all deregistering non-financial firms traded on both the major exchanges and OTC.

Finally, Panel 5 of Table 20 shows that the liquidity effects on deregistering financial institutions' stocks are less adverse than for deregistering firms in general. Indeed, only one of the five liquidity measures, the (decrease in) the number of trading days, shows an adverse move that is statistically significant. This is consistent with going dark financial institution production of information for regulatory purposes (post-deregistration) impacting liquidity in a favorable fashion relative to non-financial firms that go dark.

4.5.2 Robustness Check: Matched Firm Liquidity

As a robustness check we also analyzed the liquidity of those firms that deregistered with those matched firms in our logit test in Section 4.3.2. We compare the liquidity of the deregistering firms pre- and post-deregistration with the liquidity of the non-deregistering firms pre- and post- the date of the matched firm's deregistration. Here, we consider three measures of liquidity, in particular, the daily volatility of stock returns, volume turnover and trading days.[74] These results are shown in Table 21.

[74] We were unable to obtain spread data for over-the-counter traded matching firms from Pink Sheets LLC.

Panel 1 of Table 21 shows that the three measures of liquidity are significantly less for the full sample of the going dark stocks pre- and post-deregistration in comparison to the full sample of the size matched stocks. However, the difference in liquidity between the matched and the going dark firms increases in the post-deregistration period. For example, the pre-deregistration volatility for going dark stocks is significantly larger than the volatility of the size matched stocks – a difference of 3.64% (see column 9 of Table 21). By comparison, following deregistration the mean volatility of going dark firms is 11.4% greater than that of matched sample firms. The result of a t-test (see column 11 in Table 21) shows that the 7.77% increase in the pre- versus post-deregistration difference in volatility is significantly different from zero at the 1% level.

When we restrict our full sample by excluding financial firms in Panel 2 of Table 21, similar results hold. Finally, financial firms that went dark appear to be more liquid than non-financial firms (see Panel 3 of Table 21). For example, for the pre-deregistration period only one measure of liquidity (trading days) is significantly less for going dark financial institutions relative to matched financial institutions, while for the post-deregistration period two measures (out of the three) are significantly less. These results are again what one might expect, a priori, given the information production requirements of regulators for both matched and going dark financial firms.

4.5.3 Post-Deregistration Stock Price Performance

We next examined the long-run stock return performance of going dark stocks. We first examined their six, seven, eight, nine, ten, eleven month and one-year returns post deregistration. We also examined six month and one year returns for those firms that

only had a full year of post deregistration data.[75] None of the holding period returns are significantly different from zero.[76] In panel 1 of Table 22 we report both six-month and one-year buy and hold returns following deregistration for firms that had one-year of data post-deregistration.[77] We calculate buy and hold market-adjusted returns for the *j*th firm in our sample in the same manner as in Section 4.3.1:

$$BHMAR_{j,T_1,T_2} = \left[\prod_{t=T_1}^{T_2}\left(1+R_{jt}\right)\right] - \left[\prod_{t=T_1}^{T_2}\left(1+R_{mt}\right)\right],$$

where T_1 is the first and T_2 is the 126th (252nd for the one-year return period) trading day after the firm filed for deregistration with the SEC, R_{jt} is the daily return for sample firm j on date t, and R_{mt} is the return on the Russell 2000 Index on the same date. Post-deregistration returns were obtained from Datastream, limiting our sample to those firms included in the event study in Section 4.4. Since going dark is a relatively recent phenomenon, we could not include all 238 firms in Table 1. There were 8 firms that did not have at least one year of post-deregistration data. Both raw returns and market-adjusted returns are reported for all stocks in our sample. Market adjusted returns are obtained by deducting the return on the Russell 2000 Index from the return on the stock.

For the full sample, the average raw and market adjusted buy and hold returns were 0.28% (-10.51%) for the six-month period and 10% (-9.15%) for the one-year period. However, these buy and hold returns were not significantly different from zero at any of the usual levels of significance. Panels 2 and 3 in Table 22 report buy and hold

[75] As a result firms do not drop out of the sample over time. Thus a comparison of the six month and one-year samples will not affect our results.
[76] For reasons of space we do not report the seven to eleven month returns but they showed no significant long-run returns.
[77] LTW (2005) do not look at the long-run performance of deregistering shares. We look at the long-run effect on stockholder returns in this subsection.

returns for firms that have deregistered from a major exchange (panel 2) and firms that went dark while trading over-the-counter (panel 3), respectively. Again, the buy and hold returns are not significantly different from zero. Panels 4 and 5 show similar results for all non-financial firms and financial institutions, respectively. Thus, we find no evidence that on average investors have recouped their initial losses, suffered at the time of the deregistration announcement, in the after-market for deregistered stocks.

4.6 CONCLUSIONS AND PUBLIC POLICY IMPLICATIONS

Consistent with anecdotal evidence, we find that the audit costs of complying with the Sarbanes-Oxley Act have been one of several major driving forces behind firms' decision to go dark. Firms with fewer valuable growth opportunities, greater insider ownership, lower institutional ownership, lower market momentum and higher leverage are also more likely to go dark. Our results from a univariate test comparing pre- and post-SOX stock price performance are consistent with SOX driving higher performing firms to go dark. It is also clear that investors suffer significant negative cumulative abnormal returns upon the announcement of deregistration and are generally left holding less liquid shares.

The adverse impact on investors is the direct result of insiders' ability to exploit Section 12(g)(5) of the 1934 Securities Exchange Act. That is, insiders exploit the "300 shareholder" rule for remaining a publicly registered company, whereby "stockholders" are measured only by the number of shareholders of record (e.g. street names) rather than beneficial shareholders (the actual number of shareholders). While there is certainly some correlation between the number of beneficial owners and the number of shareholders of record, shareholders of record (as currently defined) is a rather arbitrary criterion for deregistration. A firm that has more than 300 shareholders of record is not allowed to deregister, even though it may have fewer beneficial owners than a similar firm (with less

than 300 holders of record) that has gone dark. The "costs" of tracking the number of beneficial owners is not a sufficient argument in favor of maintaining the status quo. Indeed, firms are able to determine the number of their beneficial owners for all other purposes (such as soliciting proxies) without difficulty. Clearly the loss of shareholder value and liquidity as a consequence of this rule, suggests that there may be a case for the SEC to reexamine Section 12(g)(5) – especially in its approach towards counting the minimum number of shareholders required for registration as a public company.

Finally, since the high costs of SOX compliance appears to have fallen heavily on smaller companies, the SEC might consider ameliorating some of the reporting burden on these companies. Indeed, the SEC created "the Advisory Committee on Smaller Public Companies" in April 2005 to examine these issues so as to better match the costs and benefits of SOX to such companies (see, SEC Eyes Tailoring Sarbanes-Oxley to Smaller Companies, Justin Burrows, EDGAR Online Newsletter (May 2005)).

Chapter 5: Conclusion

The common theme among the three essays included in my dissertation is that financial strength matters. While strong finances are the result of past successes, a feedback mechanism seems to exists which allows larger, better financed firms to compete more effectively. The model presented in Chapter 2 shows how firms could prey on financially constrained rivals by taking actions that have a negative impact on the prey's share price. If the prey's shares are undervalued by markets, issuing equity to fund new investment may no longer be feasible. Preventing a rival from raising funds in equity markets may not eliminate the prey completely as a competitor. Such predation will nevertheless reduce the amount of investment undertaken by competing firms, leading to lower industry output and higher future profits for the predator.

Firms may try to protect themselves against such predation by building up cash reserves which would allow them to invest even when issuing equity would not be feasible. Alternatively, a firm may adopt a "puppy dog" strategy, essentially bowing out of the way of its larger rival and specializing in a niche market that the larger firm has no interest in entering. Neither of these strategies ensures that incumbent firms will be challenged and their customers will benefit from increased competition. Firms may not be in a position to build up financial slack early in their life cycle, and niche producers will not pose a competitive threat (in fact, not threatening the incumbent is a key element of the puppy dog strategy). This underscores the importance of ensuring competition through enforcing anti-trust laws and protecting new entrants from predation.

Chapter 3 of my dissertation is an empirical investigation of patent litigation, which is often considered one of the actions a predator might take in order to keep competition at bay. My research contributes to the still relatively small empirical

literature on product market competition and financial structure using a sample of firms involved in patent suits. The results are consistent with the hypothesis that large plaintiffs inflict greater damage on relatively smaller defendants when those defendants are also competitors. My findings also provide additional evidence that leverage affects the way firms compete in product markets, and that firms with higher leverage tend to be less aggressive competitors. Lastly, the analysis of defendants and a control sample of firms that did not get sued provides evidence that firms that are unable to generate cash internally are more likely to be sued for patent infringement.

The chapter on going dark focuses on the incentives of small firms to opt out of SEC disclosure regulations, and on the consequences of such going dark decisions on outside shareholders. While seemingly unrelated to the earlier chapters, this essay also examines a problem unique to smaller, financially weaker firms. The burden of Sarbanes-Oxley falls disproportionately on smaller firms, and (besides governance problems and the diverging incentives of insiders vs. outsiders), the cost of regulatory compliance seems to be the most important contributing factor to firm's decisions to deregister with the SEC. For some investors in smaller firms, the complete loss of regulatory oversight as a result of going dark became an unforeseen side effect of the new, stricter regulatory regime.

The findings from my dissertation seem to be consistent with an important thesis of the recent popular book by Rajan and Zingales (2003) titled "Saving capitalism from the capitalists." Rajan and Zingales claim that free markets have been held back not so much by economic deficiencies, but in large part because of opposition from incumbents. Firms (and entrepreneurs) who have already established a dominant position in the marketplace would prefer to restrict access by new entrants. Antitrust legislation is

necessary not because government has a duty to temper competition. Rather, it is needed in order to ensure that today's winners cannot become tomorrow's monopolists.

Table 1: Patent cases in the Wall Street Journal (01/01/1990 to 12/31/2001)

This table presents the number of patent cases between firms included in both the CRSP and the Compustat databases that were reported by the Wall Street Journal each year over the January 1, 1990 – December 31, 2001period.

