

**RAMIFICATIONS OF SARBANES-OXLEY CORPORATE GOVERNANCE
LEGISLATION ON INITIAL PUBLIC OFFERINGS OF RESEARCH-
INTENSIVE FIRMS**

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JANINE BLACK

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Examining Committee Members:

Dr. Shreeram R. Mudambi, Strategic Management, Temple University, - Advisor
Dr. Jayanthi Krishnan, Accounting, Temple University
Dr. Arun Kumaraswamy, Strategic Management, Temple University
Dr. William Dunkelberg, Economics, Temple University

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ABSTRACT

The Sarbanes-Oxley (SOX) Act of July 2002 was created to address the financial malfeasance revealed during the investigations of several large firms by the Securities and Exchange Commission (SEC). The Act required public companies traded on U.S. exchanges to provide increased transparency in financial statements. Key portions of the legislation required firms to create internal financial controls and placed personal accountability with top executives. SOX mandated and standardized a greater degree of self-regulation. In the years following SOX, firms experienced significantly higher compliance costs, but they also benefited from the reduction of statement errors and fraud, increased accuracy in reporting, and greater investor confidence.

After the Sarbanes-Oxley (SOX) Act of 2002, anecdotal evidence suggested that SOX impeded small, research intensive firms. We looked at research intensive firms going public before and after SOX to determine if there was a change in volume and quality of research intensive firms post-SOX. We found that firms that went public after SOX were fewer and had lower patenting activity. In the case of small and medium size firms, the cost of SOX compliance is likely to divert funds from research investments. We speculate that highly research intensive firms are more likely post-SOX to *divert* their IPO to non-U.S. exchanges, *delay* going public, or *dismiss* the idea of going public, as proposed in a “3Ds” model.

The 2002 SOX US Congressional Act levied millions of dollars in new compliance costs on each foreign or domestic firm that went public on U.S. exchanges. Funding for regulatory expenditures must come from somewhere. We proposed that one

likely candidate was research budgets, as research efforts have a more distant, less immediately visible, long term effect on firm performance. We suggested that large firms more easily absorbed the additional costs of SOX with a reduced effect on research and development budgets, while small firms were less able to maintain research budgets after SOX. In the aftermath of SOX, research spending did go down, most visibly in Biotech and Electronics. As the total number of IPO firms decreased dramatically after SOX, these two research intensive industries, plus Computer Software, were the only industries with a large enough sample size to evaluate. We saw that research intensive firms diminished dramatically, along with many non-research intensive firms, from IPO events after SOX. Where we had sufficient sample size, in computer software, biotechnology, electronics, and “other”, we noted that research-intensive firms generally resisted the temptation to raid research budgets, finding funding for compliance elsewhere within the company or from the additional cash flow at time of IPO. Where firms did appear to greatly reduce research budgets was in the non-research intensive industries, where research budgets might be more of a discretionary expense. Firm size was not a factor in whether research intensive firms could better absorb the costs of SOX, although smaller firms tended to spend proportionally more on research in an effort to grow faster. After the enactment of SOX, we observed an indication that the markets valued research intensity even more than prior to SOX, perhaps understanding the vulnerability of research budgets being diverted to compliance costs.

Overall, the data suggested that the effect of SOX was underestimated in this study, as the firms that were deterred from going public on U.S. exchanges were not in

the sample evaluated. We only analyzed those firms prepared to accept the higher costs of SOX. The data set consisted of survivors, selected firms still willing to pay for SOX compliance as well as for research programs.

ACKNOWLEDGEMENTS

I would like to acknowledge my advising committee for their sage, experienced advice during the research process, my colleagues and friends who provided unwavering support, and my family who displayed tremendous patience throughout the process.

DEDICATION

I would like to dedicate this to my father and his ancestors. This will be the first Ph.D. degree in his family. My father has demonstrated great familial pride in this achievement.

PREFACE

I have always been interested in technology and science, especially in the business arena. One of my undergraduate degrees was a BS in Chemistry. This thesis topic combined my interests in technology (research-intensive firms), finance (initial public offerings), accounting (Sarbanes-Oxley legislation of 2002), entrepreneurship (small firms), and strategy (decision-trees for funding options). There was also a good dose of humor during the research process as this topic also dealt with “The Law of Unintended Consequences” as a result of government actions.

While this topic may be relevant to a very short time frame (2002-2010) on the surface, the consequences of government regulation on business activities is an issue of concern in the long term. If we occasionally do learn from history, this research may guide future politicians and historians in discussions on the ramifications of regulations and constraints on business activities.

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CHAPTER 1. SARBANES-OXLEY LEGISLATION: AN OVERVIEW OF THE ACT AND RAMIFICATIONS

Introduction

Sarbanes-Oxley legislation was enacted hastily in July 2002 to address numerous, highly publicized, acts of financial malfeasance on the part of top executives at several large companies within the U.S. While many of these executives landed in jail soon after being exposed, the ramifications for the employees and stockholders were also extreme. Stock prices plummeted at many of these firms. Several companies, such as Enron, were delisted as stock values plunged and/or they went out of business. Pension funds evaporated and paychecks bounced. The level of job loss was striking as large firms suddenly closed. The stock market slumped as investors lost confidence in how corporations were governed. SOX legislation was written to improve investor confidence by instilling a higher level of corporate governance into public firms, with the intention to avoid this same scenario in the future. Additionally, with greater investor confidence in the markets, it was expected that markets would stabilize and recover, and that the economy would rebound.

Since enactment, SOX legislation has received strong, but mixed, reviews. The business world resisted government intervention into firm governance, claiming the cost of SOX compliance depressed stock value, impeded business activities, placed inappropriate personal accountability on executives, and did not increase shareholder value. Negative responses to the new regulations were observed in the above normal

number of firms that delisted, or went dark, from public stock exchanges, and in the initial public offering activity that faded in the U.S. and blossomed in Asia and Europe. On the other hand, if one watched the stock market since 2003, after SOX, it would appear that the increased regulations, resulting in greater financial disclosure and transparency, were viewed in a positive light by investors. This was evidenced by slowly increasing stock market activity, until the recession of 2008, and possibly in improved market values at SOX compliant firms.

Eventually, eight years after the enactment of SOX, firms generally adapted to the new regulations. More accountants and financial personnel were hired to manage the process, budgets were adjusted to absorb the high costs of SOX compliance, new computer software programs were implemented to better track financials, consultants were hired to guide firms through SOX compliance, and complaints about SOX from firms diminished as firms adapted to the new regulations.

SOX oversight boards adjusted implementation deadlines to take into consideration more burdensome cases. Foreign firms listed on U.S. stock exchanges were given extra time to assimilate new U.S. accounting standards with their own domestic standards. Small firms were allowed more time to become SOX compliant as the cost burden was disproportionately heavier on them. By 2010, small firms were exempted from costly Section 404 (b). Much discussion took place in the literature on guidelines for compliance to SOX legislation. Researchers are now teasing out the finer ramifications of SOX regulations on public firms and the economy, those effects not so obvious to the stock market and business world observer.

In the end, SOX made it more difficult to hide fraud within public companies. Investors saw SOX compliance as an improvement in corporate governance. With greater regulation and information transparency, there would be greater protection for the investor, which likely satisfied the bulk of the government's objectives with this legislation. In reality, SOX addressed only a small slice of fiscal responsibility: mainly that of more accurate and effective financial record-keeping, greater personal accountability on the part of top executives, and the creation of internal controls meant to uncover fraud within the firm sooner, or discourage it altogether.

Background

High Profile Examples of Malfeasance Leading to Sarbanes-Oxley (SOX) Legislation

In the more than two decades prior to the enactment of Sarbanes-Oxley corporate governance legislation, investors saw steady and significant growth in the U.S. stock market (See Figure 1). Investors' portfolios were heavily weighted with stocks. Institutional investors wielded considerable clout with their portfolio firms. As stock valuations grew, compensation incentives for the company's top executives became tied to the firm's stock performance as a measurement of managerial effectiveness. Quarterly stock performance as a corporate objective dominated disproportionately, versus longer term corporate performance. Executives became uniquely focused on performance measurements that enhanced the value of their personal stock options, particularly as stock options became the incentive of choice within Boards of Directors. Pressures to

perform in the short run led to ethical challenges which not all executives had the moral courage to face gracefully. (Garner, McKee, & McKee, 2008)

High profile examples of this short term focus, to the long term detriment of the company, are numerous. Retail pharmacy firm, Rite Aid, saw several top executives indicted for inflating profits by \$1.6 billion between the years 1997-1999 and ‘conspiracy to defraud, fraud in connection with the purchase or sale of securities, making false statements to the Securities and Exchange Commission, tampering with witnesses, obstructing various investigations, conspiracy to obstruct justice, and making false declarations to a grand jury¹. Rite Aid’s accounting firm resigned as auditor. A class action suit was filed against the company in 1999² with Rite Aid paying \$195 million to settle³. Imclone, a biotechnology company, was the subject of a federal investigation launched in 2002 when Imclone did not fully disclose to investors the tenuous status of their new cancer drug. By March 2003, the SEC accused Imclone of improper accounting for stock options for the founders and required the firm to restate earnings for 2001 and possibly more years, risking delisting if they didn’t comply.⁴ Adelphia Communications filed for bankruptcy in 2002 after Federal investigators discovered that the owners hid \$100 million that they ‘borrowed’ from the company.⁵ They also were discovered to have covered up \$2.3 billion in off-balance-sheet debt. Eventually, the SEC estimated that there were \$3.1 billion paid in ‘loans’ to the owners.⁶

¹ <http://money.cnn.com/2002/06/21/news/companies/riteaid/index.htm>

² <http://www.citizenworks.org/enron/corp-scandal.php>

³ <http://money.cnn.com/2002/06/21/news/companies/riteaid/index.htm>

⁴ <http://www.fastcompany.com/magazine/86/imclone.html>

⁵ <http://www.msnbc.msn.com/id/8291040/>

⁶ http://money.cnn.com/2002/06/26/news/companies/accounting_scandals/

In perhaps the highest profile corporate scandal, Enron, an energy company claiming \$101 billion in revenues in year 2000, hid nearly \$1 billion in debt⁷ and inflated profits through off-the-books partnerships. This led to the largest bankruptcy in U.S. history at the time. In collateral damage, Enron's auditors, the premier accounting firm, Arthur Andersen, ceased to exist by August 2002.⁸

Use of firm funds for personal spending by corporate executives continued to be headlined in media accounts through 2002. In June 2002, Worldcom announced that it would have to restate its earnings, referencing nearly \$4 billion that were improperly accounted for in financial statements.⁹ Worldcom hid \$3.85 billion in losses and posted a gain for investors' view in 2001, resulting in SEC charges of fraud. The CEO 'borrowed' \$408 million from the firm. Shares of Worldcom traded at over \$64 at one point, dropping to 21 cents by June 2002.¹⁰ By September 2002, the Manhattan District Attorney charged the CEO of Tyco with stealing more than \$170 million from the firm and fraudulently earning \$430 million on the sale of shares.¹¹

For many years at these companies, top executives managed to "cook the books" to the tune of hundreds of millions of dollars for their personal gain, and used their firms as their own personal bank account. While these actions took place over time, it was not until whistleblowers came forward, that the fraud was revealed to the public. The SEC responded with a surge of investigations into corporate malfeasance from the late 1990s through 2002. (See Figure 2)

⁷ http://money.cnn.com/2002/06/26/news/companies/accounting_scandals/

⁸ <http://www.time.com/time/business/article/0,8599,263006,00.html>

⁹ http://money.cnn.com/2002/06/26/news/companies/accounting_scandals/

¹⁰ http://money.cnn.com/2002/06/26/news/companies/accounting_scandals/

¹¹ http://www.usatoday.com/money/industries/manufacturing/2005-06-17-tyco-timeline_x.htm

Many of these companies exposed during the SEC investigations were contracted with the Arthur Andersen accounting firm for auditing and other services. Andersen was the largest of the Top Five accounting firms at the time. The extremely negative media attention surrounding the activities at these client firms also tainted Arthur Andersen, leading to a complete withdrawal of clientele, the subsequent spin-off of consulting services to be renamed Accenture, and the folding of the accounting core of the company. It was suggested later that Arthur Andersen turned a blind eye to the dubious accounting practices of their clients in order to maintain the more lucrative consulting services contracts.

As newsworthy as these criminal investigations were, the impact on employees and stock holders was devastating. Stock values plummeted and hundreds of thousands employees lost not only their jobs, but also their pensions and savings in employee stock plans. The American public lost faith in the U.S. corporate world, resulting in a slump in the stock markets and a pervasive, and continuing, negative perception of the lack of ethical governance of corporations.

Sarbanes-Oxley Act of 2002 Timeline

These examples of corporate malfeasance spurred the U.S. Congress to create detailed legislation to improve the transparency of financial information. The objective of the legislation was to minimize fraud and improve financial transparency. It would hold firms, and their executives, accountable for full and accurate financial disclosures to investors, who would then be in a better position to monitor the firm. The resulting

legislation, the Sarbanes-Oxley Act, was enacted in July 2002. While much of the legislation went into effect at the time of enactment, several key sections were finalized and instituted at later dates.

By the end of August 2002, CEOs and CFOs had to personally “certify that (a) they have reviewed the report, (b) the report does not contain any misrepresentation, (c) the financial information in the report is fairly presented, (d) they are responsible for internal controls, (e) they have reported any deficiencies in internal controls and fraud involving management to the audit committee, and (f) they have indicated any material changes in internal controls” (Section 302).¹² By the end of October 2002, SOX made it unlawful to manipulate or coerce the auditor resulting in misleading financial reports (Section 303). Any restatement of earnings would result in executives returning to the company any profits made on the sale of stock during the time frame covered plus any bonuses or other compensation (Section 304). In January 2003, no independent auditor could offer non-audit services to the client being audited (Section 201).¹³

By April 2003, the U.S. Securities and Exchange Commission (SEC) was to have finalized the Public Company Accounting Oversight Board (PCAOB) including its organization and responsibilities (Sections 101(d) and 103(a)). This Board was responsible for monitoring all registered public accounting firms and setting the standards for auditing procedures. No unregistered accounting firm would be able to audit a public

¹²

[http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/\\$FILE/Timeline Stand Alone Final 2.pdf](http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/$FILE/Timeline%20Stand%20Alone%20Final%202.pdf)

¹³ Ibid.

company (Section 102(a)).¹⁴ The board was funded from fees paid by public companies, as much as \$2 million annually at some larger firms (Solomon and Bryan-Low, 2004), adding to the cost of compliance to SOX.

By November 15, 2004, most large companies had to comply with Section 404, the most costly section of SOX legislation, requiring the implementation of internal controls, an evaluation of internal controls, and an outside auditor's assessment of the effectiveness of the internal controls. By 2005, foreign firms fell under the corporate governance requirements of SOX.

In summary, Sarbanes-Oxley legislation created more stringent guidelines for independent auditors and the audited firm (Sections 102(a), 103(a), 201, 202, 203, 204, and 301), formalized executive accountability (Section 302, 304, 305/1105, 306, and 906), enhanced information transparency between the firm and investors, standardized accounting and auditing controls within the firm (Section 404(a) and 404(b)) as well as financial reporting (Section 204, 307, 401, 408, and 409), defined and discouraged conflicts of interest (Sections 201, 203, and 206) and off-balance sheet transactions (Section 401(a)), prohibited loans to executives (Section 402(a)), required reporting on insider stock transactions (Section 403), and called for a code of ethics at each firm applicable to the CFO (Section 406), expertise on Boards of Directors and Auditing Committees (Section 202 and 407), and criminal penalties for violations (Section 802 and 807).

¹⁴

[http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/\\$FILE/Timeline_Stand_Alone_Final_2.pdf](http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/$FILE/Timeline_Stand_Alone_Final_2.pdf)

Executive Summary of Sarbanes-Oxley Legislation

The Sarbanes-Oxley Act of 2002 was intended, “to protect investors by improving the accuracy and reliability of corporate disclosures made pursuant to the securities laws, and for other purposes.”¹⁵ The legislation covers public companies, domestic and foreign, listed on U.S. stock exchanges, with a few exceptions such as the mutual fund industry. The Act is divided into many sections, the most discussed sections involve mandating personal responsibility for misstatements or fraud to the CEO and CFO, and management’s design and implementation with the subsequent outside auditors’ assessment of the effectiveness of internal financial controls (the most costly and contentious requirements). As CEOs and CFOs can now go to jail for misstatements of the firm’s financial situation, they are highly motivated to install the most thorough internal controls available. These controls serve as a very costly insurance policy for the executives and the firm. To a lesser extent, key sections include disclosures required by SOX, criminal penalties for altering documents, and retaliation against informants.

Summary of Key Sections to Legislation

The following descriptions summarize what are likely the most discussed sections of the Sarbanes-Oxley Act.

¹⁵ Public Law 107-204, 116 Stat. 745

Section 302: Corporate Responsibility for Financial Reports

Section 302 placed responsibility on top executives of the firm to understand the financial statements, be accountable for their accuracy, implement and review the internal controls, and report any deficiencies to auditors. It was primarily an anti-fraud regulation within SOX and the most contentious section for executives personally. This clause also translated with great difficulty to foreign countries where personal responsibility is legally distinct from company operations.

Specifically, this section required the CEO and the CFO, or persons performing similar functions, to certify in each annual or quarterly report that they have reviewed the report, the facts are accurately represented, there are no omissions, and the facts fairly represent the operations of the firm. This section further stated that the signing officers established and maintained internal controls, evaluated the effectiveness of the controls within 90 days prior to signing the report, and reported on the evaluation of internal controls. The officers disclosed to the auditors any deficiencies in internal controls, any fraud involving management or employees with a significant role in internal controls, and any changes in the internal controls since their evaluation. The legal force of this section did not lessen if the company reincorporated or moved outside of the U.S. This section went into effect 30 days after enactment of the SOX Act.

Section 401: Disclosures in Periodic Reports

The intent of Section 401 was to bring formerly off-balance sheet transactions, invisible to the investor, back to the financial statement for all to see. This was a

common route, during the corporate scandals of the 2002 era, to hide the true financial status of the firm, as well as hide cash flow to personal bank accounts of the executives. This section amended Section 13 of the Securities Exchange Act of 1934. Financial statements, prepared in accordance to generally accepted accounting principles, should reflect all material adjustments identified by a registered public accounting firm. Reports should include all material off-balance sheet transactions that have a material current or future effect on the financial condition of the firm. Reports should not contain any untrue or misleading facts, nor omit material facts necessary to fairly present the financial condition of the firm. These rules went into effect within 180 days of the enactment of SOX.