Year	Number of patent suits files
2001	11
2000	24
1999	18
1998	15
1997	17
1996	10
1995	20
1994	20
1993	21
1992	20
1991	14
1990	11
Total 1996 - 2001	95
Total 1990 - 1995	106
Total 1990 - 2001	201
Median	17.5
Mean	16.75

Table 2: Event study results for the full sample (all plaintiffs and defendants)

Cumulative abnormal returns (CARs) accruing to plaintiff and defendant firms in patent cases filed between January 1, 1990 and December 31, 2001, using the market model and the CRSP Equally Weighted Index.

Event Window	N	Mean CAR	Precision Weighted CAAR	Median CAR	Z		Sign Z	
			Plaintiff firms 1990 - 2001					
$(-30,-2)$	205	2.43%	1.50%	1.45%	1.688	*	2.593	***
$(-1,0)$	205	0.60%	0.52%	0.61%	2.213	**	2.314	**
			Plaintiff firms 1990 - 1995					
$(-30,-2)$	110	0.10%	0.60%	−0.18%	−0.553		0.547	
$(-1,0)$	110	0.55%	0.68%	0.86%	2.391	**	2.457	**
			Plaintiff firms 1996 - 2001					
$(-30,-2)$	95	5.13%	4.66%	4.09%	3.073	***	3.222	***
$(-1,0)$	95	0.66%	0.27%	0.01%	0.678		0.755	
The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.								
			Defendant firms 1990 - 2001					
$(-30,-2)$	229	0.01%	0.59%	−0.16%	0.658		0.730	
$(-1,0)$	229	−1.10%	−0.64%	−0.59%	−2.720	***	−1.389	
			Defendant firms 1990 - 1995					
$(-30,-2)$	122	−0.40%	−0.15%	−0.09%	−0.148		0.484	
$(-1,0)$	122	−1.13%	−0.49%	−0.84%	−1.800	*	−1.149	
			Defendant firms 1996 - 2001					
$(-30,-2)$	107	0.48%	1.85%	−0.29%	1.109		0.551	
$(-1,0)$	107	−1.07%	−0.91%	−0.45%	−2.054	**	−0.805	
The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.								

Table 3: Event study results (excluding preventive and follow-on suits)

Cumulative abnormal returns (CARs) accruing to plaintiff and defendant firms in patent cases filed between January 1, 1990 and December 31, 2001, using the market model and the CRSP Equally Weighted Index and excluding preventive and follow-on suits.

Event Window	N	Mean CAR	Precision Weighted CAAR	Median CAR	Z		Sign Z	
			Plaintiff firms 1990 - 2001					
$(-30,-2)$	146	3.83%	2.17%	1.96%	2.024	**	2.675	***
$(-1,0)$	146	1.04%	0.80%	0.78%	2.841	***	2.344	**
			Plaintiff firms 1990 - 1995					
$(-30,-2)$	71	1.72%	0.07%	0.45%	0.051		0.796	
$(-1,0)$	71	1.32%	1.28%	1.41%	3.454	***	2.697	***
			Plaintiff firms 1996 - 2001					
$(-30,-2)$	75	5.83%	4.50%	3.97%	2.774	***	2.959	***
$(-1,0)$	75	0.77%	0.26%	0.01%	0.603		0.645	
The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.								
			Defendant firms 1990 - 2001					
$(-30,-2)$	164	0.20%	1.11%	−0.10%	1.001		0.635	
$(-1,0)$	164	−1.14%	−0.82%	−0.82%	−2.793	***	−1.712	**
			Defendant firms 1990 - 1995					
$(-30,-2)$	81	1.17%	0.87%	−0.17%	0.654		0.230	
$(-1,0)$	81	−1.32%	−0.76%	−1.20%	−2.176	**	−1.328	*
			Defendant firms 1996 - 2001					
$(-30,-2)$	83	−0.74%	1.45%	0.08%	0.760		0.665	
$(-1,0)$	83	−0.95%	−0.90%	−0.59%	−1.783	**	−1.094	
The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 1-tail test.								

Table 4: Cross sectional regressions using R&D expenses (1990 – 2001)

Estimated coefficients for regressions of two-day event window CARs for defendant firms on variables measuring the relative size of plaintiffs versus defendants, plaintiff leverage, defendant leverage and defendants' ratio of research and development expenses to sales. Sample firms are litigants in patent cases reported by the Wall Street Journal between January 1, 1990 and December 31, 2001. Firms involved in preventive and follow-on suits have been excluded, as well as those without research and development expense data on Compustat, leaving a sample of 156 defendants.

	Measures of Firm Size:							
	(A)		(B)		(C)		(D)	
Independent Variables	**Market Value of Equity**		**Market Value of Assets**		**Book Value of Assets**		**Net Sales**	
SIZER	0.000056		−0.000029		0.000002		−0.000048	
	(0.38)		(−1.48)		(0.01)		(−2.84)	***
SIZER COMP	−0.000570		−0.000364		−0.000169		−0.000066	
	(−2.47)	**	(−2.96)	***	(−0.81)		(−2.94)	***
PLEVER	3.880		4.484		4.581		4.741	
	(2.16)	**	(2.42)	**	(2.52)	**	(2.62)	***
PLEVER COMP	2.885		1.009		2.017		1.181	
	(0.53)		(0.19)		(0.37)		(0.22)	
DLEVER	−0.585		2.528		0.526		1.020	
	(−0.16)		(0.82)		(0.14)		(0.35)	
INTAN-GIBLE	−0.005091		−0.004908		−0.005814		0.001093	
	(−0.88)		(−0.87)		(−0.91)		(0.25)	
DUMMY	Yes		Yes[a]		Yes[b]		Yes[c]	
R^2	0.175		0.189		0.141		0.200	

The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.

[a]Computer and Office Equip. industry dummy: $\hat{\beta}_{Comp} = -0.0279$, $t = -1.97$, $p = 0.051$.

[b]Computer and Office Equip. industry dummy: $\hat{\beta}_{Comp} = -0.0252$, $t = -1.77$, $p = 0.078$.

[c]Drug industry dummy: $\hat{\beta}_{Drugs} = 0.0153$, $t = 1.72$, $p = 0.087$ and Computer and Office Equip. industry dummy: $\hat{\beta}_{Comp} = -0.0255$, $t = -1.88$, $p = 0.062$.

Table 5: Cross sectional regressions using q-ratio (1990 – 2001)

Estimated coefficients for regressions of two-day event window CARs for defendant firms on variables measuring the relative size of plaintiffs versus defendants, plaintiff leverage, defendant leverage and defendant q-ratios. Sample firms are litigants in patent cases reported by the Wall Street Journal between January 1, 1990 and December 31, 2001. Firms involved in preventive and follow-on suits have been excluded, leaving a sample of 164 defendants.

	Measures of Firm Size:							
Independent Variables	(E) **Market Value of Equity**		(F) **Market Value of Assets**		(G) **Book Value of Assets**		(H) **Net Sales**	
$SIZER$	0.000066		−0.000021		0.000015		−0.000040	
	(0.49)		(−1.02)		(0.08)		(−2.98)	***
$SIZER$	−0.000469		−0.000312		−0.000177		−0.000072	
$COMP$	(−2.01)	**	(−2.41)	**	(−0.86)		(−3.24)	***
$PLEVER$	3.586		4.102		4.343		4.461	
	(2.10)	**	(2.40)	**	(2.56)	**	(2.67)	***
$PLEVER$	0.640		−0.718		0.724		−0.372	
$COMP$	(0.13)		(−0.14)		(0.14)		(−0.08)	
$DLEVER$	−2.438		0.348		−1.316		−0.843	
	(−0.64)		(0.10)		(−0.32)		(−0.31)	
$INTAN-$	−0.000002		−0.000002		−0.000002		−0.000002	
$GIBLE$	(−1.93)	*	(−1.79)	*	(−1.67)	*	(−1.71)	*
$DUMMY$	Yes		Yes[a]		Yes[b]		Yes[c]	
R^2	0.170		0.185		0.152		0.214	

The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.

[a]Computer and Office Equip. industry dummy: $\hat{\beta}_{Comp} = -0.026$, $t = -1.81$, $p = 0.072$.

[b]Drug industry dummy: $\hat{\beta}_{Drugs} = 0.0128$, $t = 1.68$, $p = 0.095$

[c]Drug industry dummy: $\hat{\beta}_{Drugs} = 0.0151$, $t = 1.99$, $p = 0.049$ and Computer and Office Equip. industry dummy: $\hat{\beta}_{Comp} = -0.0237$, $t = -1.76$, $p = 0.080$.

Table 6: Cross sectional regressions: pre- and post-1995 sub-periods

Estimated coefficients for regressions of two-day event window CARs for defendant firms on variables measuring the relative size of plaintiffs versus defendants, plaintiff leverage, defendant leverage and the importance of intangible assets for defendants. Firm size is measured as the market value of assets. Sample firms are litigants in patent cases reported by the Wall Street Journal between January 1, 1990 and December 31, 2001. Firms involved in preventive and follow-on suits have been excluded.

	Measures of the Importance of Intangible Assets:			
	R&D-to-Sales Ratio		**Tobin's Q Ratio**	
Independent Variables	*From* 01/01/90 *to* 08/09/95[a]	*From* 08/10/95 *to* 12/31/01	*From* 01/01/90 *to* 08/09/95[a]	*From* 08/10/95 *to* 12/31/01
SIZER	−0.000031	0.000447	−0.000030	0.000405
	(−1.73) *	(2.16) **	(−1.29)	(1.73) *
SIZER COMP	−0.000229	−0.001048	−0.000221	−0.000825
	(−3.08) ***	(−4.45) ***	(−2.98) ***	(−2.59) ***
PLEVER	0.830	7.180	2.296	6.429
	(0.06)	(2.63) ***	(0.18)	(2.52) **
PLEVER COMP	6.158	−11.128	5.443	−13.015
	(0.60)	(−1.05)	(0.54)	(−1.43)
DLEVER	1.835	3.291	1.537	1.823
	(0.55)	(0.42)	(0.36)	(0.26)
INTANGIBLE	−0.076740	−0.003243	−0.000002	−0.000001
	(−2.53) **	(−0.48)	(−0.44)	(−1.29)
DUMMY	Yes	Yes	Yes	Yes
R^2	0.184	0.375	0.127	0.328
N	76	80	79	85

The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, using a 2-tail test.