Section 404: Management Assessment of Internal Controls

While prior sections described the evaluation of the internal controls by management, this section required the auditing firm to assess the evaluation by management of the internal controls. This section put the auditing firm in a challenging situation. On the one hand, the auditor was given an assessment by management about the effectiveness of internal controls, as well as information about any deficiencies observed by the executives of the firm. On the other hand, the auditor was required to make his or her own assessment of the internal controls not based on management's information. This section can be considered a check and balance to management's opinion.

This section also caused the greatest costs for the firm. To protect the top executives, the internal controls designed and implemented by management tended to be very costly. New software programs, procedures, policies, consultants to guide the organization to become SOX compliant, more employees in finance and accounting to handle the compliance process, and higher fees from auditing firms were the basis for the majority of the costs from the internal controls mandate. These costs, of compliance and of compliance maintenance, did not significantly decrease in later years.

Section 802: Criminal Penalties for Altering Documents

Criminal penalties, involving fines and/or imprisonment of not more than 20 years, are described for any alteration, tampering, cover up, falsification, etc. of records or documents. Any impediment or obstruction of an investigation carries the same penalties. This section also requires the auditing firm to maintain all documentation from an audit for 5 years. If an auditor does not maintain the records for 5 years, they face a fine and/or imprisonment for up to 10 years.

This section directly recalls actions of Arthur Andersen accountants during the federal investigation of several of their clients. Criminal penalties were specified, both to warn and to standardize outcomes for this type of fraud. Note that criminal penalties are outlined for both employees of the corporation and of the auditor.

Sections 806 and 1107: Retaliation against Informants

Any person who knowingly retaliates against a person who provides a law enforcement officer with true information relating to a Federal offense can be fined and/or imprisoned up to 10 years. Retaliation can take the form of harm or interference with employment or livelihood (Section 1107). Those employees who feel that they have been discriminated against due to their actions in revealing financial malfeasance may file a complaint with the Secretary of Labor (Section 806).

These sections attempt to protect whistleblowers that have notified the SEC of fraud and assisted with the investigation. Unfortunately, whistleblowers have not fared well in the years following their reporting of large scale fraud at numerous companies, both in maintaining their jobs and in their track records of promotions. According to an article in the Wall Street Journal, October 4, 2004, page A1, Deborah Solomon writes that more than 300 people have been penalized by their firms for reporting financial impropriety since the enactment of SOX, and not one has been reinstated to their old job. Conventional wisdom today suggests that a person consider very thoroughly whether to report fraudulent behavior at their company. Many suggest that changing firms might be the best strategy for most people.

Main Concern – Cost of Compliance

This key concern was probably the most contentious and most discussed ramification of SOX legislation. The single largest portion of the cost, both financially and in human resources, was lodged in creating and implementing internal controls.

These controls must provide the CEO and CFO with a high degree of confidence so that they could personally sign off on the financial statements without worrying about facing a jail term for providing false or misleading information. In the 2004 survey by Financial Executives International, total compliance costs for the first year were estimated at \$3 million for firms with \$2.5 billion in average annual revenues and approximately \$1 million for firms with \$1 billion or less in annual average revenues. Later annual compliance costs also ran into the millions of dollars (Block 2004; Engel, Hayes, Wang 2004; Zhang 2005). A 2004 survey by Foley and Lardner of 115 firms suggested that audit and reporting costs increased 130% after SOX in companies with less than \$1 billion in annual revenues. This survey additionally found that one fifth of all public firms within the US were contemplating delisting and going private.

In the years following SOX, delistings did increase (Woo 2011), while there was a drastic decline in foreign listings. John Thain (2004), then CEO of the New York Stock Exchange, attributed this decline to the costs of compliance to Sarbanes-Oxley (especially Section 404 internal control requirements), lack of convergence in US and European accounting standards, increased litigation in the US, and the increasing strength of the Euro and European capital markets.

Small Firms

As firms attempted to comply with SOX, their costs were similar in that the vast majority of firms, post-SOX, contracted with a Big Four accounting firm (now charging premiums for their auditing services), bought similar software packages, and hired

additional employees and consultants. This meant that smaller firms bore a disproportionate burden of the costs as these expenses were a larger portion of their revenues. Concern was raised that “the onerous costs of Sarbanes-Oxley...fall disproportionately on small and mid-cap companies – the very ones that provide the innovations and entrepreneurship we rely on for economic growth” (Zuckerman 2006). Wolkoff (2006) wrote in the Financial Times that “SOX has unintentionally created an environment that discourages smaller, innovative companies from accessing U.S. capital markets”.

This was a tremendous deterrent for small firms going public in an initial public offering (IPO) as they would have to add SOX to their list of expenses as a public company. The number of IPOs after SOX slumped and took several years before recovering. (See Figure 3)

Accommodations were eventually made for smaller companies. In July of 2010, small firms, defined as those with a public float of less than \$75 million (called “non-accelerated filers”) were finally exempted from SOX’ costly Section 404(b) by Congress. With these costs as substantial as they were, it will be interesting to observe the findings of researchers as to how this legislated financial drain affected firms in the long and short run.

Literature Review on SOX

Key topics discussed by researchers

The most discussed topics in the literature on SOX included: legislated requirements of the Act, especially discussions of specific sections such as 404; compliance; auditors and audits; costs/benefits; small firm concerns; and ramifications for foreign firms. Information technology and quality systems, such as ISO or Six Sigma, were discussed in terms of how they could aid with compliance to SOX legislation.

SOX Requirements

The learning curve experience with SOX regulations was lengthy and not always definitive. Sections of the legislation were written and modified some years after the initial legislation was enacted. Training and guidance from the SEC on SOX reporting was essential and continued to be discussed in the literature (Weber, Erickson, Stone 2011; Weirich and Rouse 2007). Recently, surveys have indicated that corporate accountants were finally spending less time on SOX compliance. As accountants gained experience and implemented processes to aid in compliance, they were able to shift their attention back to traditional accounting responsibilities, such as advising senior management or regulatory activities.^{16 17}

Section 404 was likely the most discussed portion of SOX legislation. This section required the auditing firm to assess the evaluation by management of the internal

¹⁶ www.protivni.com/go/rebalandng3

¹⁷ **SOX** Guidance Has Helped Decrease Compliance Burden. *Journal of Accountancy*, Sep2008, Vol. 206 Issue 3, p23-23

controls put in place by upper management. The focus was on weaknesses, or deficiencies, in the internal controls. Some of these weaknesses involved inadequate Information Technology (IT) systems that provided insufficient or incorrect information resulting in misstatements (Klamm and Watson 2009). Schneider, Gramling, et al (2009) provided a review of academic literature on internal control reporting.

The drawbacks to substandard internal controls involved higher systemic risk and higher cost of equity (Ashbaugh-Skaife, Collins, Kinney, LaFond 2009; Ogneva, Subramanyam, Raghunandan 2007), lower quality accruals (Ashbaugh-Skaife, Collins, Kinney, LaFond 2008), delays in audits (Ettredge, Sun, Chan 2006), and the potential for being dropped by a Big Four accounting firm (Duchac, Douthett, Goldberg 2006).

Audits, Auditors, and Audit Committees

The effect of SOX on audits, auditors, and audit committees is a highly researched area. From the improved quality of audits after lower quality of auditors exited the market (DeFond and Lennox 2011), or were dismissed (Ettredge, Heintz, Chan, Scholz 2011), after SOX was enacted, to technology enhancements to make auditing easier (Burnett and Friedman 2005), to advice to CEOs and CFOs on pitfalls and warning signs regarding internal controls (Paul 2010), audits/auditors/audit committees is one of the most covered topics in business research on SOX.

Auditing costs increased substantially post-SOX, especially in the creation and evaluation of internal controls at public firms. Client firms paid more for their audits, in general, post-SOX. First year discounts used to run around 24% in 2001, an incentive to

attract customers to auditing firms. Post-SOX, the Big 4 accounting firms charged a premium of 16% to new clients in 2005-2006 (Huang, Raghunandan, Rama 2009).

Material weaknesses were a key issue to be identified by auditors. Auditors were expected to identify major problems with the financial statements and internal controls independently, even while being provided information by executives who have already come to their own conclusions on issues. Numerous guidelines were created to assist auditors in their mission, including fundamental changes in policies and controls, enhanced review and monitoring of non-routine transactions, better training for auditors, hiring more personnel in accounting and finance, improved documentation and communication, new software, and hiring consultants (Hermanson, Ivancevich, Ivancevich 2008). Stephens (2011) found that the use of external auditors increased the likelihood of an internal control deficiency disclosure prior to the audit.

One of the after effects of SOX was reflected in the creation and evolution of audit committees on corporate boards. These committees grew in size, expertise, and power. As more accountants and CPAs were attracted onto boards, these boards became more conservative and more likely to support auditor recommendations for adjustments (DeZoort, Hermanson, Houston 2008), especially within strong boards (Krishnain and Visvanathan 2008). Guidelines for audit committees included clear articulation of philosophy of financial reporting, review of control processes, flexibility in processes as organizations change, and assigning of financial reporting responsibilities to specific people within the organization (Duchac, Douthett, Goldberg 2006).

Audit committees were required to be solely populated by independent directors of the board. In addition, boards of directors of publicly traded firms were required by SOX to have independent directors forming the majority of the board. This was intended to increase the impartiality of the board. Concern was expressed of the unintended consequences of this change, in that independent directors know less about the business than managers of the firm, and tend to be more conservative and cautious as they have no immediate incentive to take risks. The question raised here is whether this significant change to director independence affected the pace of recovery in a bad economy. While the markets apparently responded positively to SOX legislation in terms of improved investor confidence translated into market gains, did the markets and the economy recover as fast as they would have without the financial burden of SOX on businesses?

Along with the post-SOX emphasis on independent board members, there is an increased expectation of effort on the part of board members to ensure compliance to SOX. Increased expectations of board members have made it more difficult to attract CEOs and CFOs for board duty, as executives are less likely to agree to serve on multiple boards. Board fees increased as an incentive to attract high caliber executives, while search committees have had to look more at levels below the executives for potential candidates for boards.

Costs/Benefits

While the high financial cost of SOX compliance is the main complaint of firms, benefits have been recognized. In a 2005 survey by Oversight Systems, Inc., a firm that

monitors controls used for SOX Section 404 certification, of 222 U.S. financial executives, the majority (74%) said they have seen a benefit from SOX compliance. Specifically, there was a benefit gained in stronger internal financial controls (79%), improved accuracy of financial reports (27%), reduced error rate (31%), and a lower risk of financial fraud (33%).¹⁸

According to the same survey, shareholder value went both up and down. Investors saw value in the ethical credibility gained from SOX compliance (37%), while others (33%) suggested that the additional financial burden of SOX depressed stock value. The actual cost of SOX compliance was more than most (54%) financial executives expected. Respondents' firm size was fairly evenly distributed across greater than \$5 billion in annual revenues (25%), \$1-\$5 billion (23%), \$250 million - \$1 billion (22%), and \$250 million or less (30%).

Costs for Section 404 compliance finally went down slightly (5.4%) in 2007, according to a 2008 Sarbanes-Oxley compliance survey by Financial Executives International. Nearly 24% of all annual audit fees involve Section 404 compliance, when auditors attest to the evaluation by firm executives of the effectiveness of internal controls. Average costs to comply with just Section 404, at firms with market capitalization at more than \$75 million ("accelerated filers"), were approximately \$850,000, or 24% of average annual audit fees of \$3.5 million.¹⁹

In a 2008 research study by Krishnan, Rama, and Zhang, firms that voluntarily disclosed costs related to Section 404 compliance between years 2003 to 2005, averaged

¹⁸ Financial Executives Evaluate SOX Compliance. Strategic Finance, Jan2005, Vol. 86 Issue 7, p19-23.

¹⁹ SOX Compliance Costs Fall. Journal of Accountancy, Jul2008, Vol. 206 Issue 1, p16-16.

\$2.2 million in fees targeting labor, consulting, technology, and auditor charges. Costs increase with firm size, material weaknesses, hiring of large accounting firms, technology implementation, new CEOs, and the establishment of internal control policies (Krishnan, Rama, Zhang 2008). Guidelines provided to reduce compliance costs mainly have to do with narrowing the focus of audits to those key areas that are most problematic (Foster, Ornstein, Shastri 2006), providing a top-down, risk-based approach to the audit (O'Brien 2006), or implementing technology or quality systems such as six sigma (Martin, Juras, Aldhizer 2006).

Small Firms

While all public companies saw a substantial increase in both human resource and financial costs due to SOX, small cap public firms experienced an increase in audit costs of over 300%, or about an additional \$1 million, annually mainly in the form of audit fees, board compensation, and legal fees.²⁰ Small firms, those with sales less than \$1 billion, often have more material weaknesses in their internal controls than larger firms (Foster, Ornstein, Shastri 2007) due to lack of resources which also increases costs for compliance. Costs, necessary to comply with Section 404 (internal controls), alone at small companies were estimated in 2006 to be in the \$3 million range.²¹

Overall, SOX reduced the market value of small firms (Iliev 2010) by draining funds. According to a 2006 survey funded by SAP, an enterprise resource planning (ERP) software provider, small companies were cutting back on expenditures for

²⁰ SOX Costs Sock Small Firms. Information Management Journal, Mar/Apr2008, Vol. 42 Issue 2, p14-14.

²¹ Small Firms Seek Different SOX Rules. Information Management Journal, Jan/Feb2006, Vol. 40 Issue 1, p6-7.

research, marketing, and on personnel to pay for compliance costs. Almost half of those surveyed stated that SOX made it more difficult for them to conduct business. More than half of the respondents said that cost was the biggest issue.²² In the year 2005, the SEC addressed the difficulties small firms had to comply with SOX by extending compliance deadlines for small companies (less than \$75 million in public shares) to July 2007. In July of 2010, small firms were finally exempted from SOX' costly Section 404(b) by Congress.

Guidelines were produced by numerous sources for small companies' compliance efforts (Devonish-Mills 2008; Cozad 2005). These suggestions included 26 fundamental principles developed by the Committee of Sponsoring Organizations of the Treadway Commission, which is funded by the major accounting industry groups. The guidelines targeted key components of internal control.²³

Conclusion

The Sarbanes-Oxley Act of 2002 comprised regulatory legislation intended to reduce fraud within public companies traded on U.S. stock exchanges. The Act mandated and standardized internal financial controls within firms, gave top executives personal responsibility for the accuracy and thoroughness of the reports - with financial and criminal penalties attached, and redefined the auditing firm's relationship with the client. As a result, investor confidence appeared to improve, after a drastic market slump during the corporate scandals of 2002. Contrarily, SOX created an unexpectedly high

²² Ibid.

²³ Ibid.

financial burden on compliant firms, detrimentally affecting small and foreign firms most significantly.

While no public firm initially would have embraced SOX regulations voluntarily, mainly due to the regulatory costs, they adapted over several years and generally came into compliance. Benefits of improved financial reporting, reduced chance of fraud, and apparently improved investor confidence have been significant enough to convince even some private firms to look into becoming compliant (Bradford and Brazel 2007).

The continuing financial drain, of initial compliance and annual maintenance, is worrisome. The extended ramifications of SOX compliance are not yet fully understood. The funds are being drained from other resources and it is not yet clear how the restriction of these other resources will affect the firm in the long term. A lingering question remains as to whether the market would have recovered faster without the heavy financial burden of SOX on industry. Has SOX discouraged firms from going public, or from listing on U.S. exchanges? Will SOX compliance dampen economic dynamism, through conservative boards of directors, burdensome regulations, and high costs of compliance?

It is likely that the unintended consequences of SOX are significant, if not fully identified yet. The challenge will be to measure the long term costs and benefits of SOX, and the resulting impact on the economy.

CHAPTER 2. SOX AND THE IPOs OF RESEARCH INTENSIVE FIRMS: RAMIFICATIONS OF THE SARBANES-OXLEY (SOX) ACT

Introduction

This study looks at the relationship between research intensity and the act of going public before and after the enactment of The Sarbanes-Oxley Act of 2002 (SOX). We look at research intensity, as a measure of research activity at research intensive firms, longitudinally before and after firms go public. We then compare patterns in this activity in firms going public before and after SOX.

Sarbanes-Oxley (SOX) corporate governance legislation was enacted in the United States in 2002 [Public Law No. 107-204], as a result of several high profile corporate governance failures at large public firms. The intent of the SOX Act was to enhance the information transparency between firms and investors, with the expectation that numerous investors were better positioned than the U.S. Securities and Exchange Commission (SEC) to more effectively monitor the firm and the firm's executives when investors have easier access to information about the firm. The widespread concern with this Act was the high cost, in the millions of dollars, to implement and maintain compliance annually at public firms listed on U.S. exchanges (Block, 2004; Engel, Hayes, & Wang, 2004; Zhang, 2005).

The enactment of SOX imposed costs on all public firms, but there was considerable anecdotal evidence that it disproportionately affected smaller firms. In particular, "the onerous costs of Sarbanes-Oxley...fall disproportionately on small and

mid-cap companies – the very ones that provide the innovations and entrepreneurship we rely on for economic growth” (Zuckerman, 2006). The assets of small, research intensive firms are concentrated in intangibles that are hard for the market to value and collateralize (Lev, 2001; Mudambi, 2008). Therefore, research intensive firms are more likely to be liquidity constrained. Following this line of reasoning, we suggest that SOX-related costs are more significant for research intensive firms looking to go public, especially small research intensive companies, and yet these are the firms most important to the national innovation system (Lundvall, 2007). It is possible that this unintended consequence of SOX may harm long term economic growth.

This work extends disclosure and information asymmetry research by exploring the unintended outcomes of mandated disclosure and the associated costs. The paper focuses on whether enhanced disclosure requirements and costs, in terms of opportunity costs, place a heavier burden on smaller, entrepreneurial, research intensive firms, forcing them to rethink whether they will seek capital on public exchanges through an initial public offering (IPO), the traditional route to raising funds in market economies.

This paper is structured as follows. Following the introduction we introduce the reasoning behind the enactment of SOX. Following this, we introduce the cost considerations brought about by SOX legislation. Next we present our propositions, our evidence to support our theory in a comparison of IPO firms’ research intensity and patenting activity before and after SOX legislation enactment, followed by our results, and a discussion of the results. We speculate on the decision process for going public at research intensive firms and present a model concerning the likelihood of research

intensive firms going public in the current U.S. disclosure environment. A “3Ds” model of divert, delay, or dismiss the idea of going public presents a holistic view of alternatives available to a research-intensive firm facing mandatory disclosure costs. Finally, we conclude, discuss limitations to the study, and suggest avenues for future research.

SOX Legislation

Two crucial events affected the initial public offering (IPO) markets in the early 2000s: 1) the Sarbanes-Oxley Act of 2002 (SOX) which followed 2) the “bursting” of the “Internet Bubble” in 2001. The number of IPOs in the U.S. ramped up over the few years leading to the bubble, after which IPO activity dropped precipitously (Figure 3). IPO activity remained more subdued for several years, under adverse market conditions, following the bursting of the bubble.