[a] August 9, 1995 was the date of Netscape's IPO.

Table 7: Descriptive statistics: firms included in conditional logit analysis

Descriptive statistics for the 112 defendant firms and the 112 matching firms. Differences of means tests are two-sided tests and assume unequal variances. 112 firms that were reported by the Wall Street Journal as having been sued for patent infringement over the 1994-2001period were included in the sample. The matching firms were chosen from among those competitors of the defendant firm at the time of the lawsuit which have not been sued for patent violations during the two years prior and two years following the patent suit involving the sample firm. 10-K filings and the Hoover's Online database were used to compile a list of competing firms for each of the 112 defendants. The total number of matching firms is 112.

Variables	Defendant Firms	Matching Firms	T-Statistics
Total Assets ($ millions)	8664.919	7166.786	-0.82
Leverage	0.484	0.465	-0.56
R&D/Sales	0.553	0.231	-1.88 *
q-ratio	5.153	4.205	-1.22
Cash/Assets	0.309	0.232	-2.30 **
Op.Inc./Assets	-0.008	0.099	2.96 ***
Age (years)	17.579	24.369	2.27 **

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 8: Conditional logistic regression of the probability of becoming a defendant in patent litigation (1994 – 2001)

This table reports the coefficients and odds ratios of conditional (fixed-effects) logit tests for defendant firms using a matched control group. The dependent variable takes the value of one for firms that were sued and zero for matching firms. The standard error (SE) is reported in parentheses. 112 firms that were reported by the Wall Street Journal as having been sued for patent infringement over the 1994-2001period were included in the sample. The matching firms were chosen from among those competitors of the defendant firm at the time of the lawsuit which have not been sued for patent violations during the two years prior and two years following the patent suit involving the sample firm. 10-K filings and the Hoover's Online database were used to compile a list of competing firms for each of the 112 defendants. The total number of matching firms is 112.

Variables	**Model 1**			**Model 2**			**Model 3**		
	Coeff.	SE	Odds ratio	Coeff.	SE	Odds ratio	Coeff.	SE	Odds ratio
Cash flow (CF)	-3.57 ***	1.27	0.03						
Cash/Assets				2.22 ***	0.88	9.17			
High R&D							1.32 *	0.69	3.73
q-ratio	0.10 *	0.06	1.11	0.02	0.03	1.02	0.05	0.04	1.05
Log(Assets)	0.04	0.11	1.04	-0.08	0.10	0.92	-0.06	0.10	0.94
Leverage	-0.15	0.81	0.86	1.35 *	0.80	3.85	0.52	0.69	1.69
Number of observations		224			224			224	
LR χ^2		18.12***			12.14**			9.07*	
Pseudo R^2		0.12			0.08			0.06	

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 9: Conditional logistic regression of the probability of becoming a defendant in patent litigation (1994 – 2001)

This table reports the coefficients and odds ratios of conditional (fixed-effects) logit tests for defendant firms using a matched control group. The dependent variable takes the value of one for firms that were sued and zero for matching firms. The standard error (SE) is reported in parentheses. 112 firms that were reported by the Wall Street Journal as having been sued for patent infringement over the 1994-2001period were included in the sample. The matching firms were chosen from among those competitors of the defendant firm at the time of the lawsuit which have not been sued for patent violations during the two years prior and two years following the patent suit involving the sample firm. 10-K filings and the Hoover's Online database were used to compile a list of competing firms for each of the 112 defendants. The total number of matching firms is 112.

	Model 1			**Model 2**			**Model 3**		
Variables	Coeff.	SE	Odds ratio	Coeff.	SE	Odds ratio	Coeff.	SE	Odds ratio
Cash flow (CF)	-3.20 ***	1.19	0.04						
Cash/Assets				2.21 **	0.91	9.15			
High R&D							1.17 *	0.69	3.23
Log(Age)	-0.29 *	0.16	0.75	-0.05	0.16	0.95	-0.19	0.15	0.83
Log(Assets)	0.12	0.13	1.13	-0.07	0.11	0.93	-0.02	0.12	0.98
Leverage	-0.32	0.78	0.73	1.35 *	0.80	3.86	0.53	0.68	1.70
Number of observations	224			224			224		
LR χ^2	18.67***			12.02**			8.70*		
Pseudo R^2	0.11			0.08			0.06		

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 10: Number of firms that deregistered (went dark) from January 1996 to May 2004

This Table contains the yearly breakdown of the firms that went dark between 1996 and May 2004 and we were able to collect their financial reporting (Compustat) and stock price (Datastream) data.

Year	Firms with Financial data	Firms with price data
2004 (May)	37	27
2003	101	104
2002	44	42
2001	22	20
2000	13	11
1999	21	17
1998	13	12
1997	6	2
1996	4	3
Total	261	238

Table 11: Variable index

Financial data were collected from many sources (Compustat and from a firm's filing 10K with the SEC) depending on its availability. Financial data, the data from filing DEF14 with the SEC (insider ownership) and Audit Fee Analytics for the deregistering firm's were collected from the last annual financial report before a firm went dark. For the matching firms, these data were collected from the same fiscal year of the sample firm. Spreads were collected from multiple sources (Datastream, CRSP and the Pink Sheets) depending on the availability of the data. Prices and volume were collected from Datastream.

Panel 1: Logit Variables

Variables	Description
Binary	Dependent variable takes a value of 1 for firms who chose to go dark and 0 for the matching firms. The deregistered firms were matched based on three criteria: 1. Their 4 digit SIC code 2. Their asset size, 3 year average prior to the sample firms deregistration date. The matched firm's asset value may vary between the maximum and the minimum of the 3 years asset value. 3. Equity market: major exchange or OTC.
q-ratio	This measure was based on Chevalier's (2004) Tobin's Q measure, i.e., the market value of assets divided by the book value of assets. The market value of assets equals the book value of assets plus the market value of common equity less the book value of common equity.
Log of firm assets	The logarithm of the firm's asset value.
Intangible asset ratio	The ratio of the firm's intangible assets to total assets. Intangible assets include: blueprints or building designs, client lists, computer software patent costs, contract rights, costs associated with approved patents, copyrights design costs and etc..
Leverage	Leverage is calculated as the ratio of total liabilities to total assets and alternatively the ratio of long-term debt over assets.
Financial institution (FI) dummy	Is one for firms from the financial sector (SIC codes 6020 to 6500) and zero otherwise.
Insider ownership	The ratio of holdings of common (voting) shares by all directors and officers as a group to total outstanding (voting) shares. The insider ownership ratio was hand collected from either proxy statements (form DEF14A) or Form 10K on the SEC website.
Audit fees to MVE	The dollar value of the annual audit fees paid by a firm for certifying its financial reports divided by the firm's market value of equity (MVE). The annual audit fees were obtained from the Audit Analytics database. It is usually reported by the firm in the proxy statement (form DEF14A) on the SEC database.

Table 11: Variable index (continued)

Variables	Description
Free cash-flow†	This measure is based on the Opler and Titman (1993) measure of free cash flow, i.e., a firm's cash-flow is measured as operating income before taxes, interest and depreciation (EBITDA). It is expressed as a ratio of the market value of assets. The market value of asset is equal the risk adjusted sum of discounted cash flows. Accordingly, firms with relatively greater cash flow to market value today are expected to have relatively less cash flow growth in the future.
Insider *(x)* Free cash-flow (FCF)	Free-cash flow variable multiplied by insider ownership.
Dummy*(q-ratio<1, free cash-flow>0)*	A dummy variable that is one when both the q-ratio is less than one and the free cash-flow variable is positive. The dummy is zero otherwise.
Momentum	Following Loughran and Ritter (1996), we define momentum as buy and hold market-adjusted returns for the *j*th firm in our sample as: $BHMAR_{j,T_{-150},T_{-31}} = \left[\prod_{t=T_{-150}}^{T_{-31}}\left(1+R_{jt}\right)\right] - \left[\prod_{t=T_{-150}}^{T_{-31}}\left(1+R_{mt}\right)\right]$, where T_{-150} and T_{-31} are the first and the last trading day included in the holding period we use to calculate buy and hold returns (i.e. 150 and 31 trading days prior to the deregistration announcement, respectively), R_{jt} is the daily return for sample firm *j* on date *t*, and R_{mt} is the return on the Russell 2000 Index on the same date.
Volume (turnover)	It is computed as the ratio of average daily trading volume over a period of 150 trading days over total outstanding shares. We computed the turnover in the *pre*-deregistration period (t_0*-150* to t_0 *-31*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on the volume (turnover), we excluded 30 days before that date.

† Our results are robust to an alternative measure of free cash flow. In particular, the measure suggested by Lehn and Poulsen (1989).

Table 11: Variable index (continued)

Panel 2: Market Liquidity Variables

Variables	Description
Mean dollar spread ($)	Dollar spreads are defined as (closing ask price – closing bid price). Computed using daily average dollar spread over a period of 60 trading days.To analyze the change in dollar spread we compare it then before and after deregistration. To do this, we compare dollar spread in the *pre*-deregistration period (t_0-*90* to t_0 -*31*) with that for the *post*-deregistration period (t_0+*31* to t_0 +*90*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on mean dollar spread, we excluded the 30 days before and after the deregistration date.
Mean percentage spread (%)	Percentage spreads are calculated as (closing ask price –closing bid price) / (midpoint of closing ask and bid prices) *x* 100. Computed using daily average mean percentage spread over a period of 60 trading days. To analyze the change in mean percentage spread we compare it then before and after deregistration. To do this, we compare mean percentage spread in the *pre*-deregistration period (t_0-*90* to t_0 -*31*) with the that for the *post*-deregistration period (t_0+*31* to t_0 +*90*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on mean percentage spread, we excluded the 30 days before and after the deregistration date.
Mean volatility (%)	Volatility is calculated as the standard deviation of the daily returns of the stocks in the sample. It is computed over a period of 60 trading days. To analyze the change in mean volatility we compare it then before and after deregistration. To do this, we compare mean volatility in the *pre*-deregistration period (t_0-*90* to t_0 -*31*) with the that for the *post*-deregistration period (t_0+*31* to t_0 +*90*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on mean volatility, we excluded the 30 days before and after the deregistration date.
Volume (Turnover) (%)	Volume traded over total outstanding shares *x* 100. Computed using the average daily trading volume over a period of 60 trading days. To analyze the change in relative turnover we compare it then before and after deregistration. To do this, we compare relative turnover in the *pre*-deregistration period (t_0-*90* to t_0 -*31*) with the relative turnover for the *post*-deregistration period (t_0+*31* to t_0 +*90*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on the relative turnover, we excluded the 30 days before and after the deregistration date.
Trading days	The number of days a firm's stock is traded in which the traded volume is greater than zero. Computed using the sum of trading days a firm's stock is traded (in which volume is greater than zero) over a period of 60 trading days. To analyze the change in relative trading we compare it then before and after deregistration. To do this, we compare the trading days in the *pre*-deregistration period (t_0-*90* to t_0 -*31*) with the trading days for the *post*-deregistration period (t_0+*31* to t_0 +*90*), where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement on the trading days, we excluded the 30 days before and after the deregistration date.

Table 12: Descriptive statistics for deregistering firms and the matching sample

This table presents the descriptive statistics of the going dark sample and its matched control sample. It excludes foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (a corporation without any business activity) and firms for which Compustat accounting or stock price data unavailable. After such screening 261 firms remained in our sample. The matching firms were chosen based on three criteria: (i) a firm's 4 digit SIC code and (ii) a firm's average asset size over the 3 years prior to announcing it was going dark and (iii) the market for the common stock (major exchanges or over the counter) at the end of the last fiscal year prior to deregistration. The total number of the matching firms is 281.

Variables	Full sample (matching firms and deregistering firms)					Deregistering firms from 2001-2004					Matching firms				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Binary	543	0.481	0.500	0	1	261	1	0	1	1	281	0	0	0	0
q-ratio	543	2.428	4.109	0.043	39.325	261	2.016	3.079	0.170	25.989	281	2.809	4.846	0.043	39.325
Log(assets)	543	2.785	1.704	-2.254	9.185	261	2.678	1.712	-1.981	9.185	281	2.884	1.695	-2.254	7.416
Intangible asset ratio	543	0.073	0.148	0	0.942	261	0.066	0.142	0	0.760	281	0.078	0.153	0	0.942
Leverage	538	0.393	0.870	0	9.352	257	0.448	1.006	0	9.352	281	0.344	0.721	0	6.637
Financial institution dummy	543	0.214	0.410	0	1	261	0.215	0.411	0	1	281	0.213	0.410	0	1
Insider ownership	540	0.388	0.232	0	0.997†	261	0.438	0.237	0	0.98†	279	0.342	0.217	0	0.997†
Free cash-flow (FCF)	533	-0.073	0.377	-6.317	1.506	255	-0.099	0.480	-6.317	1.506	278	-0.048	0.245	-1.945	0.756
Dummy(q<1, FCF>0)	533	0.248	0.432	0	1	255	0.267	0.443	0	1	278	0.230	0.422	0	1
Insider (x) FCF	530	-0.018	0.137	-1.731	0.813	255	-0.021	0.140	-1.011	0.813	275	-0.016	0.134	-1.731	0.363
Volume (turnover)	528	0.002	0.006	0	0.098	248	0.001	0.004	0	0.049	280	0.002	0.007	0	0.098
Momentum	501	-0.014	0.815	-1.282	8.068	234	-0.100	0.819	-1.282	7.419	267	0.061	0.805	-1.088	8.068
Audit fees to MVE	310	0.030	0.085	0.000	1.119	138	0.047	0.115	0.000	1.119	172	0.017	0.045	0.000	0.486

† A few firms have close to 100% insider ownership because insiders own close to 100% of the voting class of shares.

Table 13: Mean values of explanatory variables for going dark firms and matching firms and corresponding t-statistics for differences in means

This table shows t-test statistics for differences in means for our logit model variables between going dark firms and their matched firms, These statistics exclude foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (a corporation without any business activity) and firms for which accounting or stock price data was not available. After such screening 261 firms remained in our sample. The matching firms were chosen based on three criteria: (i) a firm's 4 digit SIC code and (ii) a firm's average asset size over the 3 years prior to announcing it was going dark and (iii) the market for the common stock (major exchanges or over the counter) at the end of the last fiscal year prior to deregistration. The total number of the matching firms is 281.

Variables	Mean values		Mean difference	t-Statistics for difference in means
	Deregistering firms	Matching firms		
q-ratio	2.016	2.809	-0.793	-2.25**
Log(assets)	2.678	2.884	-0.205	-1.40
Intangible asset ratio	0.066	0.078	-0.012	-0.95
Leverage	0.448	0.344	0.104	2.40**
Insider ownership	0.438	0.342	0.096	4.91***
Free cash-flow (FCF)	-0.099	-0.048	-0.051	-1.56
Dummy(q<1, FCF>0)	0.267	0.230	0.036	0.97
Insider (x) FCF	-0.021	-0.016	-0.005	-0.43
Volume (turnover)	0.001	0.002	-0.001	-2.52***
Momentum	-0.100	0.061	-0.161	-2.21**
Audit fees to MVE	0.047	0.017	0.030	3.17***

*** Indicates *p* value of 1%
** Indicates *p* value of 5%
* Indicates *p* value of 10%

Table 14: Conditional logistic regression of the probability of deregistration over the January 1996 – May 2004 period, using the matched control group.

This table reports the coefficient score results and odds ratios of conditional (fixed effects) logit tests for the going dark firms using the matched control group. The dependent variable that takes the value of one for firms that chose to deregister and zero for matching firms. The standard error (SE) is reported in parentheses. These tests exclude foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (a corporation without any business activity) and firms for which accounting or stock price data was not available. After such screening 261 firms remained in our sample. The matching firms were chosen based on three criteria: (i) a firm's 4 digit SIC code and (ii) a firm's average asset size over the 3 years prior to announcing it was going dark and (iii) the market for the common stock (major exchanges or over the counter) at the end of the last fiscal year prior to deregistration. The total number of matching firms is 281.

Variables	**Model 1**		**Model 2**		**Model3**		**Model 4**		**Model 5**	
	Coeff.(SE)	Odds R.	Coeff.(SE)	Odds R.	Coeff.(SE)	Odds R.	Coeff.(SE)	Odds R.	Coeff.(SE)	Odds R.
q-ratio	-0.22(0.06)***	0.80	-0.17(0.06)***	0.84	-0.17(0.06)***	0.84	-0.32(0.09)***	0.72	-0.16(0.11)	0.85
Log(assets)	-0.50(0.16)***	0.61	-0.37(0.17)***	0.69	-0.47(0.17)***	0.63	-0.36(0.20)*	0.70	-0.86(0.43)**	0.42
Intangible asset ratio	-0.68(0.68)	0.50	-0.48(0.70)	0.62	-0.59(0.70)	0.56	-0.45(0.81)	0.63	3.01(1.75)*	20.23
Leverage	0.41(0.12)***	1.51	0.32(0.12)***	1.37	0.33(0.12)***	1.39	0.50(0.15)***	1.65	0.22(0.21)	1.25
Insider ownership	----	----	1.82(0.50)***	6.20	1.62(0.48)***	5.03	1.60(0.58)***	4.97	2.74(1.137)**	15.43
Free cash-flow (FCF)	----	----	-0.53(0.40)	0.59	----	----	-0.42(0.41)	0.66	-0.21(0.67)	0.81
Dummy(q<1, FCF>0)	----	----	0.34(0.25)	1.41	0.27(0.25)	1.31	0.27(0.28)	1.31	1.17(0.49)**	3.23
Insider (x) FCF	----	----	----	----	0.28(0.83)	1.32	----	----	----	----
Volume (turnover)	----	----	----	----	----	----	-113.7(43.9)***	0.00	-569.0(202.2)***	0.00
Momentum	----	----	----	----	----	----	-0.39(0.16)**	0.68	-0.61(0.29)**	0.54
Audit fees to MVE	----	----	----	----	----	----	----	----	16.01(6.31)**	8930959
Number of observations	542		520		520		442		242	
LR χ^2	41.87***		53.35***		51.10***		65.97***		67.29***	
Pseudo R^2	0.11		0.15		0.14		0.21		0.40	
Log Likelihood	-168.08		-154.60		-155.73		-121.03		-50.58	

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 15: Descriptive statistics for the logit variables for going dark firms and two control groups: the unmatched sample (firms with holders of record less than 300 (500)) and firms that went private.

In addition to the summary statistics for the unmatched and going private group, this table shows the mean value of the logit variables for the going dark firms and the corresponding t-statistics for the differences in means with the two control groups. The total number of observations of the going private control group with Compustat data and market price data is 380 firms. For the unmatched control group (holders of record less than 300 (500)), after we exclude foreign firms, firms in their first year of financial reporting, shell corporation and firms with no Compustat or market price data. After such screening 7114 firm-year remained in our unmatched control group.