SOX increased the costs of going public at a time when the IPO market was relatively depressed, due to a number of factors that included high oil prices, a manufacturing recession, corporate governance scandals, fears of terrorism associated with “9/11”, in addition to the Internet bubble bursting. “SOX has unintentionally created an environment that discourages smaller, innovative companies from accessing U.S. capital markets” (Wolkoff, 2006). The issues at hand are the high costs of SOX, the effect of SOX costs on small firms versus large firms, the effect on highly innovative research intensive firms versus non-research intensive or less prolific research intensive firms, and the consequences this has for innovation within the U.S.

SOX Background

From a historical perspective, in the more than two decades prior to the enactment of Sarbanes-Oxley corporate governance legislation, investors saw steady and significant growth in the U.S. stock market (Figure 1). Investors' portfolios were heavily weighted with stocks. Institutional investors wielded considerable clout with their portfolio firms. As stock valuations grew, incentives for firms' top executives became tied to the firm's stock performance as a measurement of management effectiveness. Quarterly stock performance as a corporate objective dominated disproportionately over longer term corporate performance. Executives became uniquely focused on performance measurements that enhanced the value of their personal stock options, particularly as stock options became the incentive of choice within Boards of Directors to compensate their top executives. Pressures to perform in the short run led to ethical challenges which not all executives had the moral courage to face gracefully. (Garner, McKee, and McKee, 2008)

Rite Aid, Imclone, Adelphia Communications, Enron, Worldcom, and Tyco were among the firms targeted by the SEC, primarily in 2002, for corporate governance transgressions (Figure 2). These and other examples of corporate malfeasance, measuring in the many billions of dollars, spurred the U.S. Congress to create detailed legislation to improve the transparency of financial information. The objective of the legislation was to hold firms, and their executives, accountable for full and accurate financial disclosures to investors, who would then be in a better position to monitor the firm. The resulting legislation, the Sarbanes-Oxley Act, was enacted in July 2002. While

much of the legislation went into effect at the time of enactment, several key sections were finalized and instituted at later dates.

By the end of August 2002, CEOs and CFOs had to personally “certify that (a) they have reviewed the report, (b) the report does not contain any misrepresentation, (c) the financial information in the report is fairly presented, (d) they are responsible for internal controls, (e) they have reported any deficiencies in internal controls and fraud involving management to the audit committee, and (f) they have indicated any material changes in internal controls”.²⁴ Any restatement of earnings would result in executives returning to the company any profits made on the sale of stock during the time frame covered plus any bonuses or other compensation. In January 2003, no independent auditor could offer non-audit services, from a list of nine specific kinds of non-audit services, to the client being audited.

By April 2003, the U.S. Securities and Exchange Commission (SEC) finalized the Public Company Accounting Oversight Board (PCAOB), including its organization and responsibilities. This Board was responsible for monitoring all registered public accounting firms and setting the standards for auditing procedures. No unregistered accounting firm would be able to officially audit a public company.

Sarbanes-Oxley legislation created more stringent guidelines for independent auditors and the audited firm. It formalized executive accountability, enhanced information transparency between the firm and investors, standardized accounting as well

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[http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/\\$FILE/Timeline_Stand_Alone_Final_2.pdf](http://www.pwc.com/Extweb/NewCoAtWork.nsf/docid/D0D7F79003C6D64485256CF30074D66C/$FILE/Timeline_Stand_Alone_Final_2.pdf) (04/14/09).

as financial reporting within the firm, defined and discouraged conflicts of interest and off-balance sheet transactions, prohibited loans to executives, and required reporting on insider stock transactions. SOX called for a code of ethics at each firm, financial expertise on Boards of Directors and Auditing Committees, and defined criminal penalties for violations.

SOX Costs – Disclosure and Auditing

The concern about SOX focused on the heavy financial and regulatory costs imposed on publicly traded companies. The high financial costs of SOX compliance have been confirmed from numerous surveys (e.g. Financial Executives International, January 2004). Initial compliance costs were identified in the FEI 2004 survey at \$3 million for firms with \$2.5 billion in average annual revenues and approximately \$1 million for firms with \$1 billion or less in annual average revenues. These numbers were augmented by the high annual compliance costs running into the millions of dollars (Block, 2004; Engel, Hayes, & Wang, 2004; Zhang, 2005).

Concern was also voiced soon after enactment that SOX imposed disproportionately higher costs on smaller companies. Further, in reviewing the FEI 2004 survey results, researchers suggested that these costs could be a significant deterrent to going public (Stephens and Schwartz, 2006). Several SOX requirements were required to be in place prior to the IPO; others had to be in place within some months of the IPO. Consequently, costs faced by firms going public are distinctly higher in the post-SOX period relative to the pre-SOX era.

Challenges presented by SOX were numerous. First, new corporate governance regulations in SOX required that companies appoint independent audit committees and disclose the identity of the “financial expert” on the committee. Small companies could be expected to face particular difficulty in recruiting such directors. Under Section 302 of SOX, CEOs and CFOs were required to certify (every quarter) the reliability of their financial statements and the effectiveness of internal control over financial reporting.

Second, Section 404 of SOX, perhaps the most controversial part of the Act because of its alleged high compliance costs, required managements to provide a report on the effectiveness of internal controls over financial reporting and auditors to conduct internal control audits and express an opinion on management’s report as well as the effectiveness of such internal controls.²⁵ Newly public firms were required to comply with Section 404 one year after going public. Studies on costs of Section 404— arising from both management compliance and auditor fees - faced by public companies (e.g., Hogan and Wilkins 2008; Hoitash et al. 2008) suggested that IPOs would also be significantly impacted soon after going public if not sooner.²⁶

Third, although SOX did not introduce new accounting standards, it did require some expanded financial disclosures, for example, off-balance sheet transactions. In

²⁵ Section 404 differed from Section 302 in that it laid out detailed requirements for managements to document and report on the internal controls. The requirement in Section 404 that auditors attest to management’s report was removed in 2007.

²⁶ During the initial period of implementation of Section 404, small companies (i.e., those with public float less than \$75 million, called “non-accelerated filers”) were exempt from the audit requirement with the expectation that they would be required to comply by April 15, 2005. This compliance date was repeatedly postponed. However, the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 has now permanently exempted non-accelerated filers from internal control audits. To the extent IPOs are likely to be non-accelerated filers, the Dodd-Frank Act has removed the added audit costs relating to internal control audits. During our sample period, however, the audits were certainly expected to go into effect (Olson 2007).

addition, companies that provided proforma financial information (and non-GAAP financial measures) had to present reconciliations of these measures with the “financial condition and results of operations of the company under Generally Accepted Accounting Principles”²⁷.

As discussed, the above requirements would likely adversely impact all IPOs, but we conjecture that research intensive firms are likely to be disproportionately affected. Young research intensive firms going public are often characterized as having high asset values but low revenues. These often cash-strapped firms are the most burdened by increased regulatory costs, which can drain funds from research and redirect cash to compliance. Adverse effects may also arise from the perceived greater costs of disclosure and scrutiny from regulators.²⁸ Research intensive firms, that measure considerable firm value in intangible assets such as research discoveries and capabilities, are reluctant to disclose proprietary information regarding their research capabilities and innovations, as these are the unique assets that drive higher market valuations and long term competitive advantage (Audretsch, 1991; Banham, 2005; Mudambi and Zahra, 2007).

Arrow Paradox. Much of the value of information is in the control of the information. Once distributed, knowledge can never be retrieved and loses value for the originating firm. Research intensive firms place great value in their proprietary

²⁷ <http://www.sec.gov/news/press/2003-6.htm>

²⁸ Accounting standards require complete expensing of R&D expenses. However, the accounting for intangible assets (such as copyrights, in-process research, proprietary technology, specialty expertise, patents, trademarks, and trade secrets) is complicated. The Financial Accounting Standards Board (FASB) Statement no. 142, *Goodwill and Other Intangible Assets*, which became effective in 2001 is likely to have further complicated financial reporting for research intensive firms.

information. They control the dispersion of information to maximize the investment value while minimizing the risk of freely dispersing information (Arrow, 1962).

While investors understand the value of keeping proprietary information within the firm if the firm intends to act upon the information and gain profit from it, the markets are unable to place proper value on a firm going public without information on these intangible firm assets. This paradox creates the differential burden on research intensive firms going public in signaling to the market accurate firm value yet disguising proprietary, intangible information that the firm relies on for future value.

The higher disclosure cost and risk for research intensive firms versus non-research intensive firms is a concern ignored by most disclosure advocates. In addition to any agency-related costs derived from increased monitoring and increased costs of legal litigation – costs commonly discussed by disclosure advocates, research intensive firms are highly sensitive to the protection, and costs of protection, of proprietary information. Technology that is not easily codified is easiest to protect. Where technology can be codified, one way to protect the information is to describe it as obscurely as possible. This is a time consuming task, typically undertaken by experts who know what level of information is important to indicate value for the innovation, but can determine which information is proprietary and needs to remain secure within the firm. Therefore, this is an additional cost in time and effort of disclosure requirements, the act of achieving “security through obscurity”, or “black-boxing” the technology. Since the enactment of SOX, the financial costs of compliance and the effect of the unintended outcomes of disclosure have become more relevant. The opportunity costs of funds redirected to

compliance from research and development and the substantial financial costs of disclosure can put investment in corporate research at risk – the very foundation of long term firm success and the driver of many nations’ economic prosperity (Lundvall, 2007; Grossman and Helpman, 1994; Romer, 1994).

Propositions

Research intensive firms value innovation as the driver to greater profits and sustainable, long term prosperity of the firm. These firms try to attract and nurture creative thinkers, knowledgeable experts, and proven researchers in an effort to maximize the potential for successful innovation and development of novel technology. By hiring well, providing appropriate facilities for research, and closely managing the innovation process, research intensive firms attempt to optimize innovation opportunities.

Even so, research may not always reveal the expected results. Fung (2006) demonstrated that research and development firms tend to have greater stock price volatility due to the uncertain outcomes from research efforts. There is a certain amount of risk in the innovation process and a higher level of risk from investors’ viewpoints when evaluating research firms, particularly since most investors probably do not fully understand the technology involved. This heightened risk factor detracts from the attractiveness of research intensive firms especially when compounded with adverse market conditions. Under adverse market conditions, research intensive firms can be passed over for firms performing with greater predictability.

During the time frame studied, markets were reflecting a manufacturing recession, skyrocketing oil and natural gas prices, loss of investor confidence after corporate governance scandals, the bursting of the Internet bubble, and the detrimental effect on consumer confidence from the terrorist attacks of 2001. Included among the adverse market factors were the financial and opportunity costs of SOX. While no firm would be enthusiastic about going public under adverse market conditions, we would expect that research intensive firms, with higher risk factors and less predictability in results, would be less likely to go public in adverse stock market conditions than non-research intensive firms.

Research intensive firms tend to funnel available funds toward research and development as a strategic priority. Smaller and younger research intensive firms often have fewer financial resources, as technology takes time to develop and revenue generating sales do not typically occur immediately. The opportunity cost is great for research intensive firms if funds earmarked for research efforts are redirected toward SOX regulatory compliance. Initial SOX compliance costs run in the millions of dollars, augmented by the high annual compliance costs running into the millions of dollars (Block, 2004; Engel, Hayes, and Wang, 2004; Zhang, 2005). The burden is particularly heavy for smaller, less financially capable, research intensive firms to pay these extraordinary costs.

Research intensive firms have some advantages over non-research intensive firms. Population ecology literature suggests that young, entrepreneurial, technology firms tend to have a greater likelihood of survival (Agarwal and Audretsch, 2001; Audretsch 1991).

For small firms, high innovation rates characterize higher survival rates, while low innovation rates lead to lower survival rates (Audretsch, 1991). Higher innovation rates are often sustained by a high level of patent activity (Ashton and Sen, 1988). If highly innovative, research intensive firms decide to avoid SOX, and the related opportunity cost of SOX on innovation, we should see a decrease in research intensity and patent rates in research intensive firms going public after SOX. The financial drain of compliance costs of SOX would depress innovation rates as funds are funneled away from research and towards compliance. While there would likely be a transition period until more financially stable, research intensive firms start to budget for SOX compliance costs prior to going public, the substantial cost to small, cash-strapped, research intensive firms would continue to be an impediment to initiating an IPO. This leads us to our first proposition.

P1: The deterrent effect of SOX-related costs on the going public decision will be stronger for research intensive firms as compared to non-research intensive firms.

P1a: This effect will be particularly pronounced among smaller firms.

Comparison of IPO Firms' Research Intensity and Patent Activity Before and After SOX

Legislation Enactment

Highly innovative, research intensive firms, as we define here, are those firms with a higher rate of research intensity and innovation as indicated by patent activity

(Ashton and Sen, 1988). One might also consider these as “higher quality” firms, firms that invest effectively in research with a longer term pay-out in competitive advantage (Audretsch, 1991).

Research intensive firms commit more resources toward research and development than non-research intensive firms. Research intensity was calculated as the proportion of research and development expenses when compared to overall Selling, General, and Administrative expenses (SGA). To differentiate more highly research intensive firms from firms with lower research intensity, we defined those firms that committed over 8%, the average research intensity in this data set, as high research intensity firms.²⁹

In this study, we looked at two measures, an input and an output. The input was research expenditures as compared to SGA expenses. The output, resulting from research and development efforts, was the number of patents granted. Patent activity can be used to measure the effectiveness of research spending as well as represent a rough measure of the innovativeness of the firm (Ashton and Sen, 1988). The volume of patent activity can be used to differentiate a highly innovative firm from a relatively non-innovative firm, within the broader category of research intensive firms.

All firms with patent histories were gathered from a data set of all firms that went public from 1999 through 2004. A ranking of industries that exhibited the most patent activity during this period, as a percentage of total patent activity, can be seen in Table 1. A breakdown of IPO firms in specific industries with patenting activity over the two

²⁹ The OECD 2007 report uses a similar figure of 9% research intensity for high technology firms.

specific time frames studied can be seen in Table 2. A total of 387 firms, out of nearly 1200 firms that went public, had patenting activity prior to or within four years after their IPOs. The patent existence data used for the initial data cut was collected up to year 2006.

We compared firm patenting activity in all of the industries in which patenting occurred, grouped as follows by industries with the highest volumes of patents over the time frame of 1999-2004; Software, Biotechnology, Electronics, Medical Technology, Computer Hardware, and Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.). We further divided the patenting activity into four categories; 1) total number of patents prior to the IPO, 2) number of patents in the 12 months prior to the IPO, 3) number of patents in the 12 months after the IPO, and 4) number of patents in the four years after the IPO. From this breakdown, we expected to determine if some signaling to the market was occurring immediately before the IPO. Patent activity could be used to signal value of the firm, in terms of technological know-how and innovation, to potential investors. Despite the expense to the firm of patent applications, legal review, and patent maintenance, the return to the firm from the patenting effort in the form of greater investor enthusiasm and increased market value would be anticipated at, as well as after, time of IPO.

In terms of general patenting trends during this time frame from all private and public sources, the total number of patent applications continued to increase from 1996 through 2008 while the number of patents granted remained relatively steady with a slight dip in year 2005 (Figure 5). The rate limiting factor for patent grants during this

time frame was apparently the steady state supply of patent examiners even while the volume of patent applications rose. Another patenting trend involved foreign versus domestic patents granted. In 1996, foreign patents were 43% of the mix of foreign versus domestic patents granted. This percentage crept upwards and by 2008, foreign patents granted became the majority (50.3%). During this time, the volume of both domestic and foreign patents was increasing. (Figure 6)

Evidence

Research Intensive Firms

For those firms going public, for which we found Compustat data, the breakdown of research intensive firms versus low or non-research intensive firms over the time frame of 1999-2004 is depicted in Figure 4. Research intensity was measured as Research and Development (R&D) expenditures divided by General, Sales, and Administrative expenditures. Eight percent was chosen as the differentiating factor between high research intensity and low research intensity as it was the average point, at or above 8% was considered to be highly research intensive (OECD, 2007). While this was a somewhat arbitrary measure, it provided a relative standard against which to measure for pre- and post-SOX research intensity. Additionally, research intensity has been positively related to patent activity (Scherer, 1965; Brouwer and Kleinknecht, 1999), which we used as an output measure of innovation in this research.

Figure 6 shows the surge in research intensive firms going public during the “hot” market period of the Internet Bubble (1999-2001). After the bubble burst (year 2001

onward), the firms going public were fairly evenly split between research intensive and low or non-research intensive firms, even when the market started to recover in 2004. The fall-off also coincided with the passage of SOX. While the attractive IPO market of the Internet Bubble likely explains the proliferation of research intensive, software development and Internet start-ups going public, the pattern of spending on research and patenting pre- and post-SOX provided more fine-grained information on firms' innovative activity around the IPO event. We explored whether characteristics of research intensive firms going public after SOX changed fundamentally from the previous era. In particular, did the 'quality' of research intensive firms going public change post-SOX?

Table 3 indicates average research intensity at small, medium, and large firms going public before and after the enactment of SOX, focusing on firms with patent activity. In the majority of cases, across all sizes of firms, research intensity declined substantially at firms that went public after SOX. Research intensive firms apparently compensated for the increased costs of going public under SOX by reducing their research expenses or less research intensive firms went public after SOX.

Table 3 also looks at the percentage of firms with patenting activity out of the total for the first three quarters of 1999 versus the first three quarters of 2003. Pertaining to small firms (\$0-\$20 million in sales/year), 9% of all IPO firms were small and had patenting activity prior to SOX, while no small firms had patenting activity after SOX. Among medium size firms (\$20-\$100 million/year), 15.5% were medium size firms with patenting activity prior to SOX, while about 10% were medium size firms with patenting

activity after SOX. Among large firms (>\$100 million/year), 2.5% were large with patenting activity prior to SOX, while about 11% were large with patenting activity after SOX. This statistic suggests that larger firms were more able to continue patenting activity after going public under the new, expensive regulatory environment.

Table 4 is a summary table showing the average number of patents per small, medium, and large patenting firms in different industries, before each firm's IPO and for four years after their IPO. This average patent count per firm was used as a patent intensity measure. One of the first striking aspects of the summary table was the tremendous reduction in the number of firms with patenting activity after SOX. The pre-SOX time frame included all patenting firms (N=64) going public in the first three quarters of 1999. The post-SOX time frame included all firms with patents (N=6) going public in the first three quarters of 2003.

While we were focusing on the time frame around the enactment of SOX, the pre-Sox years of 1999 into 2001 were considered to be "hot" IPO market years, while the following years through 2004 exhibited adverse stock market conditions. We suggest that the implementation of such a costly regulatory act such as SOX contributed to the adverse stock market conditions in those later years, especially at research intensive firms, due to the potential opportunity cost of funneling significant funds to compliance efforts rather than research endeavors.

While the volume of patent applications went up in total from all sources over this time frame (Figure 4), patenting activity at these IPO firms actually decreased post-IPO. This suggested that there was an unexpected drop in innovation after going public post-

SOX, despite the influx of funds from the IPO. This, along with the decrease in research intensity at all sizes of firms after SOX, supports our first proposition, that the deterrent effect of SOX-related costs on the going public decision will be stronger for research intensive firms as compared to non-research intensive firms.

In summary, the research intensity at patenting firms, and the number of firms with patenting activity, all declined after the enactment of SOX. Small firms tended to have the lowest patent rates in general after SOX. This supports Proposition 1a: this effect is particularly pronounced among smaller firms.

Discussion

While IPO volume overall decreased in the years following the Internet Bubble of 2000, firms with demonstrated patenting capabilities also decreased in the IPO pool. This was during a period when overall patent application volume was increasing. Across industries, research intensity, the proportion of funds spent on research versus general, administrative, and selling expenses, decreased substantially after SOX.

While these findings are exploratory, they are suggestive of a shift in research spending. It is likely that SOX, the largest financial burden uniformly imposed on public firms in that time frame, draws off funds from research as finances are redirected toward regulatory compliance. Where are these research intensive firms? Are they delaying, diverting, or dismissing/deferring the idea of going public?

The Decision Process for Going Public at Research Intensive Firms

Research intensive firms, both domestic and foreign, have alternatives when they evaluate the decision to go public. First, these firms can decide to delay their IPO. This delay would give firms time to further develop their innovative products, bringing them closer to commercialization prior to going public, and delay the costs of listing. The firm is then able to build revenues to pay for the cost of SOX compliance and go to market with new products sooner after going public. Sources of bridge funding, such as from government and venture capital, can be pursued to finance the research intensive firm until the costs can be managed and the IPO undertaken. Some of this funding is often more available to technology firms than to non-research intensive firms, including government grants from Small Business Innovation Research (SBIR), National Institutes of Health (NIH), and the National Science Foundation (NSF). Research firms are also more attractive to venture capitalist and angel funding.

Additionally, innovative technology firms are attractive alliance targets for their unique technology. Strong alliance partners signal to the competition that they will make every effort to protect the technology controlled within the alliance agreement, particularly through supplying resources to black-box the technology and the legal support to protect it from plundering by competitors. Overall, innovative, technology firms are well positioned to seriously look at IPO alternatives.

The delay decision is a fundamentally different decision than divert or dismiss strategies. Delaying the IPO certainly does not eliminate going public as an eventual strategy, it just puts the event off until sometime in the future when the firm is more fully

prepared for the activity. This is also a strategy that is difficult to measure as these delays are typically not captured in the public realm.

Second, research intensive firms can divert their IPOs to foreign markets where they would be unfettered by SOX regulations. Public firms can still operate in the U.S. but are not required to comply with SOX mandates if the firms went public on a foreign exchange, if they are below \$10 million in assets, and have no more than 499 of shareholders. One of the concerns with diverting to a foreign exchange is how to control the number of shareholders once the shares are in the public domain (Partigan and Kamlet, 2008).

Third, research intensive firms may conclude that the overall benefits of going public no longer outweigh the costs. They can decide to remain private or be acquired by another firm, and dismiss the IPO as a strategic undertaking for their firm or defer the decision to a later date. Investment banker Stephen Fletcher, of Perseus Group, predicted a trend away from going public and toward merger and acquisitions (M&A) in 2006 due to the high costs of SOX. This M&A trend was observed by researchers (Stephens and Schwartz, 2006). This shift in strategy was reflected in the diminished presence of biotech, bio-pharmaceuticals, and medical technology companies in the IPO market from 2004 to 2005 (Borrell, 2006).

When the disadvantages outweigh the advantages of going public, firms also have the option to turn their strategic objective to organic growth, supporting firm growth through internal operations, look for equity funding from an alliance partner, be acquired

or partially acquired, or sell the intellectual property – an asset held more often by research intensive firms versus non-research intensive firms.

There is benefit to the entrepreneur in maintaining managerial autonomy by remaining private. In some IPO cases, such as Microsoft, eBay, and Google, the entrepreneurial founder retained sufficient share ownership to maintain control of the direction of the growing firm. In many IPO situations though, the founder ends up with less than 1 or 2% of the firm once several rounds of funding by angel investors, venture capital, and finally the IPO event occur.

The “3Ds” model of delay, divert, and dismiss or defer provides realistic options for firms unwilling to face the increased burden of cost imposed by SOX. Unfortunately, the opportunity cost to the firm for not going public may be found in reduced access to funds necessary for growth.

For research intensive firms, more than non-research intensive firms, SOX presents certain disincentives to going public: the high cost of implementation and compliance, the related opportunity cost of redirecting funds from research and development into SOX compliance, and any concerns about accurately placing value on the firm while protecting proprietary information. If we summarize graphically the conditions leading up to the enactment of SOX, then look at the alternate options for fund-raising among research intensive firms, the IPO decision tree might look similar to the model in Figure 7.

Conclusion

The decision-making process for firms going public has increased in complexity with the enactment of the Sarbanes-Oxley corporate governance legislation. The Act imposed additional administrative and financial costs for all firms that initiated the process of going public. However, it placed a particularly heavy burden on research intensive firms, especially smaller firms, due to the opportunity costs of incurring expenses for disclosure compliance versus spending on research and development. Ultimately, funding for SOX compliance draws from funds that would have gone towards research and development at research intensive firms, constraining R&D progress.

Research intensive firms considering going public can take a “3Ds” approach and delay their IPO until they are closer to commercialization, avoiding the immediate costs of SOX and reducing the competitive risks associated with the leakage of sensitive intellectual property during the going public process. Alternatively, they can dismiss or defer the decision to go public and pursue funding through other sources. Finally, they can divert their IPO to a foreign exchange with less costly and less stringent disclosure requirements. U.S. firms going public on foreign exchanges today benefit from the expansion of globalization and the surge in privatization and industry growth in Asia. Foreign capital markets have dynamic and increasing levels of activity with the participation of global investors, increasing their attractiveness for U.S. firms seeking to go public. Currently for U.S. firms, the London Stock Exchange and London’s Alternative Investment Market are likely to be most attractive due to their high standing among world exchanges, closer proximity, the relatively small time zone difference with

the U.S., similar business practices, and the common use of the English language. This would suggest that U.S. firms diverting their IPO to a non-SOX regulated exchange are most likely to consider London. We see in Figure 11 that there was a surge in firms from the US going public on the London Stock Exchange starting in 2003. Whether highly innovative firms diverted to foreign exchanges, delayed their IPO event, or dismissed/deferred the decision to go public should become evident in later years.

Current and Future Consequences

Disclosure mandates imposed by SOX legislation have increased the level and accuracy of information available in the market. This has benefited shareholders and enhanced the ability of investors and government agencies, such as the Securities and Exchange Commission (SEC), to monitor public firms. However, a change in the mix of firms in the IPO market over time will have serious policy implications. If U.S. research intensive firms delay their IPOs, this may inhibit their growth and development, making them vulnerable to being upstaged by foreign competitors. This has implications for long term U.S. competitiveness. While deterring fraud and buttressing investors' faith in the markets is an important policy priority, this may impose a cost on the economy if it unintentionally inhibits innovation. Research-intensive, high technology firms are particularly important for the long term robustness of the national economy (Lundvall, 2007; Grossman and Helpman, 1994; Romer, 1994).

Limitations

The limitations to this study include the use of summary figures and tables to identify a general trend in firms' decision to go public. A more detailed, empirical, follow up study would develop this phenomenon further and reveal contributing factors in the decision-making process. A survey of key decision-makers at research intensive firms going public would provide first hand observations into the IPO decision process post-SOX. Another limitation of this study includes the relatively brief number of years prior to and after the enactment of SOX. It will be revealing to observe longitudinally whether firms discover how to manage costly SOX disclosure requirements without detriment to innovation and long term competitiveness.

There are a number of confounding factors during this time frame leading to a "heating" then a "cooling" of the IPO market, such as the dot.com bubble bursting in 2000-2001. Adverse market conditions, to which SOX contributed, versus "hot" market environments come into play here in the going public decisions of highly research intensive versus less research intensive firms. An empirical, longitudinal study might disentangle the effect of these factors on IPO activity and provide greater insight into the rise and fall in the activity of research intensive firms going public.

Future Research

This policy study lends itself to further empirical testing. Studying the data on firms entering into the initial public offering process in the years prior to 2002 and after 2002 would bring to light factors contributing to the IPO decision, such as what role the

industry has on the decision to go public after SOX, financial capabilities, and possible age of firm influences, etc. It would also be of interest to compare this activity trend after the enactment of SOX with a parallel response from firm activity on foreign exchanges to confirm the viability of firms' decision to divert to foreign exchanges from US exchanges.

CHAPTER 3. RAMIFICATIONS OF SARBANES-OXLEY REGULATORY COST ON RESEARCH FIRMS GOING PUBLIC

Introduction

Sarbanes-Oxley (SOX) corporate governance legislation, encompassing foreign and domestic firms listed on the U.S. stock exchanges, was enacted in July of 2002 [Public Law No. 107-204]. Several sections of the Act were added, modified, or executed, in later months and years. Since this regulation went into effect, the ramifications of the legislation continue to become apparent.

One of the negative outcomes most discussed in the literature was the unexpectedly high cost of compliance (Block 2004; Engel, Hayes, Wang 2007; Zhang 2005). The cost burden was magnified with the implementation of more comprehensive internal controls (Section 404) and was an unintended consequence of mandating personal responsibility for full and accurate financial statements to the top executives of the firm, typically the CEO and CFO (Section 302). With the intent to avoid the criminal penalties outlined in the Act for financial misstatements, top executives instituted costly new procedures, implemented expensive software programs (Klamm and Watson 2009), hired additional accounting and finance personnel (Hermanson, Ivancevich, Ivancevich 2008), attracted new outside Board members with accounting expertise (DeZoort, Hermanson, Houston 2008), and generally devised as thorough a reporting process as possible to insure compliance with the SOX Act (Duchac, Douthett, Goldberg 2006). These steps, which often included switching to a more credentialed, but more expensive,

Top Four accounting firm for auditing services, increased the cost of financial reporting by millions of dollars across large and small firms.

As this cost was an added burden to public firms listed on U.S. exchanges, we raise the question, from where were funds being siphoned to pay for compliance? What operations of the firm were impeded as a result of shifting funds to pay for SOX compliance? Larger firms were expected to absorb these additional costs more easily. Smaller, less financially robust, firms would have had to significantly modify business practices to adjust to this imposed cost burden. Either way, it was unknown how, and to what degree, this financial burden would impact operations in both large and small firms.

Public firms, with an eye on their stock value, would want to hide the impact of SOX compliance from investors, to maintain high stock valuations. As such, funds would likely be drawn from areas of the firm that do not have an immediate impact on the stock valuations. These targeted resources would be linked with long term results, rather than short term, immediate results. If so, the most likely and vulnerable candidates for reduced funding would be “future projects”, Marketing, Research, and Human Resource activities (Swartz 2006).

We chose to focus on Research and Development activities as these often contribute substantially to future revenue growth in the lifetime of the firm (Chan et al., 2001 and Lev et al., 2005). Funded research typically is expected to produce results in a somewhat nebulously defined “future”, accompanied by a level of uncertainty as to the timing and eventual success of achieving the objectives. Resources targeted for research on future product innovations would be likely candidates for short term funding

reductions, at least until regulatory compliance was attained and maintained within standard accounting procedures of the firm.

In addition, the assets of small, research intensive firms are concentrated in intangibles that are difficult for investors to value and collateralize (Lev 2001; Mudambi 2008). Therefore, research intensive firms are more likely to be liquidity constrained. Following this line of reasoning, we suggest that SOX-related costs are more burdensome for research intensive firms looking to go public, and yet these firms are most critical to the national innovation system (Lundvall 2007).

These considerations combine to imply that SOX compliance costs would be a significant factor in the decision of firms to go public on U.S. exchanges, especially for small, research intensive firms – the growth engine for the economy (Grossman and Helpman 1994; Romer 1994). Therefore, in this study, we focused on research intensive firms going public on U.S. exchanges in the period before and after the enactment of SOX in 2002. We analyzed the going public behavior before and after SOX overall, with a specific focus on small, research intensive firms across all industries going public in the post-SOX era. Overall, the going public rate of all firms fell precipitously around the time of SOX enactment. IPO rates significantly diminished for research intensive firms (Figure 4).

The remainder of the paper is organized as follows. The background consists of a discussion on the “scandals” in the years leading up to SOX, the “collateral damage” from the scandals, SOX legislation and costs, including a discussion on small firms and research firms. This is followed by a section on theory and hypotheses which includes a

discussion of research intensity, small firms, and market valuations. Next follow sections on model and methodology, including sections on the data set and variables (dependent, independent, and control variables); results which includes a discussion on the sample set and the hypotheses; discussion; conclusion; future research; and references cited.

Background

Scandals

Congressmen Sarbanes and Oxley proposed corporate governance legislation to address the series of large, corporate scandals revealed during the years of 1999-2002. Corporations exposed by whistleblowers and then targeted by the Securities and Exchange Commission (SEC) for investigation included Tyco, Imclone, Worldcom, Adelphia Communications, Rite Aid, and Enron - which developed into the largest bankruptcy in U.S. history at the time, among other firms. Financial statements were manipulated as top executives used these firms as their own personal bank accounts to the tune of hundreds of millions of dollars, problems with product development were hidden from investors, and revenues were misstated, with billions of dollars in losses routed through off-the-books entities (See Table 5).

Collateral Damage from the Scandals

As these firms fell, many of their top executives landed in jail, employees were fired, paychecks bounced, pension funds were raided, retirement stock plans were decimated, leaving employees with no paychecks and no savings. The shock waves of

these scandals impacted investor confidence and stock markets plummeted. The largest accounting and auditing firm at the time, Arthur Andersen, quickly dissolved, as clients abandoned this disgraced company associated with many of these financial scandals.

SOX Legislation

The Sarbanes-Oxley Act of 2002 stressed completeness, accuracy, and transparency in financial reporting by foreign and domestic firms listed on U.S. stock exchanges. This legislation was created in an attempt to regain investor confidence - lost after the corporate governance scandals of 2002 which had immediately followed the burst of the Internet bubble in 2000, and to stabilize the markets. The goals of SOX were to improve the financial reporting and auditing practices at public companies with the ultimate objective to expose and reduce fraud at public companies.

To motivate top executives to implement SOX compliance procedures fully and quickly, Congress held them personally accountable (Section 302) for compliance. To speed compliance, those portions already written for the Act went into effect immediately upon enactment. The most costly Section 404 of SOX became effective in 2004. The Act called for criminal penalties (Section 802) for executives, who were now suddenly required to personally sign off on financial statements and attest to their accuracy and thoroughness in describing the financial situation of the firm.

Costs

To provide the CEO and CFO with an elevated degree of confidence that they could sign off on the financial statements without undue concern about facing a jail term

for providing false or misleading information, very expensive internal controls and reporting processes were devised. The single largest portion of the cost of compliance with SOX lodged in creating, implementing, attesting to, and auditing internal controls (Section 404). This was especially the case for small firms (Iliev 2010). In the 2004 survey by Financial Executives International, total compliance costs for the first year were estimated at \$3 million for firms with \$2.5 billion in average annual revenues and approximately \$1 million for firms with \$1 billion or less in annual average revenues. Continuing annual compliance costs also ran into the millions of dollars (Block 2004; Engel, Hayes, Wang 2004; Zhang 2005).

In a 2008 research study by Krishnan, Rama, and Zhang, firms that voluntarily disclosed costs related to Section 404 compliance between years 2003 to 2005 averaged \$2.2 million in fees comprising labor, consulting, technology, and auditor charges. Costs increased with firm size, material weaknesses, hiring of large accounting firms, technology implementation, new CEOs, and the establishment of internal control policies (Krishnan, Rama, Zhang 2008).

Cost was probably the most contentious and most discussed ramification of SOX legislation. Studies on costs of Section 404, arising from both management compliance and auditor fees, faced by public companies (Hogan 2008; Hoitash, Hoitash, and Bedard 2008) suggested that young IPO firms would be significantly impacted immediately after going public if not sooner. These sizable additional costs would likely dampen IPO rates as a result.

Small Firms

As firms attempted to comply with SOX, costs to small firms were nearly equivalent to those of large firms due to largely fixed costs and fees for compliance. The vast majority of firms, post-SOX, contracted with a Big Four accounting firm (now charging premiums for their auditing services due to SOX), bought similar software packages, and hired additional employees and consultants to aid in compliance. This meant that smaller firms bore a disproportionate burden of the costs as these expenses were a larger portion of their revenues. Concern was raised that “the onerous costs of Sarbanes-Oxley...fall disproportionately on small and mid-cap companies – the very ones that provide the innovations and entrepreneurship we rely on for economic growth” (Zuckerman 2006). Wolkoff (2006) wrote in the Financial Times that “SOX has unintentionally created an environment that discourages smaller, innovative companies from accessing U.S. capital markets”. In July of 2010, small firms, defined as those with a public float of less than \$75 million (called “non-accelerated filers”) were finally exempted from SOX’ costly Section 404(b) by Congress.³⁰ This section required public companies to provide an attestation report from its external auditors regarding management's assessment of internal controls over financial reporting.³¹

³⁰ During the initial period of implementation of Section 404, small companies (i.e., those with public float less than \$75 million, called “non-accelerated filers”) were exempt from the audit requirement with the expectation that they would be required to comply by April 15, 2005. This compliance date was repeatedly postponed. However, the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 has now permanently exempted non-accelerated filers from internal control audits. To the extent IPOs are likely to be non-accelerated filers, the Dodd-Frank Act has removed the added audit costs relating to internal control audits. During our sample period, however, the audits were certainly expected to go into effect (Olson 2007).

³¹

http://www.dlallc.com/about/relevant_news_releases/congress_approves_small_company_exemption_from_sox_section_404_b/

Research Firms

If we look at a breakdown of research firms in various industries going public immediately before and after SOX, we see the following. The industries studied have the highest research intensity of all industries (OECD 2007), defined here as having a larger proportion of their budget go into research versus sales and administrative expenses or assets. Both number of firms and percentage of all research intensive firms are noted on the graphs. Pre-SOX is defined here as 1999-July 2002, while post-SOX is defined as 2003-2004. The research intensive industries portion of all firms going public in the couple of years prior to SOX is depicted in Figure 8. Computer Software dominated the group, followed by Electronics and Biotechnology. Computer Hardware was a distant fourth.