Variables	Mean of Going Dark firms	Unmatched control sample (holders of record less than 300 (500))					Mean difference (Dark & Unmatched)	t-stat	Going Private control group					Mean difference (Dark & Private)	t-stat
		No. of Obs.	Mean	Std. Dev.	Min	Max			No. of Obs.	Mean	Std. Dev.	Min	Max		
Binary	1	7114	0	0	0	0	----	----	380	0	0	0	0	----	----
q-ratio	2.016	7114	2.425	2.960	0.043	38.370	-0.410	-2.19**	380	1.407	1.388	0.291	16.704	0.609	3.39***
Log(assets)	2.678	7114	4.408	1.735	-3.863	11.263	-1.729	-15.82***	380	4.733	1.726	-0.109	9.911	-2.055	-14.86***
Intangible asset ratio	0.066	7114	0.107	0.170	0.000	0.993	-0.041	-3.80***	380	0.114	0.165	0.000	0.741	-0.048	-3.81***
Leverage	0.448	7113	0.563	1.077	0.000	32.500	-0.115	-8.65***	380	0.642	0.580	0.009	7.492	-0.194	-4.94***
FI dummy	0.215	7114	0.098	0.297	0	1	0.116	6.11***	380	0.068	0.253	0	1	0.146	5.56***
Insider ownership	0.438	6726	0.303	0.220	0.000	1.00	0.135	9.67***	369	0.354	0.295	0.001	0.999	0.084	3.8***
Free cash-flow (FCF)	-0.099	6957	0.002	0.217	-6.083	0.775	-0.101	-6.83***	378	0.026	0.243	-1.953	0.788	-0.125	-4.32***
Dummy(q<1, FCF>0)	0.267	6957	0.146	0.353	0.000	1.000	0.121	5.30***	378	0.280	0.450	0.000	1.000	-0.014	-0.38
Insider (x) FCF	-0.021	6573	0.005	0.075	-2.462	0.517	-0.026	-5.16***	367	0.016	0.086	-0.914	0.348	-0.037	-4.06***
Volume (turnover)	0.001	6387	0.006	0.011	0.000	0.286	-0.005	-7.28***	249	0.004	0.015	0.000	0.225	-0.003	-2.83***
Momentum	-0.100	6298	0.085	1.145	-1.149	51.767	-0.186	-2.46**	251	0.099	0.675	-1.067	6.736	-0.199	-2.93***
Audit fees to MVE	0.047	4018	0.015	0.405	0.000	23.684	0.033	0.95	100	0.047	0.240	0.000	2.038	0.001	0.05

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

† A few firms have 100% insider ownership due to the fact that insiders own 100% of the voting class of shares.

Table 16: Logistic regression of the probability of deregistration over the January 1996 – May 2004 period, using the unmatched control group (firms with fewer than 300/500 holders of record)

This table reports the coefficient score results and the elasticity of logit tests for the going dark sample using the unmatched control group of all firms with holders of record less than 300/500. The dependent variable is binary that takes a value of one for the firms who chose to deregister and zero for the unmatched control group firms. The standard error (SE) is reported in parentheses and elasticity was calculated as *d(lnF)/d(lnx),* where *d* is the first derivative*, ln(F)* is the natural logarithm of the density function and *ln(x)* is the natural logarithm of the explanatory variable. The elasticity is evaluated at the sample means of the explanatory variables. These tests exclude foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (a corporation without any business activity) and firms for which accounting or stock price data was not available. After such screening 261 firms remained in our going dark sample and 7114 in our unmatched control group.

Variables	Model 1		Model 2		Model3		Model 4		Model 5	
	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity
q-ratio	-0.65(0.08)***	-1.55	-0.54(0.08)***	-1.29	-0.55(0.08)***	-1.31	-0.56(0.10)***	-1.31	-0.85(0.18)***	-0.38
Log(assets)	-0.71(0.04)***	-3.06	-0.71(0.05)***	-3.02	-0.73(0.05)***	-3.12	-0.62(0.06)***	-2.71	-0.72(0.09)***	-0.41
Intangible asset ratio	-0.31(0.50)	-0.03	-0.39(0.50)	-0.04	-0.40(0.50)	-0.04	-0.42(0.52)	-0.04	-0.05(0.71)	-0.08
Leverage	0.67(0.09)***	0.39	0.58(0.09)***	0.32	0.59(0.09)***	0.33	0.59(0.10)***	0.32	1.48(0.26)***	0.13
FI dummy	1.27(0.18)***	0.13	1.39(0.18)***	0.11	1.40(0.18)***	0.11	1.14(0.20)***	0.10	1.57(0.28)***	0.02
Insider ownership	----	----	1.88(0.32)***	0.58	1.83(0.32)***	0.56	1.08(0.36)***	0.33	1.45(0.51)***	0.15
Free cash-flow (FCF)	----	----	-0.17(0.19)	-0.00	----	----	-0.25(0.20)	-0.00	-0.18(0.27)	-0.00
Dummy(q<1, FCF>0)	----	----	0.49(0.17)***	0.07	0.42(0.17)***	0.06	0.24(0.18)	0.04	0.55(0.24)**	0.04
Insider (x) FCF	----	----	----	----	0.45(0.52)	0.00	----	----	----	----
Volume (turnover)	----	----	----	----	----	----	-329(57.0)***	-2.00	-262(78.4)***	-0.48
Momentum	----	----	----	----	----	----	-0.15(0.14)	-0.01	-0.14(0.20)	-0.02
Audit fees to MVE	----	----	----	----	----	----	----	----	14.46(3.27)***	0.02
Constant	-0.18(0.18)		-1.10(0.26)***	----	-0.97(0.25)***	----	-0.25(0.29)	----	-0.86(0.45)*	----
Number of observations	7374		6827		6827		6037		3662	
LR χ^2	452.29***		502.67***		502.64***		537.82***		434.19***	
Pseudo R^2	0.20		0.23		0.23		0.28		0.38	
Log Likelihood	-902.23		-837.12		-837.14		-704.97		-354.41	

***, ** and * indicate *p* value of 1%, 5% and 10%, respectively.

Table 17: Logistic regression of the probability of deregistration over the January1996 – May 2004 period, using the going private control group that become the target

This table reports the coefficient score results and the elasticity of logit tests for the going dark sample using the control group of firms that went private during the same period of time. The dependent variable is binary that takes a value of one for the firms who chose to deregister and zero for the going private control group firms. The standard error (SE) is reported in parentheses and elasticity was calculated as *d(lnF)/d(lnx),* where *d* is the first derivative, *ln(F)* is the natural logarithm of the density function and *ln(x)* is the natural logarithm of the explanatory variable. The elasticity is evaluated at the sample means of the explanatory variables. These tests exclude foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (a corporation without any business activity) and firms for which accounting or stock price data was not available. After such screening 261 firms remained in our going dark sample and 380 in our going private control group.

Variables	Model 1		Model 2		Model3		Model 4		Model 5	
	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity	Coeff.(SE)	Elasticity
q-ratio	-0.05(0.06)	-0.04794	-0.02(0.06)	-0.02	-0.03(0.06)	-0.03	-0.21(0.15)	-0.17	-0.39(0.27)	-0.23
Log(assets)	-0.89(0.08)***	-2.20582	-0.87(0.08)***	-2.17	-0.89(0.08)***	-2.20	-0.97(0.11)***	-1.82	-0.99(0.16)***	-1.21
Intangible asset ratio	0.55(0.73)	0.03298	0.72(0.75)	0.04	0.64(0.74)	0.04	0.14(0.86)	0.01	0.13(1.19)	0.00
Leverage	0.43(0.17)***	0.23257	0.39(0.18)**	0.22	0.39(0.17)**	0.21	0.68(0.26)***	0.31	1.06(0.45)**	0.36
FI dummy	2.68(0.34)***	0.21763	2.75(0.35)***	0.22	2.73(0.35)***	0.22	2.7(0.42)***	0.19	2.36(0.61)***	0.14
Insider ownership	----	----	0.76(0.42)*	0.19	0.66(0.41)	0.16	0.14(0.51)	0.03	-0.50(0.77)	-0.07
Free cash-flow (FCF)	----	----	-0.63(0.4)	-0.01	----	----	-0.15(0.37)	-0.00	-0.05(0.41)	-0.00
Dummy(q<1, FCF>0)	----	----	0.16(0.25)	0.03	0.11(0.25)	0.01884	-0.02(0.29)	-0.00	0.56(0.42)	0.06
Insider (x) FCF	----	----	----	----	-0.78(0.94)	-0.00	----	----	----	----
Volume (turnover)	----	----	----	----	----	----	-76.3(35.8)**	-0.09	-48.0 (71.5)	-0.03
Momentum	----	----	----	----	----	----	-0.45(0.16)***	-0.001	-0.34(0.21)	-0.00
Audit fees to MVE	----	----	----	----	----	----	----	----	-0.72(0.97)	-0.01
Constant	2.23(0.31)***	----	1.77(0.41)***	----	1.91(0.39)***	----	3.1(0.57)***		3.61(0.89)***	----
Number of observations	641		622		622		457		219	
LR χ^2	280.72***		281.09***		278.75***		232.94***		96.53***	
Pseudo R^2	0.32		0.33		0.33		0.37		0.33	
Log Likelihood	-292.83904		-280.45479		-281.62		-200.30		-98.45	

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 18: Mean values of variables for firms going dark before and after the passage of Sarbanes Oxley (July 31 2002) and corresponding t-statistics for differences in the means

These tests exclude foreign firms, firms that emerged from bankruptcy in the year before going dark, shell corporations (corporations without any business activities) and firms for which accounting or stock price data were not available. After such screening 261 firms remained in our sample of which 169 firms deregistered after the passage of the Sarbanes-Oxley Act on July 31 2002 with 92 firms deregistering before the Act.