The pre-SOX graph depicted in Figure 8 likely represents the dot.com bubble of 1999-2001, when a large number of software companies went public in a very short period of time. The post-SOX graph (Figure 9) tells a more complicated tale of both a considerably diminished number of initial public offerings among research intensive firms and a redistribution of research intensive industries' initial public offering (IPO) volume.

In the post-SOX years, the actual numbers in all industries were greatly reduced. Computer Software firms left the dominant, majority position, dropping to second-most IPO volume among research intensive firms and reduced in percentage by half. Biotechnology firms outpaced a diminished computer software presence. Electronics

remained strong, while Medical Technology blossomed in percentage, although not in actual numbers. Only a few oil and chemical companies went public, along with a few computer hardware companies. The composition of firms going public after SOX redistributed among industries for a number of reasons and the overall rate of firms going public notably declined.

To summarize, financial malfeasance among numerous large, public companies destroyed investor confidence in the markets. Congress enacted regulatory legislation to mandate financial transparency and accountability among top executives for the financial performance of their firms. The cost for compliance was unexpectedly high, by requiring internal audit processes to be created, implemented, and attested to by outside auditors. Much of this cost was an unintended consequence of protecting the top executives of firms from potential criminal penalties. As many of these costs were relatively flat charges (consultants, software packages, additional accounting personnel), small firms carried a disproportionate part of the burden.

Research intensive firms, defined as having a larger proportion of their budget go into research versus sales and administrative expenses or assets, were expected to be greatly affected as funds were drained from research to pay for regulatory compliance, especially at smaller, research intensive firms. Much of the larger effect of SOX was reflected in the IPO market after 2002, as many firms delisted (Woo 2011), went “dark” (Engel, Hayes, and Wang 2007; Marosi and Massoud 2007; and Leuz, Triantis, and Wang 2006), went private (Block, 2004; Carney, 2005; Hsu, 2004; Engel, Hayes, and

Wang, 2004; Kamar, Karaca-Mandic, and Talley, 2006), went public on foreign exchanges, or decided to delay their IPO.

Theory and Hypothesis

Research Intensity

IPO events are typically undertaken with the objective of raising money to fund operations, growth, acquisitions, research and development, etc. If there is a significant cost increase to going public, in this case due to high SOX compliance costs, firms can choose to delay their IPO event, go public on a foreign exchange, find funding elsewhere (Angels, Venture Capital, government technology grants, organic growth), merge or acquire another firm, or remain privately-held. If the cost of SOX was an impediment to research intensive firms going public, we would expect to observe fewer research intensive firms going public post-SOX, those research intensive firms that do go public would have lower research intensity rates post-SOX versus pre-SOX due to compliance costs draining research funds, leading to an overall decrease in the average research intensity of firms that do go public due to the absence of research-intensive firms in the mix and lower research intensities at firms in general.

Hypothesis 1: Average Research Intensity of firms going public decreases after the enactment of SOX.

Small Firms

While all public companies saw a substantial increase in costs due to SOX, small cap public firms experienced an increase in audit costs of over 300%, or about an additional \$1 million annually, mainly in the form of audit fees, board compensation, and legal fees.³² Small firms, those with sales of less than \$1 billion, often have more material weaknesses in their internal controls than larger firms (Foster, Ornstein, Shastri 2007), mainly due to a lack of resources, which also leads to increases in compliance costs. Costs, necessary to comply with Section 404 (internal controls) alone as required in the second year after a firm goes public, at small companies were estimated in 2006 to be in the \$3 million range.³³

Overall, SOX reduced the market value of small firms (Iliev 2010) by draining funds. According to a 2006 survey funded by SAP, an enterprise resource planning (ERP) software provider, small companies were cutting back on expenditures for research, marketing, and on personnel to pay for compliance costs. Almost half of those surveyed stated that SOX made it more difficult for them to conduct business. More than half of the respondents said that cost was the biggest issue.³⁴ In 2005, the SEC addressed the difficulties of SOX compliance at small firms by extending compliance deadlines for small companies (less than \$75 million in public shares) to July 2007. Subsequent extensions were also announced. Finally, in 2010, small firms were exempted from the costly Section 404 (b), requiring an outside auditor to attest to management's evaluation

³² SOX Costs Sock Small Firms. Information Management Journal, Mar/Apr2008, Vol. 42 Issue 2, p14-14.

³³ Small Firms Seek Different SOX Rules. Information Management Journal, Jan/Feb2006, Vol. 40 Issue 1, p6-7.

³⁴ Ibid.

of internal controls (Dodd-Frank Act 2010, legislation to improve accountability and transparency in the financial system).

If smaller firms disproportionately carried the cost burden of SOX and were drawing from their research budgets as one possible source for funds to pay for SOX compliance, we would expect that fewer small, research intensive firms would go public post-SOX. When they did go public, research intensity would decrease as firm size decreases. The assumption here is that firm management would already know about SOX costs prior to going public and would adjust budgets to cope with the high costs of SOX compliance once the firm went public. Large firms should be able to absorb costs more easily and are often more likely to comply. We would expect to see a greater percent decrease in research budgets at small firms than at large firms. We saw a suggestion of this in Table 3 where small firms showed no patenting activity during a specific time frame after SOX, medium size firms demonstrated less patenting activity than prior to SOX, and large firms continued with patenting activity at high levels after SOX. The one consideration here is that the volume of firms was so low after SOX was enacted, that we are looking at a very small number of firms post-SOX.

Hypothesis 2: The association between Research Intensity and Size will be more positive post-SOX when compared to the pre-SOX association.

Market Valuation

As previously noted, the cost to firms to comply with SOX regulatory legislation was considerable and unexpected. Conversely, the benefits gained by firms have been well recognized. According to a 2005 survey by Oversight Systems, Inc. of 222 U.S. financial executives, benefits from SOX compliance included stronger internal financial controls (79% of respondents), improved accuracy of financial reports (27%), reduced error rate (31%), a lower risk of financial fraud, and investors saw value in the ethical credibility gained from SOX compliance (37%). Coates' 2007 review of SOX literature was generally positive about the benefits of SOX.

In the aforementioned 2005 Oversight Systems survey, though, others (33%) suggested that the additional financial burden of SOX depressed stock value. To better understand the market response to SOX with regards to research firms, we calculated the average market value of research firms going public before and after SOX within research intensive industries. Generally, market values at time of IPO after SOX were lower overall for research firms, the exception being with software companies (Figure 10). This lower average market value after SOX may have resulted from generally lower valuations in a colder market, or from lower quality firms dominating the IPO activity after SOX.

We would expect investors to be leery about investing in IPO firms that will have larger financial burdens. This was likely a factor in the lower valuations of IPOs in all of these industries after SOX, with software being an exception worthy of further study. Newly-minted IPO firms must designate funds to pay for SOX compliance, something

they were not required to do prior to going public. Granted, there is usually an influx of funding from the IPO event. These funds would normally have gone to a variety of purposes such as growth, operations, acquisitions, research and development, etc. If investors viewed long term research budgets as likely candidates for raiding to pay for the short term costs of SOX compliance in firms that recently went public, then we would expect that investors would view research intensive firms with a higher level of uncertainty in meeting innovation objectives once public and under the regulatory guidelines of SOX. For those firms that attracted a high market value, for whatever reasons, financial constraints would be looser and, therefore, firms would be able to absorb the costs of SOX more easily.

Hypothesis 3: The association between research intensity and market valuations is more positive post-SOX when compared to pre-SOX.

All hypotheses suggest that SOX is creating a selection bias of research intensity shifting toward larger firms. This would be an outcome of “The Law of Unintended Consequences”, essentially of the government, in attempting to level the playing field and make it more difficult for firms to conduct financial malfeasance, are simultaneously diminishing the effectiveness of small firms to be able to innovate. Historically, it has been the small firms that have been the most efficient and effective innovators, until now.

Model and Methodology

Data Set

Between 1999 and 2004, there were approximately 1409 initial public offerings listed on IPOMonitor.com. Not all of these firms followed through with their offering. Prior to 2002, the year of the enactment of SOX, during the years of 1999 – 2001, there were 1005 IPOs. In year 2002, there were 81 IPOs, a dramatic decrease in the IPO rate. In 2003 and 2004, the rate of going public continued to be diminished as 323 IPO events took place. In the final data set for this research, all firms with incomplete information were eliminated. All financial firms, with SIC codes in the 6,000s, were also eliminated as they are considered to have significantly different behavior from non-financial firms. Overall, in the final data set, 590 firms remained, of which 447 went public prior to July of 2002, the month when SOX was enacted, and 143 firms went public post-SOX, after July 2002 then through 2004.

The data was divided into industries to increase sensitivity in the results (Dess, Ireland, and Hitt, 1990). Research intensive industries were selected from the OECD report on technology industries (OECD 2007). Industries selected included Computer Software, Computer Hardware, Biotechnology, Medical Technology, Electronics, Oil and Chemicals, and Other (non-research intensive firms) (Table 6 of SIC Codes).

Each of the six research intensive industries was tested independently, along with a general category of “Other” which comprised non-research intensive firms (<8% R&D Expenses/Assets). We examined industries separately (and combined), expecting that each industry would have different research intensities (Dess, Ireland, and Hitt, 1990).

The presence of firms in these industries would change in proportion within the whole of all firms going public after SOX for a variety of reasons, including the ability to recoup SOX costs readily.

Variables

Dependent Variable

Research intensity was used as the dependent variable in this study and calculated as the ratio of quarterly research and development expenses to assets (Note: this is a different calculation from earlier in the research when SGA expenses were used). This figure was scaled by adding 1, then the natural log taken. The data was extracted from COMPUSTAT North American quarterly reports.

Independent Variables

Independent variables included the natural log of market value at date of IPO (Market Value), the number of employees (Employees) as a firm size measurement, and a SOX (SOX) dummy indicating the period of time before or after SOX legislation was enacted.

The number of employees (Employees) was reported by the firm at the end of the calendar year of the IPO in this study. The number of employees was extracted from the annual reporting function of COMPUSTAT. In sensitivity tests, we also looked at the natural log of assets (Assets) as an additional firm size indicator. SOX was a dummy

variable indicating pre- (0) and post- (1) July of 2002 (SOX). Interactions between the independent variables and SOX were evaluated.

Control Variables

Control variables included age (Age), capital intensity (Capital Intensity), and market to book ratio (Market to Book).

Age was calculated as the natural log of the difference in years from year of founding to year of IPO plus the number of days in the IPO year (Age). The year of founding was determined from Jay Ritter's list posted on his website. The Field-Ritter dataset of company founding dates has been vetted by Ritter's academic team. An explanation of his criteria is found on the website, (<http://bear.cba.ufl.edu/ritter/foundingdates.htm> 04/23/07). To add some increased sensitivity and to eliminate any zero time-to-IPO numbers since the natural log was taken of the final data, the number of days from January 1 to the date of the IPO was added to the difference in years.

Capital intensity was measured by the natural log of assets / number of employees (Capital Intensity). The market to book value, a figure often used to represent information asymmetry, is also considered to be Tobin's Q. The market to book value is calculated by dividing the market value (MV) of a company, i.e., the total value of all its outstanding shares, by the value of its tangible assets (TA) (also known as Tobin Ratio = MV/TA). In COMPUSTAT it is calculated as the $(\text{Price at Close} - \text{Price at 3rd Month of IPO Quarter}) / [(\text{Common Equity} - \text{Total}) / \text{Common Shares Outstanding}]$. Market to

book value may also be calculated as the Fiscal Year End / Quarter End. These data were obtained from the COMPUSTAT quarterly North American reports.

The model evaluated is shown below:

$$\begin{aligned} R\&D\ Intensity = \beta_1 SOX\ dummy + \beta_2 Market\ Value + \beta_3 Employees\ (or\ Assets) + \beta_4 Age \\ &+ \beta_5 Capital\ Intensity + \beta_6 Market\ to\ Book\ Value + \beta_7 SOX:Market\ Value + \\ &\beta_8 SOX:Employees\ (or\ Assets) + \varepsilon \end{aligned}$$

Results

Sample Set

The linear regression model was designed to highlight the relationships between SOX, market value, capital intensity, firm size, and market to book value (proxy for information asymmetry) with the research intensity of firms going public on US stock exchanges. Firm age, capital intensity, and market to book values were used as controls. Variables evaluated and their derivations may be found in Table 7.

We also looked at the relationships between Research Intensity and the various variables in each industry as well as combined industries (Tables 10-17). We modeled the control variables (Model 1) in each industry (including ‘Other’), adding the independent variables (Models 2), and then interactions (Models 3 and 4) in each industry separately and in a combined data set of all industries (Table 10-17).

Descriptive statistics (Table 8) and correlations (Table 9) are included here. R&D Intensity ranged from an average of 0.02 (Computer Software, Oil and Chemicals,

Medical Technology) to 0.05 (Biotechnology) among the research intensive industries. Non-research intensive industries averaged 0.009. If all industries were averaged together, research intensive and non-research intensive, the average was closer to 0.03. There were no obvious correlations between the variables.

Testing Hypothesis 1 - Average Research Intensity of firms going public decreases after the enactment of SOX.

As observed previously, the rate of initial public offerings dropped precipitously after the enactment of SOX legislation. In the data set of firms with complete data, there were approximately 480 firms going public before SOX (1999- early 2002) and 191 firms going public after SOX (late 2002-2004) for a total of about 671 firms. Tables 10-16 presented regression results for individual industries, while Table 17 presented results for the combined sample. The adjusted R^2 values were generally low, not more than 11% in the larger industry samples, suggesting that the model did not explain a large portion of the variability. The p-values for the models were mainly significant for the Computer Software industry and the ‘Other’ category. In each Table, Model 1 represented the regression of the control variables, Model 2 represented regressions of control and independent variables, while Models 3 and 4 represented full regressions with interactions.

Only the research intensive industries of Biotechnology (N=79), Electronics (N=81), and Computer Software (N=204) had a large enough sample size, greater than 40 in this case, from which to draw any conclusions. In none of these individual industries,

did the SOX coefficient exhibit a significant negative relationship with research intensity. In these individual industries, the results did not support Hypothesis 1: Average Research Intensity of IPO firms decreased after the enactment of SOX. Unexpectedly, though, in the “Other” (N=224) category of non-research intensive firms, the p-value and the SOX variable was strongly significant and negative (SOX), suggesting that those firms that did not rely on research intensity to enhance market value and contribute to the future of the firm eliminated, or minimized, any research budgets upon going public under SOX. This supports Hypothesis 1, but only for non-research intensive firms.

Testing Hypothesis 2 - The association between Research Intensity and Size will be more positive post-SOX when compared to the pre-SOX association.

Hypothesis 2 predicted that the association between Research Intensity and Size will be more positive post-SOX when compared to the pre-SOX association, implying that mainly the larger, research-intensive firms would have the wherewithal to absorb the additional regulatory costs of SOX. Size (as measured by number of employees) alone did have a significant but negative relationship with research intensity in Computer Software and Biotechnology, suggesting that smaller firms invested more significantly in research in an effort to grow. The interaction term of SOX and Number of Employees (a proxy for size), representing the association of the two, was not significant in any of these industry groups, suggesting that there were no differences in the effects of SOX on research intensity across small and large firms. Research trumped SOX in the competition for funds. These results did not support hypothesis 2.

As a robustness test, if Assets were used as a size indicator rather than Number of Employees, Assets were found to be strongly significant but negative, in Computer Software, Biotechnology, Electronics, Oil and Chemicals, and Other (non-research intensive firms) industries (Table 18). This suggested that small firms spent relatively more on research than larger firms, likely in an effort to grow faster. The variable SOX was moderately significant, but negative, in the “Other” non-research intensive industries model, where research intensity was greater prior to the enactment of SOX versus afterward. The interaction of SOX and Assets (a proxy for size), representing the association of the two, was not significant in any of the industry models. Again, these results did not support hypothesis 2.

Testing Hypothesis 3 - The association between research intensity and market valuations is more positive post-SOX when compared to pre-SOX.

Hypothesis 3 suggested that the association between research intensity and market valuations will be more positive post-SOX when compared to pre-SOX. This implied that while investors recognized the potential to raid research budgets to pay for SOX costs, those firms that continued with high research budgets at time of IPO had the best chances at innovation over time. These firms prioritized research and found funding for compliance in other areas of the company. The market rewarded these firms with higher market value. Additionally, those firms with higher Market Value would have greater cash flow coming into the firm from the IPO and so would be in a better position to cover the costs of compliance.

To test this hypothesis, we looked at the interaction of Market Value with SOX. In the largest sample, that of Computer Software, the SOX-Market Value interaction was positive and moderately significant (Table 10, Model 4). This result supported Hypothesis 3.

Discussion

After SOX was enacted in 2002, the costs of going public in the U.S. rose significantly, into the millions of dollars annually, for large and small, foreign and domestic firms. Funds to pay these costs for regulatory compliance had to be rerouted from other areas of the firm, an opportunity cost to the firm. It was proposed in this study that departments, such as research and development, within firms would be targeted for short term withdrawal of funding to pay for SOX compliance in the early years of being public. R&D appeared to be an especially likely target as products of R&D efforts typically evidenced themselves in future years, so a decrease in funding would not have such an immediate effect on the firm that would be visible to shareholders.

Early analyses in this study indicated that looking at all research intensive industries lumped together would not result in an analysis that was sensitive enough to the changes in the IPO market after SOX. This is supported by work of numerous researchers (Dess, Ireland, and Hitt, 1990). The reason behind this lack of sensitivity in this case was the notable change in the proportions that industries represented among the firms going public after SOX. The percentage for each research intensive industry within the whole of firms going public after SOX changed dramatically after SOX, with

Computer Software shrinking (possibly an artifact of the Internet Bubble burst), and Medical Technology and Biotechnology increasing within the whole of IPO firms. With changing proportions, the inherent ability and motivation to go public after SOX would change according to the weights of the industry sectors, muddying the sensitivity of the analysis if all industries were lumped together.

The most marked phenomenon in the IPO market after the enactment of SOX was the dearth in firms going public from 2002 to 2004, as compared to 1999-2001. Since so few firms went public in the years after SOX, studying each research intensive industry separately yielded too few data points for effective use of statistical tools in many of the industries. Only in the Computer Software, Biotechnology, and Electronics industries, as well as “Other”, were there sufficient data points (>40 firms) for a feasible study. One should note here though, that these were not samples of firm data but were complete censuses, as all of the firms that went public in these years were included in the study, as long as there was data for them in the database.

Because of the sudden lack of firms interested in going public after SOX, we suspect that many firms delayed their IPO, diverted to foreign exchanges, or dismissed the idea of going public altogether, at least for the moment. We see in Figure 11 that there was a surge in firms from the US going public on the London Stock Exchange starting in 2003. Those firms that were unprepared for the additional costs of SOX compliance, or that wanted to avoid the cost burden altogether, would likely be among the group of firms that found alternatives to an IPO. Firms that actually did go public after SOX had sufficient warning of the cost burden and would have prepared for this

requirement. Therefore, the pool of firms going public after SOX does not contain those firms that were deterred from going public by the additional cost burden of SOX. This current data set only reflects those firms still willing to pay for SOX compliance and for research. Therefore, if we limited ourselves to those companies that decided to go public despite SOX in Computer Software, Biotechnology, Electronics, and Other industries, the largest sample sizes, we observed that none of the research intensive firms significantly reduced their research budgets upon going public. Funds to pay for the elevated cost of SOX were found elsewhere. As a reminder, one aspect of the high cost of Section 404 is that it went into effect one year after the firm becomes public. It was not an immediate cost, although firms should have been preparing for it. Where there was a strongly significant decrease in research budget funding was in the non-research intensive industries (“Other”). Here firms cannibalized their discretionary research budgets, an expense not considered fundamentally important to these firms, and diverted the monies toward SOX costs.

Firm size was also studied with the expectation that larger firms would absorb the costs of SOX easier than smaller firms. Here no evidence was seen to suggest that smaller firms were forced to raid research budgets to pay for SOX. To the contrary, there was no difference seen among large or small firms in regards to the effect of SOX on research intensity. Smaller companies actually spent proportionally more on research than larger firms, likely with the objective to grow faster.

In an efficient market, where information is transparent and known to all, investors likely recognized the potential to raid research budgets to pay for SOX costs.

The market would still value innovation potential within research intensive firms and expect that those firms that continued with high research budgets at time of IPO had the best chances at innovation over time, resulting in higher market values. These firms would prioritize research and find funding for compliance in other areas of the company or from the increased cash flow created at time of IPO. In the largest sample, computer software, we found this to be true, that the market rewarded firms for continuing to fund research budgets with a higher market value.

If we looked at the market values of firms going public in Biotechnology, where firms generally were smaller than in other industries, we saw that firms going public prior to SOX averaged \$466 million and after SOX averaged \$294 million. While the millions of dollars of costs for SOX compliance are a significant additional cost to being public, the sheer size of IPO valuations in even the industries with the lowest valuations may be sufficient to absorb these additional costs in many companies.

Conclusion

The compliance cost burden on firms going public after the enactment of SOX has been well discussed in the literature. The cost of compliance to SOX regulations has been the most common complaint among public firms. This cost must be paid for from internal funding on an annual basis. From where are these public firms drawing their funding? In this study, we proposed that a likely candidate for rerouting of funds would be from research budgets, since the results of research efforts often become evident only in the long term, so a decrease in funding might not be immediately obvious to

shareholders or potential investors. We saw that research intensive firms diminished dramatically, along with many non-research intensive firms, from IPO events after SOX. Many firms likely decided to dismiss their plan to go public, divert their IPO to foreign exchanges, or delay their IPO until the ramifications of SOX were fully understood and the cost burden could be budgeted.

The results underestimated the effect of SOX corporate governance legislation on public firms, as those firms that were deterred from going public on U.S. exchanges by the high costs of SOX compliance were not in the mix of firms to be evaluated. These firms may have delayed their IPO event until they were more financially robust, diverted the IPO to a foreign exchange, or dismissed the idea of going public altogether. This data set only looked at the survivors of SOX, those selected firms that were still willing to pay for SOX compliance and for research programs. Those firms that were not in a position to afford the high costs of SOX compliance opted out of going public on U.S. exchanges. This was a deterrent effect of SOX legislation.

Where we had a larger sample size (>40 firms), in computer software, biotechnology, electronics, and “other”, we noted that those research-intensive firms that went public despite SOX generally resisted the temptation to raid research budgets, finding funding for compliance elsewhere within the company or from the additional cash flow at time of IPO. Where firms did appear to greatly reduce research budgets was in the non-research intensive industries, where research budgets might be considered as more of a discretionary expense.

Firm size was not a factor in whether research intensive firms could better absorb the costs of SOX, although smaller firms tended to spend proportionally more on research in an effort to grow faster. After the enactment of SOX, we observed an indication that the markets valued research intensity even more than prior to SOX, perhaps understanding the vulnerability of research budgets being diverted to compliance costs.

An unintended consequence of the Sarbanes-Oxley Act is the heavy financial burden of the cost of compliance that has been placed on the number of firms going public, as well as the opportunity cost for firms that do not go public. As firms implement their IPO strategy and therefore fall under SOX guidelines, firms fund SOX compliance with monies from other areas of the firm or from enhanced cash flow at time of IPO. Private firms may forego the funds raised in an IPO, but continue to fund research projects organically, or go public on a foreign exchange, or delay their going public event. Either way, firms dampen their potential for growth by draining funds away from firm activities and towards compliance, or by foregoing the influx of funding from an IPO event by remaining private and avoiding SOX. On a macro level, as firm growth is hampered, so too is the economy.

One of the contributions from this research was to emphasize that a selection process occurred in the census of firms going public after the enactment of SOX corporate governance legislation in 2002. Only those firms that had planned for the additional cost of compliance to Sarbanes-Oxley legislation went public after 2002. Those firms that decided to delay, divert, or defer their IPO were not part of the

evaluation as they remained private or went public on foreign exchanges. Their data was not captured for analysis.

Future Research

This study provides some exploratory results that will be improved as more firms go public on U.S. exchanges over the years following SOX. At some point, though, we expect that firms will somehow more completely understand the ramifications of SOX and find ways to adjust to better cope with the burden of compliance. A future study would look at more than a few more years post-SOX, but limit itself to some defined time frame not too long after SOX, when SOX has been fully internalized and accommodated. A reasonable end date would be 2010, when smaller firms were exempted from some of the heaviest financial burden of SOX.

With more years to study, it would be interesting to look at differences between research intensive industries and attempt to determine if there is a fundamental factor for ease of adjusting to SOX compliance. Speed to market, financial stability, and levels of research investment required in general may be key elements in how well an industry copes with large regulatory financial burdens or how willing industries are to take on compliance costs. Firm growth would be a valuable area for study as compliance costs likely slowed the growth of many firms by tying up funding. Looking at other areas within the firm, such as Marketing, or Human Resources, might be interesting to identify if one particular department suffered more than others in the financing challenge of SOX.

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Table 1. Ranking of Industries that Exhibited the Most Patent Activity from 1999-2004.

INDUSTRY	PERCENTAGE OF TOTAL PATENTS
Computer Software	26% (SIC 7370-7374)
Biotechnology	17% (SIC 2833, 2834, 2835, 2836, and 8731)
Electronics	13% (SIC 3651-3690)
Medical Technology	8% (SIC 3827-3851)
Computer Hardware	5% (SIC 3570-3577)
Oil and Chemicals	3% (SIC 1311, 2870-3089, 3533)
Other	28% (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)

Total: 100% of All Patents

Table 2. Firms with Patenting Activity Over the Two Specific Time Frames

Studied.

Percentage of Firms with Patents*	Comprehensive for first 3 quarters of 1999	Comprehensive for first 3 quarters of 2003
Software (7370-7374)	68%	17%
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	3%	0%
Electronics (SIC 3651-3690)	5%	0%
Medical Technology (SIC 3827-3851)	0%	0%
Computer Hardware (3570-3577)	3%	17%
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	21%	67%
	<i>100% (N=62)</i>	<i>100% (N=6)</i>

**no firms with mainly design patents were included*

Table 3. Average Research and Development Intensity (QTRLY R&D Expenses/QRTLY SGA Expenses) per Firms with Patenting Activity

<i>RESEARCH AND DEVELOPMENT INTENSITY - small firms (\$0 - \$20 million/year)</i>				
Average Research and Development Intensity (QTRLY R&D Expenses/QRTLY SGA Expenses) per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999		Comprehensive for first 3 quarters of 2003	
	% of total # of firms going public (N=239)	Average Research and Development Intensity (MM\$)	% of total # of firms going public (N=28)	Average Research and Development Intensity (MM\$)
Software (7370-7374)	5% (N=12)	3.14	none	
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	0% (N=1)	na	none	
Electronics (SIC 3651-3690)	1% (N=2)	0.29	none	
Medical Technology (SIC 3827-3851)	none		none	
Computer Hardware (3570-3577)	none		none	
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	3% (N=6)	10.52	none	

<i>RESEARCH AND DEVELOPMENT INTENSITY - medium firms (\$20-\$100 million/year)</i>				
Average Research and Development Intensity (QTRLY R&D Expenses/QRTLY SGA Expenses) per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999		Comprehensive for first 3 quarters of 2003	
	% of total # of firms going public (N=239)	Average Research and Development Intensity (MM\$)	% of total # of firms going public (N=28)	Average Research and Development Intensity (MM\$)
Software (7370-7374)	11% (N=27)	7.30	3.6% (N=1)	0.37
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	0% (N=1)	na	none	
Electronics (SIC 3651-3690)	0% (N=1)	0.43	none	
Medical Technology (SIC 3827-3851)	none		none	
Computer Hardware (3570-3577)	1% (N=2)	0.52	none	
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	3% (N=6)	0.30	7% (N=2)	0.33

<i>RESEARCH AND DEVELOPMENT INTENSITY - large firms (>\$100 million/year)</i>				
Average Research and Development Intensity (QTRLY R&D Expenses/QRTLY SGA Expenses) per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999		Comprehensive for first 3 quarters of 2003	
	% of total # of firms going public (239)	Average Research and Development Intensity (MM\$)	% of total # of firms going public (28)	Average Research and Development Intensity (MM\$)
Software (7370-7374)	1% (N=3)	0.10	none	
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	none		none	
Electronics (SIC 3651-3690)	none		none	
Medical Technology (SIC 3827-3851)	none		none	
Computer Hardware (3570-3577)	1% (N=2)	0.35	3.6% (N=1)	0.13
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	0% (N=1)	0.25	7% (N=2)	0.36

Totals: 27% (N=64) 21% (N=6)

Table 4. Summary Table of Small, Medium, and Large Firms with Patenting Activity, pre- and up to 4 years post- IPO

Summary Table of Firms with Patenting Activity, pre- and up to 4 years post- IPO

PATENT INTENSITY - Small Firms*										
Average # of Patents Granted per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999					Comprehensive for first 3 quarters of 2003				
	% of total # of firms going public (N=239)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years	% of total # of firms going public (N=28)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years
Software (7370-7374)	5% (N=12)	1	0	1	4	none				
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	0% (N=1)	0	0	0	1	none				
Electronics (SIC 3651-3690)	1% (N=2)	6	2	3	9	none				
Medical Technology (SIC 3827-3851)	none (N=0)					none				
Computer Hardware (3570-3577)	none (N=0)					none				
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	3% (N=6)	1	0	1	6	none				

*small firms (\$0 - \$20 million/year)

PATENT INTENSITY - Medium Firms*										
Average # of Patents Granted per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999					Comprehensive for first 3 quarters of 2003				
	% of total # of firms going public (N=239)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years	% of total # of firms going public (N=28)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years
Software (7370-7374)	11% (N=27)	0	0	0	3	3.6% (N=1)	1	1	2	26
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	0% (N=1)	5	1	1	10	none				
Electronics (SIC 3651-3690)	0% (N=1)	1	0	0	2	none				
Medical Technology (SIC 3827-3851)	none (N=0)					none				
Computer Hardware (3570-3577)	1% (N=2)	1	1	0	8	none				
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	3% (N=6)	1	0	2	4	7% (N=2)	7	1	1	1.5

*medium firms (\$20-\$100 million/year)

PATENT INTENSITY - Large Firms*										
Average # of Patents Granted per Firms with Patenting Activity	Comprehensive for first 3 quarters of 1999					Comprehensive for first 3 quarters of 2003				
	% of total # of firms going public (N=239)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years	% of total # of firms going public (N=28)	Prior to IPO	12 months prior to IPO	12 months post IPO	Post IPO up to 4 years
Software (7370-7374)	1% (N=3)	0	0	1	1	none				
Biotech (SIC 2833, 2834, 2835, 2836, and 8731)	none (N=0)					none				
Electronics (SIC 3651-3690)	none (N=0)					none				
Medical Technology (SIC 3827-3851)	none (N=0)					none				
Computer Hardware (3570-3577)	1% (N=2**)	24	13	15	41	3.6% (N=1)	1	0	0	2
Other (Furniture, Food, Tobacco, Printing, Financial, Real Estate, Retail, Services, Communications, etc.)	0% (N=1***)	46	8	6	26	7% (N=2****)	18	4	2	31.5

* large firms (>\$100 million/year)

**Paradyne Corporation, Largo, FL had the vast majority of these patents.

***MKS Instruments, Andover, MA

Totals for all size firms with patent activity: 27% (N=64 out of 239)

****Sigmatel, Inc. (Austin, TX) holds the vast majority of the patents and appears to be an outlier in this data.

21% (N=6 out of 28)

Table 5. Examples of Corporate Malfeasance, 1999-2002

Firm	Year(s) Investigated	\$\$ Misappropriated
Rite Aid Pharmacy	1997-99	\$1.6 billion
Imclone Biotech	2002	New Cancer Drug Problems Not Disclosed
Adelphia Cable	2002	\$3.1 billion
Enron Energy	2000	\$102 billion
Worldcom	2002	\$4 billion
Tyco	2002	\$600 million

Table 6. Data SIC Code Categorization

Industry	SIC Codes	% of All Firms Going Public 1999-2004	% of All Firms in Final Data Set	% of All Firms in Final Data Set Pre-SOX	% of All Firms in Final Data Set Post-SOX
Other	<i>Everything else: Agriculture, Furniture, Food, Tobacco, Printing, Financial, Retail, Services, Communications, etc., except Financial and Real Estate firms (6000s)</i>	47%	36%	28%	55%
Computer Software	SIC 7370-7374	25%	32%	40%	12%
Electronics	SIC 3600-3690	10%	11%	13%	6%
Biotechnology	SIC 2833, 2834, 2835, 2836, and 8731	9%	9%	8%	12%
Medical Technology	SIC 3827-3851	4%	6%	5%	10%
Computer Hardware	SIC 3570-3577	3%	4.5%	5%	2%
Oil and Chemicals	SIC 1311, 2800-2821, 2860, 2870-3089, 3533	2%	1.5%	1%	3%

Total: 100% of firms in data set

Table 7. Variables and their Derivations

VARIABLE	CALCULATION
<i>Dependent Variable</i>	
Research Intensity	Natural log [(quarterly research and development expenses / assets) + 1]
<i>Independent Variables</i>	
SOX dummy	(0) Pre-SOX = 1999-June 2002 (1) Post-SOX = July 2002 - 2004
Market Value	Natural log of the market value at date of IPO
Number of Employees Or Assets	Number of employees at end of calendar year of the IPO Natural log of Assets at time of IPO
<i>Control Variables</i>	
Age	Natural log (difference in years from year of founding to year of IPO plus the number of days in the IPO year leading up to the IPO)
Capital Intensity	Natural log (assets / number of employees) at time of IPO
Market to Book Ratio	Ratio of the fiscal year end to the quarter end, or price at close of 3 rd month of IPO quarter / (total common equity / common shares outstanding)
<i>Interactions</i>	
SOX:Market Value	
SOX:Employees (or :Assets)	

Table 8. Descriptive Statistics by Industry**Computer Software (N=204)**

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	ln Assets
Min.:	0.0000	-0.79	3.26	-66.87	0.000	1.19	0.045	1.63
Median:	0.0243	1.70	5.76	8.11	0.000	6.18	0.264	4.41
Mean:	0.0272	1.80	5.73	10.69	0.108	6.23	0.386	4.47
Max.:	0.1443	3.71	7.63	107.68	1.000	10.82	5.025	7.97

Computer Hardware (N=29)

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	ln Assets
Min.:	0.0068	0.91	4.27	0.00	0.000	3.16	0.058	3.00
Median:	0.0321	1.92	6.22	8.72	0.000	7.21	0.240	4.92
Mean:	0.0361	1.99	6.10	14.61	0.138	6.59	1.851	4.82
Max.:	0.0769	3.49	6.93	65.39	1.000	9.73	45.000	8.08

Oil and Chemicals (N=15)

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	ln Assets
Min.:	0.0000	-0.24	4.41	0.57	0.000	4.78	0.029	2.34
Median:	0.0114	2.71	6.68	2.84	0.000	6.52	0.200	6.29
Mean:	0.0249	2.51	6.67	16.79	0.400	6.69	36.463	6.30
Max.:	0.1866	4.60	9.05	205.09	1.000	9.46	508.168	10.64

Medical Technology (N=39)

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	ln Assets
Min.:	0.0000	1.28	5.06	1.48	0.000	4.04	0.0090	2.74
Median:	0.0186	2.15	6.11	4.13	0.000	5.47	0.1830	4.43
Mean:	0.0209	2.28	6.19	5.26	0.462	5.55	0.5953	4.58
Max.:	0.0555	3.94	9.78	20.62	1.000	9.37	11.8000	8.48

Electronics (N=81)

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	ln Assets
Min.:	0.0000	-0.21	4.18	-33.36	0.000	3.81	0.038	3.12
Median:	0.0283	2.06	6.15	8.22	0.000	6.23	0.214	4.68
Mean:	0.0359	2.13	6.06	11.11	0.148	6.29	1.219	4.90
Max.:	0.1663	4.20	7.41	48.62	1.000	10.00	29.166	8.84

Biotechnology (N=79)

	R&D Intensity	In Age	Capital Intensity	Market To Book	SOX	In Market Value	Employees	In Assets
Min.:	0.0000	0.80	4.91	-2.77	0.000	2.27	0.017	2.13
Median:	0.0544	1.99	6.78	3.70	0.000	5.58	0.091	4.48
Mean	0.0595	1.93	6.80	4.69	0.405	5.66	0.172	4.55
Max.:	0.1950	3.36	8.44	16.39	1.000	7.63	2.500	6.43

Other (N=224)

	R&D Intensity	In Age	Capital Intensity	Market To Book	SOX	In Market Value	Employees	In Assets
Min.:	0.00000	-1.17	2.64	-333.50	0.000	1.06	0.002	0.944
Median:	0.00000	2.07	6.02	3.75	0.000	6.04	0.397	5.292
Mean:	0.00931	2.23	6.16	6.42	0.433	6.03	3.259	5.561
Max:	0.08360	4.93	11.89	462.74	1.000	10.60	89.700	12.588

Combined (N=671)

	R&D Intensity	In Age	Capital Intensity	Market To Book	SOX	In Market Value	Employees	In Assets
Min.:	0.00000	-1.17	2.64	-333.50	0.000	1.06	0.002	0.944
Median:	0.01970	1.91	6.03	5.37	0.000	6.02	0.246	4.678
Mean:	0.02604	2.05	6.10	8.60	0.285	6.09	2.302	4.959
Max.:	0.19500	4.93	11.89	462.74	1.000	10.82	508.168	12.588