Variables	Deregistering sample post-Sarbanes-Oxley		Deregistering sample pre-Sarbanes-Oxley		Comparison between means		Proportion of firms deregistering post-Sarbanes-Oxley relative to the total deregistering sample
	Number of observations	Mean	Number of observations	Mean	Mean difference	T-statistics for difference in means	
q-ratio	169	1.916	92	2.200	-0.284	-0.75	0.65
Log(assets)	169	2.732	92	2.580	0.152	0.69	0.65
Intangible asset ratio	169	0.075	92	0.051	0.023	1.21	0.65
Leverage	169	1.279	92	0.979	0.300	1.13	0.65
FI dummy	169	0.231	92	0.185	0.046	0.80	0.65
Insider ownership	169	0.456	92	0.404	0.053	1.71 *	0.65
Free cash-flow (FCF)	164	-0.105	91	-0.088	-0.017	-0.23	0.64
Dummy(q<1, FCF>0)	164	0.280	91	0.242	0.039	0.59	0.64
Insider (x) FCF	164	-0.024	91	-0.016	-0.007	-0.36	0.64
Volume (turnover) (%)	164	0.064	84	0.207	-0.143	-2.90***	0.66
Momentum (%)	158	-2.211	76	-26.208	23.997	2.06**	0.68
Audit fees to MVE	125	0.050	13	0.025	0.025	0.65	0.91

***, ** and * indicates *p* value of 1%, 5% and 10%, respectively.

Table 19: Stock price reaction to the announcement of deregistration over the January 1996 – May 2004 period

The table below presents the results of an event study testing the impact of deregistration announcements on the share price. The model is: $R_{i,t} = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t}$, where $R_{i,t}$ is the return on the common stock of the i^{th} company in our sample at time t; $R_{M,t}$ is the return on the value-weighted Market Index (Russell 2000) at time t, and $\varepsilon_{i,t}$ is the error term. Return data for each sample firm was obtained from Datastream. Standardized abnormal returns are following Patell (1976). The Patell test standardizes the event-date prediction error for each stock by its standard deviation. The market model was estimated using the Scholes-Williams adjustment for thinly traded firms over a 255-day period, ending 46 days before the event day. Panels 1 presents the results for 188 non-financial sample firms that had return data available on Datastream. Panel 2 divides non-financial firms into two sub-samples based on their trading venue before deregistration and shows the cumulative average abnormal returns (CAAR) for each group. Panel 3 contains the results for the pre- and post-Sarbanes-Oxley sub-samples. Results for all 50 financial institutions with Datastream data are displayed in Panel 4. Panel 5 displays the CAARs for both firms that either repurchased shares or implemented a reverse stock split and those that did neither. Panel 6 shows the results of an event study on the smple pre-1999 OTCBB deregistering firms and Pink sheets deregistering firms.

Event Windows	Number of Observations	CAAR	Positive: Negative	Patell Z Test
Panel 1a: Abnormal Returns - non-financial firms that announced their deregistration over the sample period (the event date is earlier of the announcement and the filing date, unless stated otherwise)				
(0,+1)	188	-12.03%	55:129	-12.526***
(0,+5)	188	-12.01%	55:129	-7.534***
Panel 1b: Abnormal Returns - non-financial firms that announced their deregistration over the sample period (the event date is the announcement date)				
(0,+1)	188	-10.99%	56:128	-11.167***
(0,+5)	188	-7.97%	55:129	-5.174***
Panel 1c: Abnormal Returns - non-financial firms that announced their deregistration over the sample period (the event date is the filing date)				
(0,+1)	187	-10.33%	58:125	-10.659***
(0,+5)	187	-0.43%	64:119	-0.722
Panel 2a: Abnormal Returns – non-financial firms that announced their deregistration while trading on one of the major exchanges				
(0,+1)	38	-16.74%	11:27	-12.200***
(0,+5)	38	-18.68%	9:29	-9.131***
Panel 2b: Abnormal Returns – non-financial firms that announced their deregistration while trading over-the-counter (on the OTC BB or the Pink Sheets)				
(0,+1)	150	-10.84%	44:102	-7.682***
(0,+5)	150	-10.32%	46:100	-3.674***
Panel 3a: Abnormal Returns – firms that deregistered after the passage of the Sarbanes-Oxley Act of 2002				
(0,+1)	124	-13.65%	35:87	-11.792***
(0,+5)	124	-8.96%	38:84	-5.390***
Panel 3b: Abnormal Returns – firms that deregistered before the passage of the Sarbanes-Oxley Act of 2002				
(0,+1)	64	-8.88%	20:42	-4.983***
(0,+5)	64	-17.92%	17:45	-5.423***

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Table 19: Stock price reaction to the announcement of deregistration over the January 1996 – May 2004 period (continued)

Event Windows	Number of Observations	CAAR	Positive: Negative	Patell Z Test
Panel 4: Abnormal Returns – financial institutions that announced their deregistration over the sample period				
(0,+1)	50	-1.67%	20:27	1.12
(0,+5)	50	-2.79%	22:25	1.669*
Panel 5a: Abnormal Returns – deregistering non-financial firms that neither repurchased shares nor implemented a reverse stock split to reduce number of their shareholders of record				
(0,+1)	154	-12.05%	41:109	-12.773***
(0,+5)	154	-10.01%	42:108	-7.086***
Panel 5b: Abnormal Returns – deregistering non-financial firms that repurchased shares or implemented a reverse stock split to reduce the number of their shareholders of record				
(0,+1)	34	-11.92%	14:20	-2.088**
(0,+5)	34	-21.05%	13:21	-2.603***
Panel 6: A Abnormal Returns – non-financial firms that announced their deregistration while trading on the Pink Sheets and on the pre-eligibility rule (i.e. pre January 1, 1999) OTCBB				
(0,+1)	40	-6.69%	13:24	-2.698***
(0,+5)	40	-12.48%	11:26	-2.139**

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Table 20: Trading and liquidity before and after deregistration

The Table below displays trading and liquidity information for the deregistered firms with the SEC. The bid-ask spread was collected from two sources CRSP (for the pre-deregistration period of sub-sample 1 the exchange deregistered firms) or the Pink Sheets. The return data, volume and number of trading days were collected from Datastream. Panels 1 to 5 provide measures of mean dollar spread, mean percentage spread, volatility volume and number of trading days for different sub groups. To analyze liquidity we compare liquidity before and after deregistration. To do this, we compare liquidity in the *pre*-deregistration period *(t_0-90 to t_0 -31)* with liquidity for the *post*-deregistration period *(t_0+31 to t_0 +90),* where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement, we excluded 30 days before and after the deregistration date. We included only that sub-sample of going dark firms that have data from the Pink Sheets/Datastream and such data is available before and after deregistration. Dollar spreads are defined as (closing ask price – closing bid price). Percentage spreads are calculated as (closing ask price –closing bid price) / (midpoint of closing ask and bid prices)×100. Volatility is calculated as the standard deviation of daily returns of the stocks in the sample. Volume turnover is calculated as the percentage of average daily volume to outstanding shares. Trading days are calculated as the sum of trading days. Difference of means tests is two-sided tests and assumes unequal variances.

	Observations	**Prior Deregistration**	**After Deregistration**	**T-Statistic**
Panel 1: ***All sample firms (financial plus non-financial)***				
Mean dollar spread ($)	174	1.108	10.801	**1.32**
Mean percentage spread (%)	174	33.976	51.353	**3.90*****
Mean volatility (%)	226	11.400	19.055	**9.27*****
Volume turnover (%)	203	0.103	0.088	**-0.54**
Trading days	203	27.192	19.557	**-4.65*****
Panel 2: A sub-sample of ***non-financial*** firms that announced their deregistration while ***trading on one of the major exchanges***				
Mean dollar spread ($)	23	0.263	0.743	**2.19****
Mean percentage spread (%)	23	14.29	37.02	**2.51****
Mean volatility (%)	36	6.81	14.53	**1.70***
Volume turnover (%)	34	0.15	0.06	**-1.61**
Trading days	34	36.765	24.471	**-2.98*****
Panel 3: A sub-sample of ***non-financial*** firms that announced their deregistration while ***trading over-the-counter (on the OTC BB or the Pink Sheets)***				
Mean dollar spread ($)	114	0.359	4.013	**1.16**
Mean percentage spread (%)	114	43.40	60.85	**3.06*****
Mean volatility (%)	144	14.67	23.99	**2.91*****
Volume turnover (%)	128	0.09	0.10	**0.11**
Trading days	128	27.57	20.77	**-3.25*****

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Table 20: Trading and liquidity before and after deregistration (continued)

	Observations	Prior to Deregistration	After Deregistration	T-Statistic
Panel 4: A sub-sample of all ***non-financial firms*** that announced their deregistration over the sample period				
Mean dollar spread ($)	137	0.34	3.46	**1.19**
Mean percentage spread (%)	137	38.51	56.85	**3.58*****
Mean volatility (%)	180	13.09	22.10	**3.28*****
Volume turnover (%)	162	0.11	0.09	**1.19**
Trading days	162	29.50	21.54	**-4.21*****
Panel 5: A sub-sample of ***financial firms***				
Mean dollar spread ($)	37	3.94	37.97	**1.03**
Mean percentage spread (%)	37	17.17	31.00	**1.28**
Mean volatility (%)	46	4.77	7.13	**0.93**
Volume turnover (%)	41	0.09	0.08	**-0.30**
Trading days	41	18.07	11.71	**-2.59*****

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Table 21: Trading and liquidity before and after deregistration for the going dark sample and the matched control sample

The Table below displays trading and liquidity information for the deregistered firms with the SEC and the matched control sample. The matching firms are chosen based on three criteria: (i) a firm's 4 digit SIC code and (ii) a firm's average asset size over the 3 years prior to announcing it was going dark and (iii) the market for the common stock (major exchanges or over the counter) at the end of the last fiscal year prior to deregistration. The return data, volume and number of trading days were collected from Datastream. Panels 1 to 3 provide measures of mean dollar spread, mean percentage spread, volatility volume and number of trading days for different sub groups. To analyze liquidity we compare liquidity before and after deregistration. To do this, we compare liquidity in the *pre*-deregistration period *(t_0-90 to t_0 -31)* with liquidity for the *post*-deregistration period *(t_0+31 to t_0 +90),* where t_0 is the effective deregistration date. In order to rule out the noise of the deregistration announcement, we excluded 30 days before and after the deregistration date. We included only that sub-sample of going dark firms and the matched control sample that have data from the Datastream and such data is available before and after deregistration. Volatility is calculated as the standard deviation of daily returns of the stocks in the sample. Volume turnover is calculated as the percentage of average daily volume to its outstanding shares. Trading days is calculated as the sum of trading days. Difference of means (between the going dark sample and match sample) tests is two-sided tests and assumes unequal variances.

	Matched Sample				**Going Dark Sample**				**Difference in means**		
Variables	**No of Obs.**	***Pre*-going dark**	***Post*- going dark**	**Difference in means**	**No of Obs.**	***Pre*-going dark**	***Post*- going dark**	**Difference in means**	***Pre*-going dark**	***Post*-going dark**	**Net Differences in differences**
Column number (col)	**1**	**2**	**3**	**4 col(3)-col(2)**	**5**	**6**	**7**	**8 col(7)-col(6)**	**9 col(6)-col(2)**	**10 col(7)-col(3)**	**11 col(10)-col(9)**
Panel 1: All sample firms (financial and non-financial)											
Mean volatility (%)	267	7.76	7.64	-0.12	226	11.40	19.06	7.66	3.64***	11.42***	7.77***
Volume turnover (%)	263	0.25	0.35	0.10	203	0.10	0.09	-0.02	-0.15***	-0.27***	-0.12**
Trading days	263	42.93	43.12	0.19	203	27.19	19.56	-7.64	-15.74***	-23.57***	-7.83***
Panel 2: a sub-sample of ***non-financial firms***											
Mean volatility (%)	211	8.88	8.66	-0.23	180	13.09	22.10	9.01	4.21***	13.44***	9.23***
Volume turnover (%)	209	0.28	0.39	0.11	162	0.11	0.09	-0.02	-0.17***	-0.30***	-0.13**
Trading days	209	44.97	45.22	0.25	162	29.50	21.54	-7.96	-15.47***	-23.67***	-8.21***
Panel 3: a sub-sample of ***financial firms***											
Mean volatility (%)	56	3.51	3.79	0.28	46	4.77	7.14	2.37	1.26	3.34	2.09
Volume turnover (%)	54	0.15	0.21	0.07	41	0.09	0.08	-0.01	-0.05	-0.13*	-0.08
Trading days	54	35.06	35.02	-0.04	41	18.07	11.71	-6.37	-16.98***	-23.31***	-6.33***

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Table 22: Long-term stock price performance of deregistering firms

This table reports mean raw and market-adjusted post-deregistration buy and hold returns for the 230 sample firms with return data available from Datastream, as well as various sub-samples. We calculate buy and hold market-adjusted returns for the *j*th firm in our sample as:

$$BHMAR_{j,T_1,T_2} = \left[\prod_{t=T_1}^{T_2}\left(1+R_{jt}\right)\right] - \left[\prod_{t=T_1}^{T_2}\left(1+R_{mt}\right)\right],$$

where T_1 is the first and T_2 is the 126th (252nd for one-year return period) trading day after the firm filed for deregistration with the SEC, R_{jt} is the daily return for sample firm *j* on date *t*, and R_{mt} is the return on the Russell 2000 Index on the same date. The last column reports *t*-statistics from testing the null hypothesis that the mean market adjusted return is not significantly different from zero.

	Raw Returns	Market Adjusted Returns	Number of Observations	*t*-statistic
Panel 1: All sample firms announcing deregistration				
Six-month returns	0.28%	-10.51%	230	-1.57
One-year returns	10.00%	-9.15%	230	-0.93
Panel 2: Firms deregistering while trading on major exchanges				
Six-month returns	6.00%	-16.07%	45	0.10
One-year returns	25.54%	-7.38%	45	0.24
Panel 3: Firms deregistering while trading over-the-counter				
Six-month returns	-1.11%	-11.61%	185	-1.51
One-year returns	6.23%	-12.13%	185	-1.08
Panel 4: Sub-sample of Financial Institutions				
Six-month returns	11.42%	-2.70%	50	-0.29
One-year returns	-2.70%	-12.30%	50	-1.23
Panel 5: Sub-sample of all firms except Financial Institutions				
Six-month returns	-1.97%	-12.67%	180	-1.55
One-year returns	9.61%	-8.27%	180	-0.67

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively

Figure 1: The two-state model

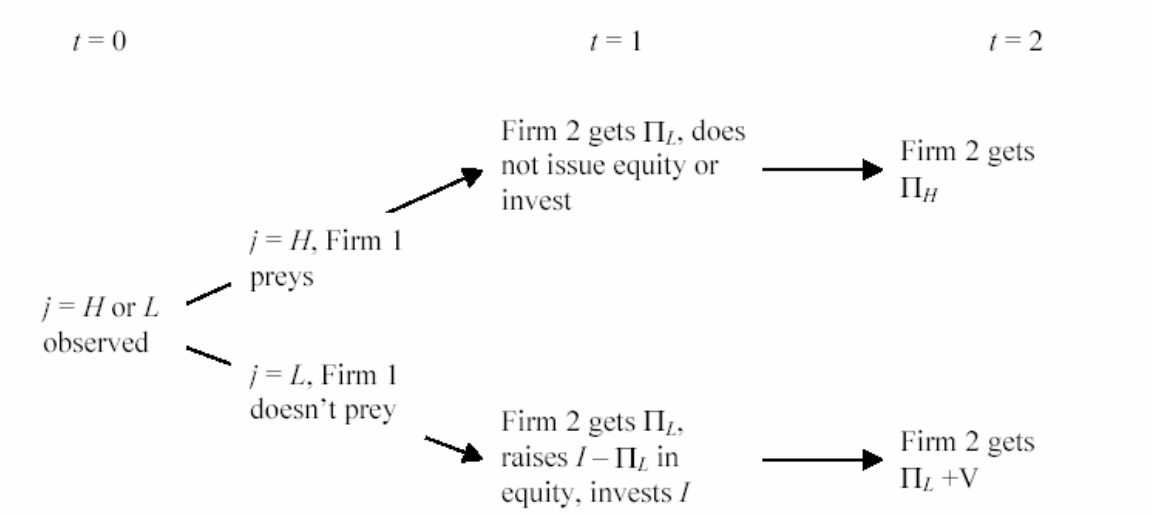


Figure 2: The two-period Stackelberg model

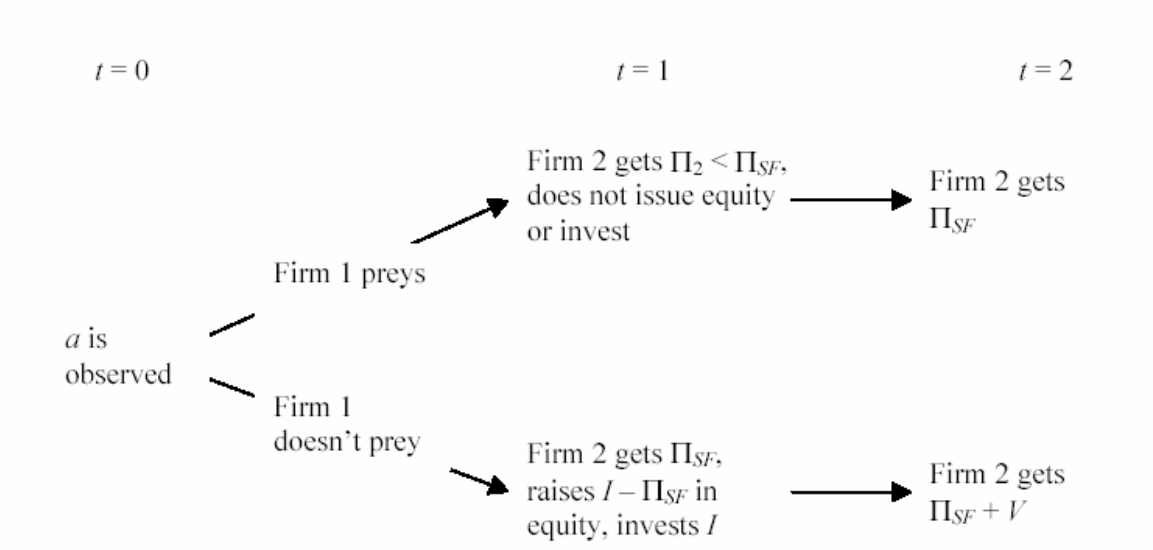


Figure 3: The realization of a and the decision to prey

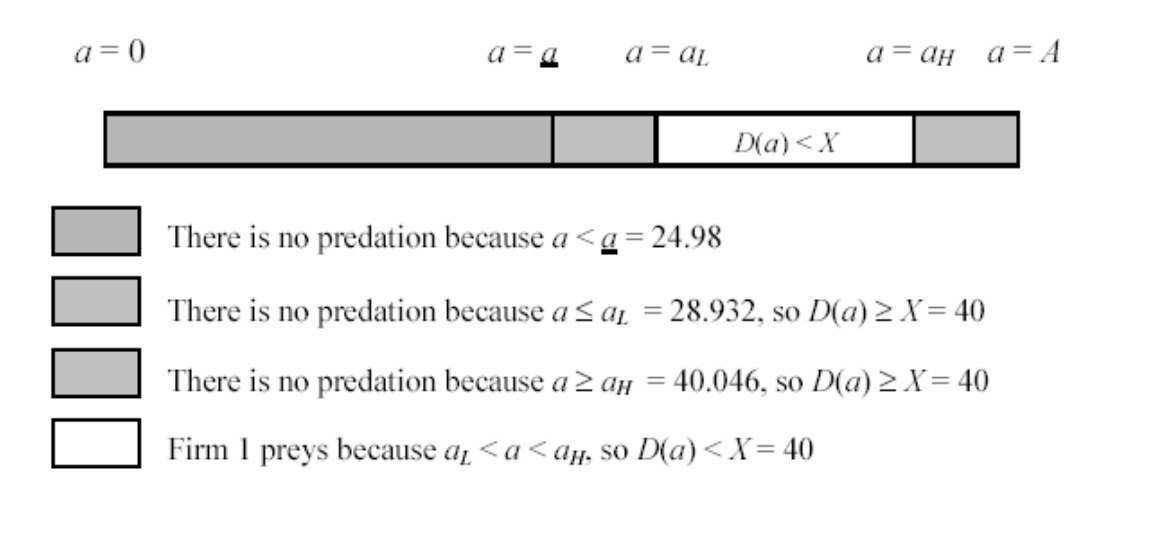


Figure 4: The breakdown of the deregistering ("going dark") sample

This figure contains the breakdown of the 406 deregistering firms sample for the period between 1996 and 2004 (May). The data collected from SEC's EDGAR database for firms which filed a Form 15 to deregister all classes of their public securities. The first sub-sample includes deregistering firms that were — at the time of the deregistration announcement — listed on one of the major exchanges, AMEX or NASDAQ. Over the January 1996- May 2004 period there were 47 such firms. The second, 359 firm sub-sample contains those companies which announced their planned deregistration while trading over-the-counter.