Table 9. Correlations of Combined Data Set

	R&D Intensity	ln Age	Capital Intensity	Market To Book	SOX	ln Market Value	Employees	Assets
R&D Intensity	1.00000							
ln Age	-0.12234	1.00000						
Capital Intensity	-0.04450	-0.238128	1.000000					
Market To Book	0.09883	-0.095359	-0.04031	1.000000				
SOX	-0.10433	0.187725	0.18684	-0.14767	1.000000			
ln Market Value	-0.04226	0.050273	0.03010	0.20252	-0.11788	1.000000		
Employees	-0.05933	0.001170	-0.10612	-0.02168	-0.01695	0.17526	1.000000	
ln Assets	-0.35780	0.281724	0.30506	-0.04258	0.19049	0.47856	0.311896	1.000000

Table 10. Coefficients (with t value) / COMPUTER SOFTWARE

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	1.90e-03 (0.87)	0.002600 (1.21)	2.59e-03 (1.21)	2.20e-03 (1.04)
Capital Intensity	-9.98e-03*** (-4.73)	-0.012363*** (-5.62)	-1.28e-02*** (-5.57)	-1.43e-02*** (-6.26)
Market to Book Value	-6.42e-05 (-0.65)	-0.000094 (-0.83)	-8.69e-05 (-0.77)	-5.33e-05 (-0.48)
SOX		-0.002370 (-0.51)	-4.32e-03 (-0.79)	-6.07e-02** (-2.73)
Market Value		0.001138 (1.02)	1.18e-03 (1.06)	4.01e-04 (0.35)
Number of Employees		-0.009711** (-3.09)	-1.26e-02* (-2.34)	-1.28e-02*** (-3.88)
SOX:Employees			4.14e-03 (0.66)	
SOX:Market Value				9.80e-03** (2.68)
Adj. R²:	0.11	0.147	0.145	0.173
p-value:	8.3e-06	1.34e-06	3.09e-06	1.59e-07
F-stat:	9.34 on 3	6.83 on 6	5.9 on 7	7.07 on 7
Note (#firms Pre-SOX/Post-SOX): 182 firms prior to SOX, 22 firms after SOX, for a total of 204 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 11. Coefficients (with t value) / BIOTECHNOLOGY

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-0.009203 (-1.05)	0.000431 (0.05)	0.00237 (0.27)	0.000949 (0.11)
Capital Intensity	-0.005571 (-0.77)	-0.014400 (-1.86)	-0.01677* (-2.13)	-0.015340 (-1.98)
Market to Book Value	0.000947 (0.63)	0.001998 (1.28)	0.00180 (1.15)	0.001998 (1.28)
SOX		0.020272* (2.28)	0.01242 (1.19)	-0.048473 (-0.88)
Market Value		0.003490 (0.66)	0.00548 (1.00)	-0.000471 (-0.08)
Number of Employees		-0.052760** (-3.03)	-0.09846** (-2.69)	-0.056590** (-3.21)
SOX:Employees			0.05004 (1.41)	
SOX:Market Value				0.012457 (1.27)
Adj. R²:	-0.0159	0.114	0.126	0.121
p-value:	0.622	0.0213	0.0187	0.0217
F-stat:	0.593 on 3	2.67 on 6	2.61 on 7	2.54 on 7
Note (#firms				
Pre-SOX/Post-SOX): 47 firms prior to SOX, 32 firms after SOX, for a total of 79 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 12. Coefficients (with t value) / ELECTRONICS

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-0.010904* (-2.64)	-0.010624* (-2.44)	-0.010589* (-2.40)	-0.010600* (-2.43)
Capital Intensity	-0.004543 (-0.92)	-0.006191 (-1.15)	-0.006275 (-1.12)	-0.006380 (-1.18)
Market to Book Value	0.000217 (0.75)	0.000112 (0.35)	0.000113 (0.35)	0.000131 (0.40)
SOX		-0.001876 (-0.20)	-0.001513 (-0.13)	-0.051811 (-0.77)
Market Value		0.002269 (0.76)	0.002282 (0.76)	0.001740 (0.57)
Number of Employees		-0.001014 (-0.99)	-0.001019 (-0.99)	-0.000970 (-0.95)
SOX:Employees			-0.000719 (-0.06)	
SOX:Market Value				0.008614 (0.75)
Adj. R²:	0.0667	0.0441	0.031	0.0384
p-value:	0.0400	0.155	0.233	0.197
F-stat:	2.91 on 3	1.61 on 6	1.37 on 7	1.46 on 7
Note (#firms				
Pre-SOX/Post-SOX): 69 firms prior to SOX, 12 firms after SOX, for a total of 81 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 13. Coefficients (with t value) / MEDICAL TECHNOLOGY

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-0.007961** (-2.75)	-0.006865* (-2.10)	-0.006132 . (-1.90)	-0.006836 (-2.06)
Capital Intensity	0.000568 (0.26)	0.000162 (0.07)	-0.001672 (-0.65)	0.000136 (0.06)
Market to Book Value	0.000709 (1.53)	0.001127 (1.89)	0.000943 (1.59)	0.001116 (1.83)
SOX		0.005119 (1.33)	0.009132 . (2.02)	0.009192 (0.33)
Market Value		-0.000635 (-0.23)	0.000774 (0.27)	-0.000295 (-0.08)
Number of Employees		-0.001037 (-0.64)	-0.001211 (-0.76)	-0.001136 (-0.64)
SOX:Employees			-0.013550 (-1.60)	
SOX:Market Value				-0.000751 (-0.15)
Adj. R²:	0.161	0.17	0.208	0.143
p-value:	0.0272	0.0592	0.0418	0.102
F-stat:	3.44 on 3	2.29 on 6	2.43 on 7	1.91 on 7
Note (#firms				
Pre-SOX/Post-SOX): 21 firms prior to SOX, 18 firms after SOX, for a total of 39 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 14. Coefficients (with t value) / COMPUTER HARDWARE

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-1.85e-02* (-2.59)	-0.018538* (-2.75)	-0.021803** (-2.97)	-0.018511* (-2.67)
Capital Intensity	-2.20e-02** (-2.84)	-0.029977** (-3.39)	-0.027249** (-2.98)	-0.029956** (-3.31)
Market to Book Value	1.24e-05 (0.05)	-0.000637 (-1.80)	-0.000533 (-1.46)	-0.000642 (-1.70)
SOX		-0.003178 (-0.27)	0.005747 (0.41)	-0.000560 (-0.01)
Market Value		0.008097* (2.55)	0.005881 (1.56)	0.008150* (2.37)
Number of Employees		-0.000818 (-1.38)	0.023512 (1.06)	-0.000788 (-0.90)
SOX:Employees			-0.024054 (-1.09)	
SOX:Market Value				-0.000491 -0.05
Adj. R²:	0.177	0.278	0.285	0.244
p-value:	0.0495	0.0354	0.0429	0.0669
F-stat:	3 on 3	2.8 on 6	2.59 on 7	2.29 on 7
Note (#firms				
Pre-SOX/Post-SOX): 25 firms prior to SOX, 4 firms after SOX, for a total of 29 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '!'.				

Table 15. Coefficients (with t value) / OIL AND CHEMICALS

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	8.19e-04 (0.29)	-4.89e-03 (-1.21)	-4.82e-03 (-1.11)	-9.29e-03 . (-2.11)
Capital Intensity	-3.76e-03 (-1.41)	-9.20e-03* (-2.51)	-8.95e-03 . (-2.05)	-1.09e-02* (-3.19)
Market to Book Value	8.29e-04*** (10.70)	7.57e-04*** (8.92)	7.59e-04*** (8.25)	7.36e-04*** (9.58)
SOX		1.06e-02 (1.22)	9.56e-03 (0.77)	1.03e-01 . (1.92)
Market Value		2.60e-03 (0.68)	2.24e-03 (0.45)	1.23e-02 (1.88)
Number of Employees		-9.53e-05 (-1.76)	-9.20e-05 (-1.45)	-1.80e-04* (-2.62)
SOX:Employees			2.54e-04 (0.13)	
SOX:Market Value				-1.39e-02 (-1.74)
Adj. R²:	0.913	0.922	0.911	0.937
p-value:	1.07e-06	5.59e-05	0.000321	9.45e-05
F-stat:	50 on 3	28.5 on 6	21.4 on 7	31 on 7
Note (#firms				
Pre-SOX/Post-SOX): 9 firms prior to SOX, 6 firms after SOX, for a total of 15 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 16. Coefficients (with t value) / OTHER

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-2.13e-03* (-2.26)	-8.93e-04 (-0.89)	-8.61e-04 (-0.85)	-9.11e-04 (-0.90)
Capital Intensity	-1.85e-03** (-2.81)	-1.09e-03 (-1.60)	-1.13e-03 (-1.64)	-1.07e-03 (-1.57)
Market to Book Value	3.62e-05 (1.37)	2.79e-05 (1.07)	2.83e-05 (1.08)	2.80e-05 (1.07)
SOX		-8.51e-03*** (-3.84)	-8.19e-03*** (-3.48)	-1.17e-02 (-1.13)
Market Value		-6.43e-04 (-0.78)	-6.42e-04 (-0.78)	-7.96e-04 (-0.83)
Number of Employees		-3.46e-05 (-0.31)	-1.78e-05 (-0.15)	-3.01e-05 (-0.26)
SOX:Employees			-1.10e-04 (-0.41)	
SOX:Market Value				5.24e-04 (0.31)
Adj. R²:	0.0414	0.0914	0.0879	0.0876
p-value:	0.00642	0.000148	0.000325	0.000334
F-stat:	4.21 on 3	4.74 on 6	4.07 on 7	4.06 on 7
Note (#firms Pre-SOX/Post-SOX): 127 firms prior to SOX, 97 firms after SOX, for a total of 224 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 17. Coefficients (with t value) / ALL INDUSTRIES COMBINED

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry				
	Model 1	Model 2	Model 3	Model 4
Age	-4.09e-03*** (-3.33)	-3.53e-03** (-2.78)	-3.37e-03** (-2.63)	-3.39e-03** (-2.66)
Capital Intensity	-1.74e-03 (-1.84)	-1.44e-03 (-1.47)	-1.58e-03 (-1.59)	-1.45e-03 (-1.47)
Market to Book Value	9.01e-05* (2.17)	9.15e-05* (2.14)	9.14e-05* (2.14)	8.88e-05* (2.08)
SOX		-4.15e-03 (-1.63)	-3.55e-03 (-1.35)	1.19e-02 (0.96)
Market Value		-1.03e-03 (-1.24)	-9.47e-04 (-1.13)	-5.29e-04 (-0.58)
Number of Employees		-7.72e-05 (-1.44)	-7.20e-05 (-1.33)	-7.93e-05 (-1.48)
SOX:Employees			3.15e-04 (-0.85)	
SOX:Market Value				-2.74e-03 (-1.32)
Adj. R²:	0.0232	0.0286	0.0282	0.0297
p-value:	0.000321	3e-04	0.000501	0.000329
F-stat:	6.3 on 3	4.29 on 6	3.78 on 7	3.93 on 7
Note (#firms Pre-SOX/Post-SOX): 480 firms prior to SOX, 191 firms after SOX, for a total of 671 firms				
Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'				

Table 18. Coefficients (with t value) / By Industry and Assets (versus # of Employees as a Proxy for Firm Size)

R&D Intensity as the Dependent Variable: Linear Regression Analysis by Industry								
	<u>Model 1</u>	<u>Model 2</u>	<u>Model 3</u>	<u>Model 4</u>	<u>Model 5</u>	<u>Model 6</u>	<u>Model 7</u>	<u>Model 8</u>
	Computer Software	Biotech	Electronics	Medical Technology	Computer Hardware	Oil and Chemicals	Other	All Industries
CONTROL VARIABLES								
Age	2.63e-03 (1.25)	1.74e-03 (0.20)	-0.008251 (-1.93)	-0.006069 (-1.80)	-0.017382* (-2.48)	2.56e-03 (1.23)	8.76e-04 (0.85)	1.16e-03 (0.91)
Capital Intensity	-5.41e-03* (-2.30)	7.97e-05 (0.01)	-0.004774 (-0.97)	0.000583 (0.25)	-0.024325** (-3.01)	-7.65e-03** (-3.47)	6.88e-04 (0.91)	2.63e-03** (2.66)
Market to Book Value	-2.87e-05 (-0.25)	9.05e-04 (0.57)	0.000115 (0.37)	0.000855 (1.64)	-0.000541 (-1.33)	5.86e-04*** (6.87)	1.86e-05 (0.74)	5.42e-05 (1.35)
INDEPENDENT VARIABLES								
SOX	-1.93e-03 (-0.43)	1.56e-02 (1.80)	-0.001248 (-0.14)	0.003325 (0.78)	-0.006628 (-0.56)	1.78e-02* (2.62)	-7.10e-03** (-3.32)	-8.34e-04 (-0.35)
Market Value	1.56e-03 (1.41)	1.60e-02* (2.25)	0.006171 (1.93)	0.002427 (0.54)	0.006909 (1.53)	1.37e-02* (2.91)	1.60e-03 (1.78)	3.52e-03*** (3.91)
Assets	-9.78e-03*** (-4.00)	-3.31e-02*** (-3.58)	-0.009947** (-2.75)	-0.004950 (-1.04)	-0.001818 (-0.31)	-1.19e-02** (-3.65)	-4.07e-03*** (-4.46)	-1.04e-02*** (-10.01)
INTERACTIONS (separate run with interactions)								
SOX:Assets	5.47e-04 (0.12)	0.017353 (1.43)	-0.002347 (-0.18)	-0.002631 (-0.54)	-0.009848 (-1.25)	-2.08e-03 (-0.61)	4.85e-04 (0.34)	-4.06e-03* (-2.41)
Adj. R ² :	0.173	0.152	0.121	0.187	0.219	0.959	0.167	0.153
p-value:	8.44e-08	0.00599	0.0154	0.0458	0.0701	4.28e-06	2.83e-08	<2e-16
F-stat:	8.07 on 6	3.33 on 6	2.83 on 6	2.45 on 6	2.31 on 6	55.8 on 6	8.47 on 6	21.2 on 6
Note (#firms Pre-SOX/Post-SOX):	182/22	47/32	69/12	21/18	25/4	9/6	127/97	480/191

Significance codes: p~ 0 '***', p< 0.001 '**', p< 0.01 '*', p< 0.05 '.'

Figure 1. Dow Jones Industrials, 1980s-2000s

(<http://stockcharts.com/freecharts/historical/djia19802000.html>)

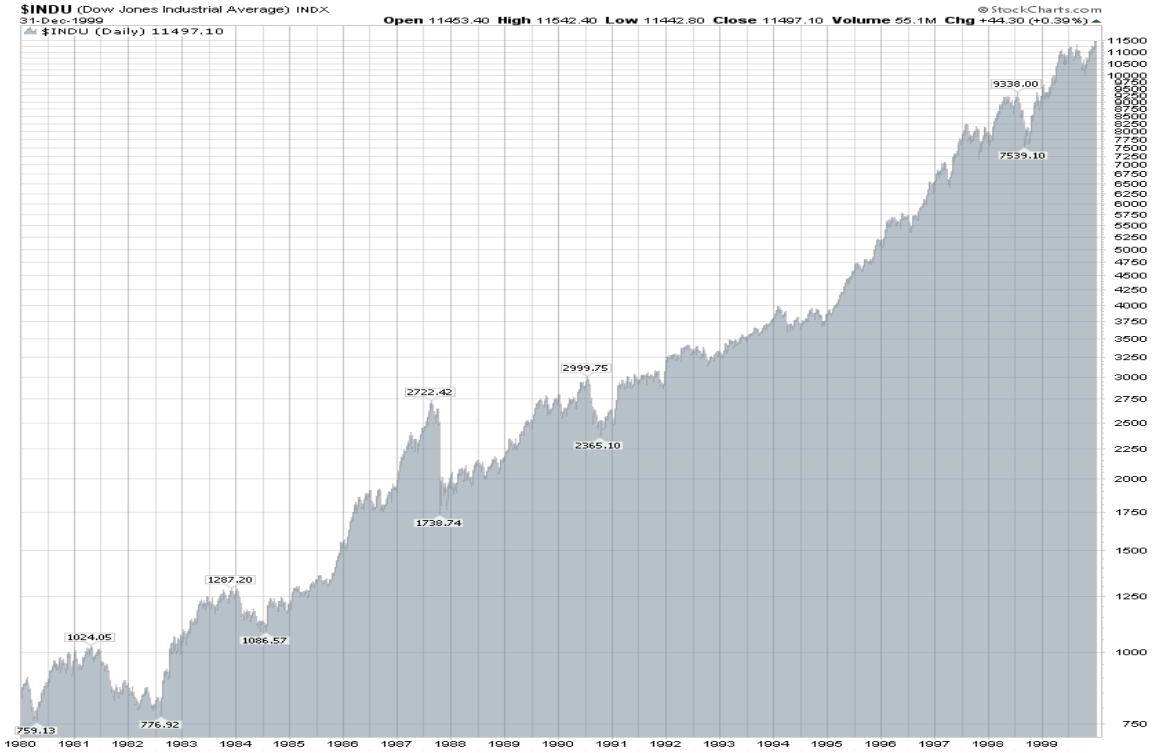


Figure 2. Events Leading to Sarbanes-Oxley Legislation (SOX)

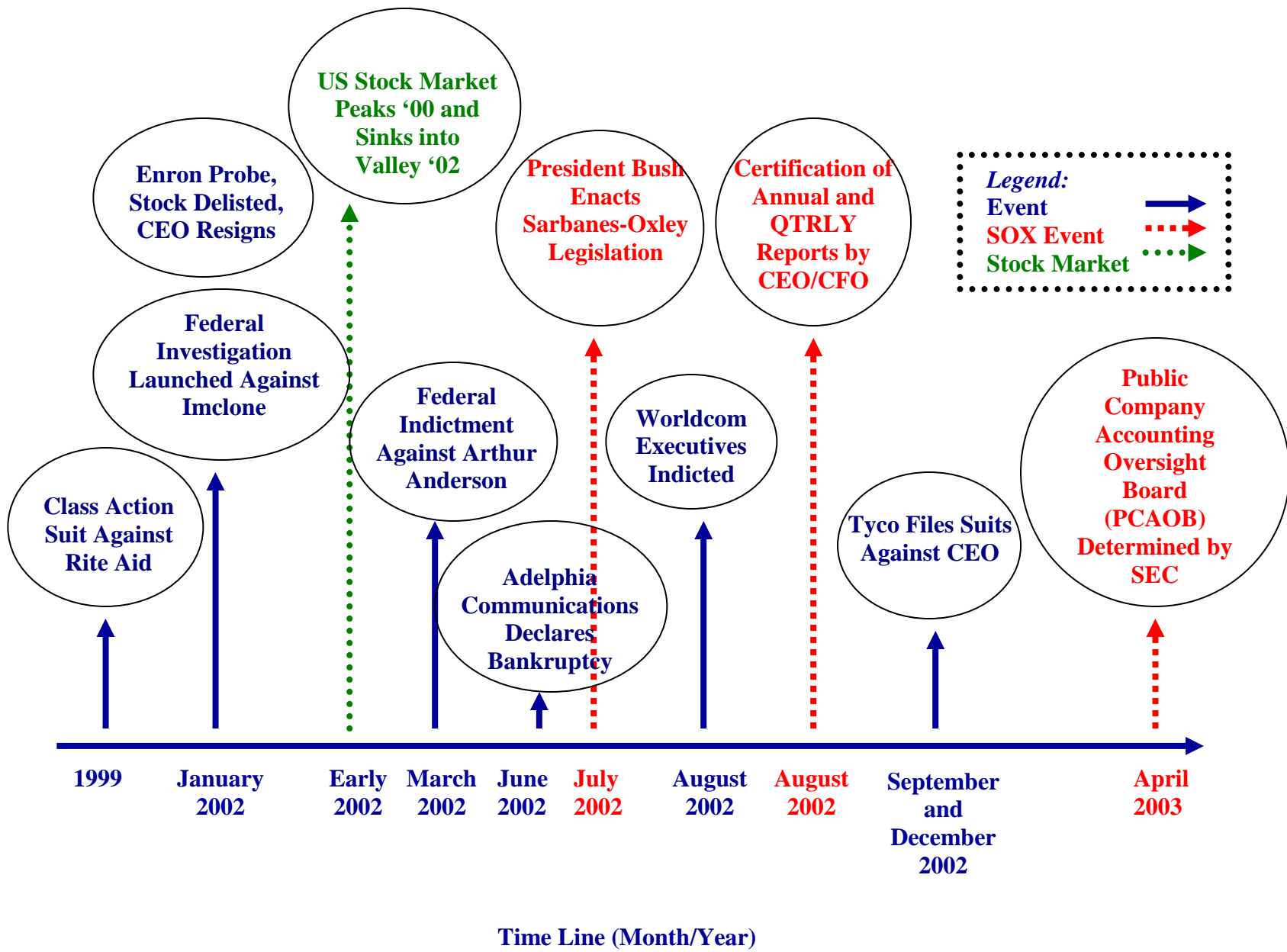


Figure 3. Number of Firms Going Public between 1999-2004.