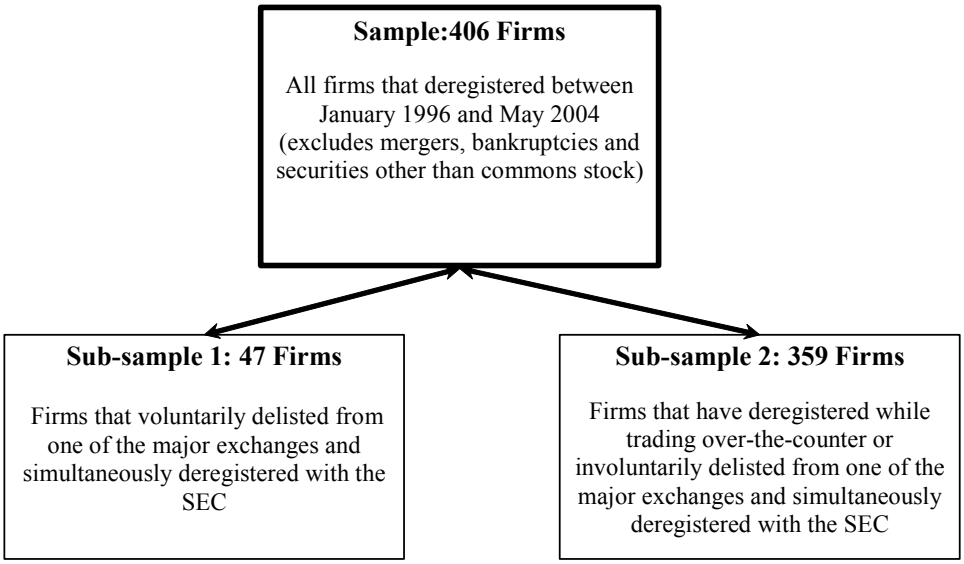
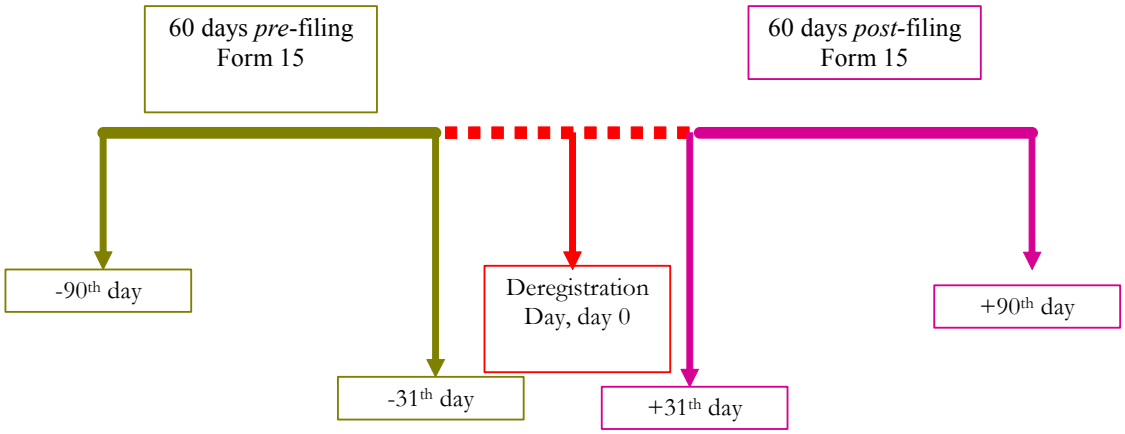


Figure 5: Time periods included in the market liquidity measures



Appendix A

Proof of Proposition 1 First consider the possible pure strategy equilibria. Suppose that investors believe that predation occurs if $j = H$ but Firm 2 issues equity for both realizations of j. This is clearly not part of an equilibrium: predation is costly so Firm 1 will not prey unless predation prevents investment. In an equilibrium where Firm 1 does not prey, investors would have to believe that observed profits equal true profits.

These beliefs will not be confirmed in equilibrium since, given these beliefs, Firm 1 could gain $X - D > 0$ by misleading investors and reducing Firm 2's profits to Π_L when $j = H$. Since Equation 2–2 holds with strict inequality, Firm 2 will then choose to forgo the investment. Investors' beliefs will be confirmed in a pure strategy equilibrium if and only if they believe that Firm 2 will issue when $j = L$, there was no predation and observed profits equal true profits, and forgo the project otherwise. If Equation 2–2 holds with equality, then the prey will be indifferent between investing and foregoing the project when predation has occurred. There will be two equilibria: one with investment and no predation, and a second with predation and no investment.

When parameter values are such that

$$\left(1 - \frac{I - \Pi_L}{\Pi_L + \Pr(H)(\Pi_H - \Pi_L) + V}\right)(\Pi_H + V) > \Pi_H + \Pi_L,$$

a mixed strategy equilibrium may exist in which Firm 2 takes the project with probability $1 > \delta > 0$ when the predator preys, and δ is chosen to ensure that the payoff to Firm 2 remains the same whether or not it invests:

$$\left(1-\frac{I-\Pi_L}{\Pi_L+\delta\cdot\Pr(H)(\Pi_H-\Pi_L)+V}\right)(\Pi_H+V)=\Pi_H+\Pi_L.$$

Since the predator will only prey if its expected gains exceed the cost of predation, a mixed strategy equilibrium will not exist unless $(1-\delta)X > D$.

Predation cannot deceive investors when it reduces Firm 2's profits below Π_L, because investors will realize that profits lower than Π_L could only occur as a result of predation.

Proof of Lemma 1 From Equation 2–4 it is easy to obtain $\underline{a}$, the value of the demand parameter where $\overline{\Pi}_2 = 0$: $\underline{a} = 4[V\ (V/I - 1)]^{1/2} > 0$. (Remember that $\Pi_{SF} = (a/4)^2$.) For $a < \underline{a}$ –- or equivalently, $\Pi_{SF} < V(V/I - 1)$ – the predator would have to reduce Π_2 and the perceived value of the prey below zero in order to prevent investment. Since this is not possible, there will be no predation when $a < \underline{a}$.

Proof of Proposition 2 Points ii) and iii) follow directly from Lemma 1 and the preceding discussion. To see point i), consider the case when the predator observes the realization $\hat{a} > \underline{a}$ and therefore knows that - in the absence of predation – the prey's period 1 profit will equal $\hat{\Pi}_{SF} = [\hat{a}/4]^2 > \underline{\Pi}_{SF} = [\underline{a}/4]^2$. Suppose also that $D(\hat{a}) < X$, so the predator gains more by preying and preventing the investment than by maximizing current profits. If the predator increases its output to $q_1 > a/2$ then the prey's profits drop to some $\Pi_2 < \hat{\Pi}_{SF}$. Π_2 might occur also as a result of a lower realization of the demand parameter: $\Pi_2 = [\tilde{a}/4]^2 = \tilde{\Pi}_{SF}$ where of course $\tilde{a} < \hat{a}$. Note however that if the predator finds it optimal to prey when the demand parameter equals $\tilde{a}$, then $\Pi_2 = \tilde{\Pi}_{SF}$ will only be observed as a result of predation so investors will know that predation must have taken place as soon as they observe Π_2. (Investors know that when the two firms observe $\tilde{a}$, Firm 2's first period profits will actually be lower than $\tilde{\Pi}_{SF}$.) In order for Firm 1 to

successfully prey by lowering 2's profits to $\Pi_2 = \widetilde{\Pi}_{SF}$, there must be no predation when $\underline{a} = \tilde{a}$, implying that either $\underline{a} > \tilde{a}$ (predation is impossible even by reducing the value of the competitor's existing business to zero) or $D(\tilde{a}) > X$ (the cost of predation is too great).

The same reasoning can be applied as in the proof of Proposition 1 in order to show that investors' beliefs will be confirmed in equilibrium when they believe that Firm 2 will issue if there was no predation and observed profits equal true profits, and forgo the project otherwise.

Appendix B

Money burning enables a high valued firm to differentiate itself by committing to sacrifice C dollars of future cash flows. Firm 2 may want to deceive investors about market conditions to sell its shares more expensively. Therefore, C has to be sufficiently high to convince investors that Firm 2 would not have an interest in burning C unless its profits were temporarily lowered to Π_L by predation. In other words, when Π_L is low due to unfavorable market conditions, Firm 2 should not find it in its interest to sacrifice C in order to pretend that its value is high. The lowest such incentive compatible C is:

$$C_E = \frac{1}{2}\left[\Pi_H + V - \sqrt{(\Pi_H + V)^2 - 4(I - \Pi_L)(\Pi_H - \Pi_L)}\right]$$

C_E is the most efficient signal level. For some values of the parameters, signaling will be too expensive. If the cost of money burning is greater than the present value of the project, then predation will cause the constrained firm to forego the investment. When $V - I > C_E$ on the other hand, Firm 2 will burn money to signal its type and will issue shares even if Firm 1 preys. Since preying cannot prevent investment, predation will be useless and will not be observed in equilibrium.

Proposition 5 summarizes the results from the above discussion.

Proposition 5 *If $V - I > C_E$ and $D < X$ hold, then Firm 1 will prey in equilibrium whenever the realization of the state variable is $j = H$. Firm 2 will not burn money, it will not issue shares and will not implement the new project. If $V - I = C_E$ and $D < X$, then predation will be one of the possible equilibria for $j = H$. There will be no predation when the realization of the state variable is. $j = L$.*

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Vita

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