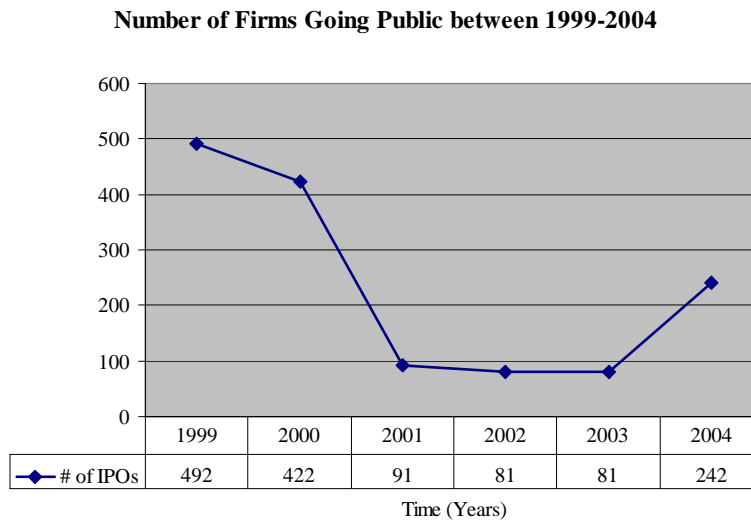


Figure 4. Number of Research Intensive and non-Research Intensive Firms Going Public between 1999-2004. (For which there is Compustat data) (Percentages similar to Ritter and Welch)

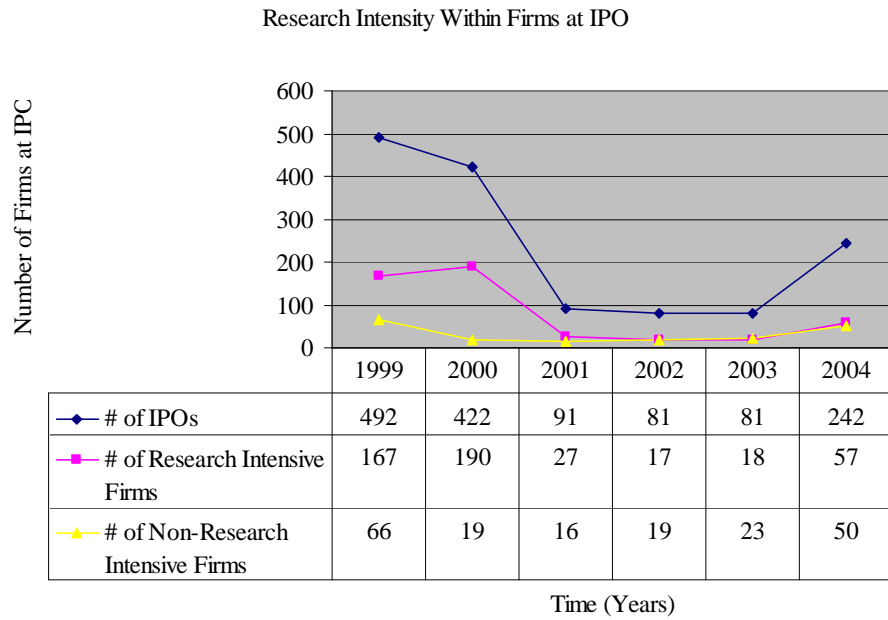


Figure 5. Total Number of Patent Applications and Grants from 1996 through 2008.

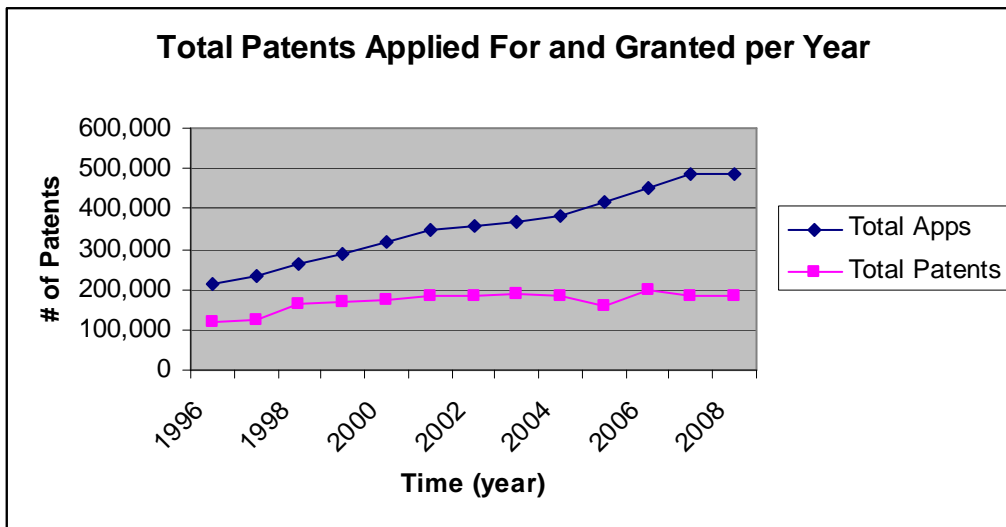


Figure 6. Foreign versus Domestic Patents Granted, 1996-2009

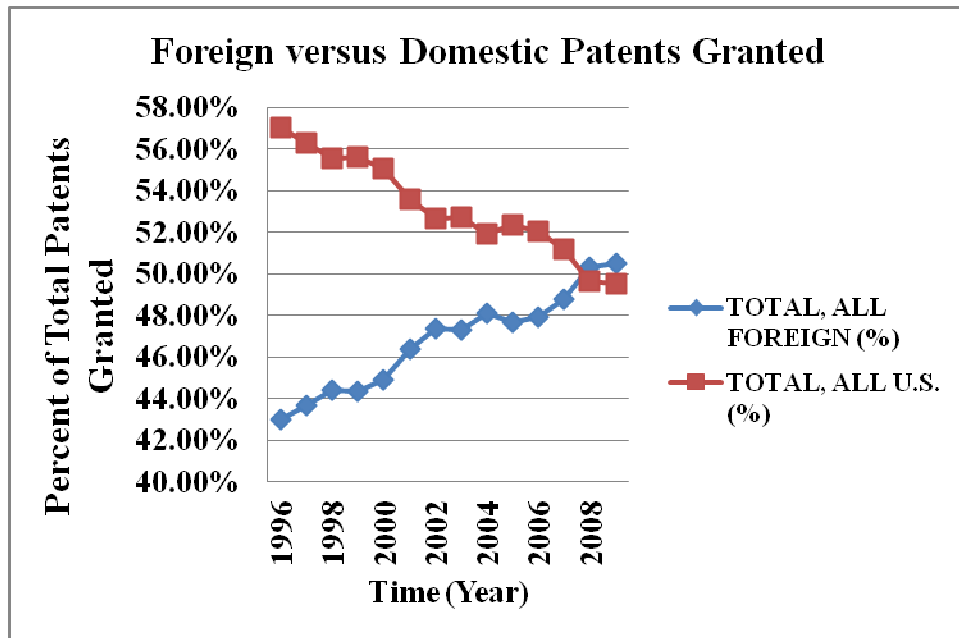


Figure 7: Decision-Making Process on Whether or Not To Go Public

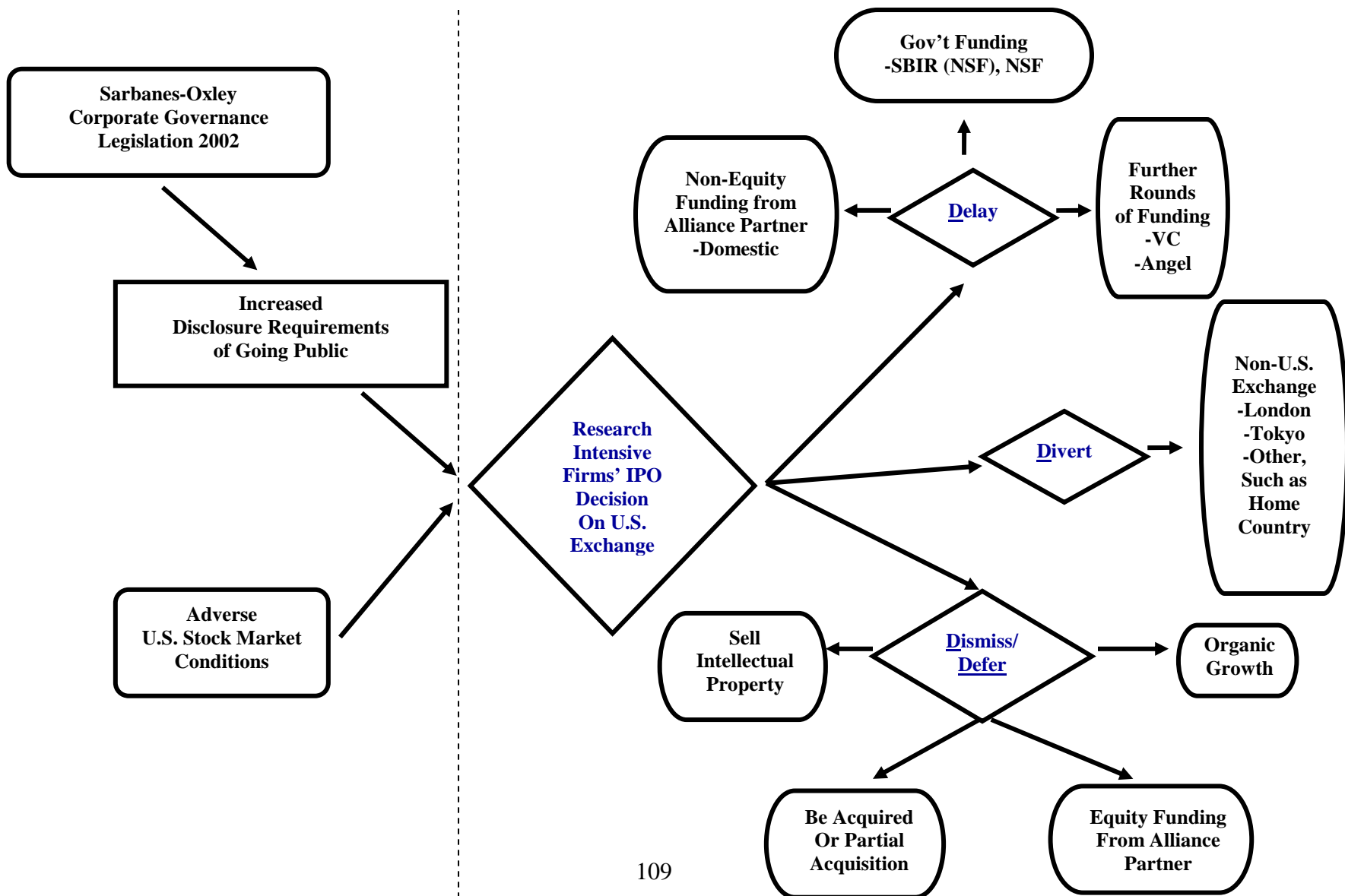


Figure 8. Pre-SOX Research Industries, 1999-2002, # of Firms and % of Total Research Industries

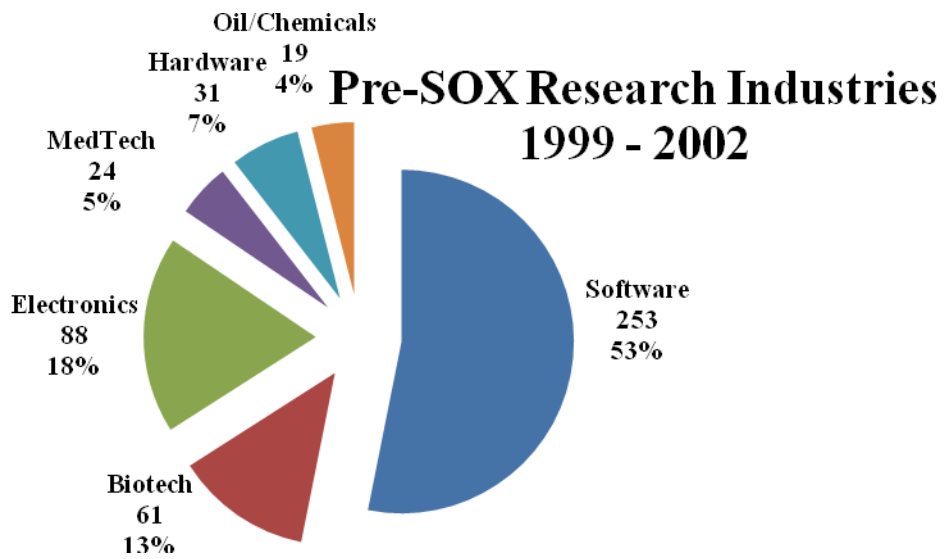


Figure 9. Post-SOX Research Industries, 2003-2004, # of Firms and % of Total Research Industries

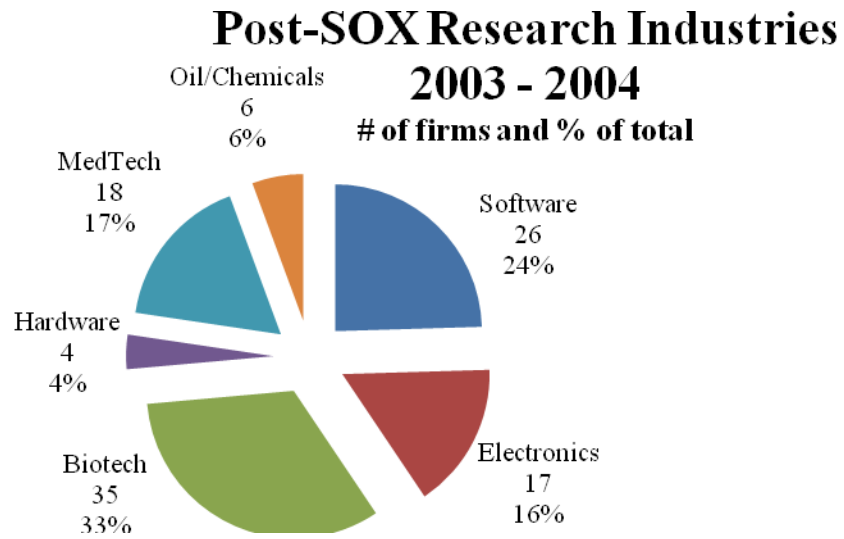


Figure 10. Average Market Value at IPO, Pre- and Post-SOX (Compustat data)

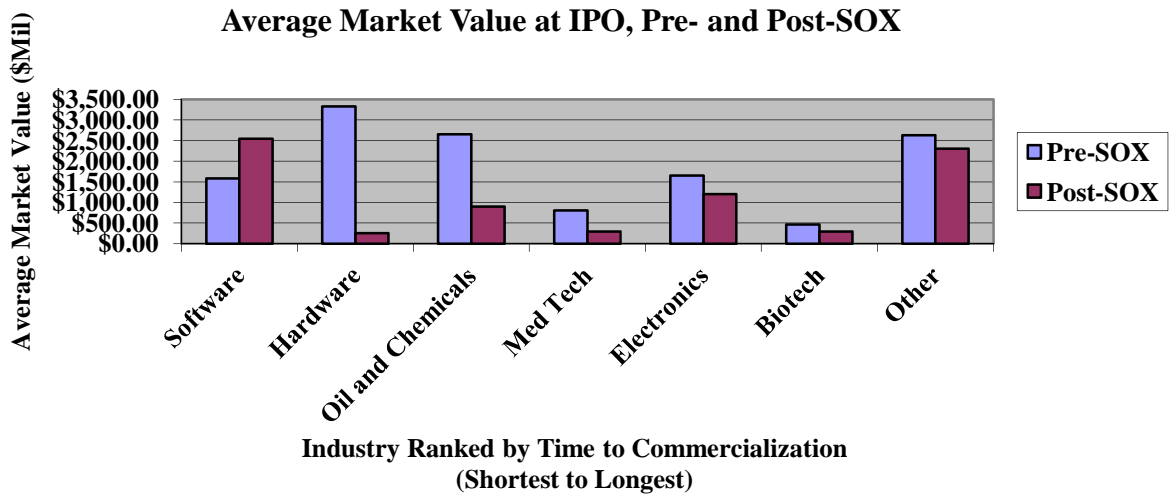


Figure 11. London Stock Exchange - IPO Activity, 1999-2004

