

**Institutional Design and Market Efficiency:
Evidence from the New York Stock Exchange IPO**

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International Society for New Institutional Economics

Stanford University, June 16-18, 2011

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Abstract

A well-designed market keeps a variety of “off the equilibrium” path behaviors at bay. Unfortunately, forgotten hazards, such as the classic “lemons” problem, can re-emerge and pose a special threat to market participants when institutional change weakens deterrence. We argue this is occurring in the U.S. capital markets in the wake of the 2006 IPO of the New York Stock Exchange (“NYSE”). The IPO was the central event in a complex process that undermined institutional features of the NYSE that had been the basis of its stability and success for 200 years, including an open-outcry auction, the monopolistic “specialist,” and the “clubby” membership system. Contrary to the conventional wisdom in the literature, which focuses on trading activity, we argue that these features all contributed to the efficient pricing of securities listed on the underwriter governed non-profit NYSE. Today’s for-profit, shareholder owned NYSE generates revenue from trading fees rather than the underwriting fees that underlay the pre-IPO NYSE and thus the Exchange now lacks the incentives to minimize volatility. Instead, we argue, the NYSE has come to resemble the NASDAQ, a venue long controlled by traders rather than underwriters. We use stock market data on the bid-ask spread of both trading venues to demonstrate this convergence and to highlight the difference in institutional design between a non-profit exchange governed underwriters and a publicly traded for-profit exchange.

I. Introduction

A well-designed market keeps a variety of “off the equilibrium” path behaviors at bay. Indeed, market participants may even forget about long-deterred problems altogether, as their appearance becomes rare. Unfortunately, forgotten hazards can re-emerge and pose a special threat when institutional change weakens deterrence, precisely because that re-emergence is unanticipated. We believe this is precisely the case at the New York Stock Exchange (“NYSE” or “Exchange”), a 200-year old market that has recently undergone significant institutional change. We show that that change has indeed weakened deterrence such that old hazards have re-emerged. The NYSE, of course, is often held up as an exemplar of market capitalism and yet just as frequently reviled as a symbol of excess and greed. When the latter view has gained the upper hand, as it did in the 1930s and has again more recently in the wake of the dotcom, telecom and housing bubbles, there is tremendous pressure on the NYSE to alter its institutional design. While such reform efforts may seem well intentioned they have not followed a careful analysis of the incentives and mechanisms that shape the institutional design long in place at the NYSE. Yet, it is exactly that institutional design that has been the basis of the NYSE’s stability and success.

The NYSE’s institutional design can sometimes appear archaic and inefficient, However, we argue that this is a misinterpretation of the logic behind the most prominent and frequently targeted features of the NYSE such as its restrictions on admission to membership or its equally restrictive approach to decisions about which firms may list their securities for trading on the Exchange. Thus, we explain here how such features as an open-outcry auction, the monopolistic “specialist,” and the “clubby” membership

system may seem outdated in an era of web-based trading platforms but in fact have long served a valuable purpose—and could have continued to do so today.

We write of the NYSE in the past tense because its “demutualization” (i.e., its conversion from a member governed non-profit to a for-profit corporation) in 2006 represented a permanent break from the institutional structures that made it successful and efficient.¹ Here we define success in terms of the profits the Exchange generated for its members, and efficiency in terms of the quality of the market provided for members’ clients, listed firms. As a non-profit, the NYSE benefited member underwriters who profited from a venue for trading high quality “blue chip” stocks. But such a venue required monopoly control over trading in order to minimize the type of price volatility that scares off investors, limiting liquidity. Today’s for-profit NYSE lacks the incentive to minimize volatility, because its shareholders profit from listing and trading fees rather than underwriting fees. Thus, we argue, the NYSE has come to resemble the National Association of Securities Dealers Automated Quotation system (NASDAQ), which was traditionally owned by traders.² We use stock market data on the bid-ask spread of both trading venues to demonstrate this convergence and to highlight the difference in incentives and mechanisms between an exchange governed by underwriters and a publicly traded for-profit corporation.

¹ On March 6, 2006, the NYSE merged into Archipelago Holdings, Inc., the owner of an electronic trading platform, which was already publicly traded. The newly formed merged company took the name NYSE Group, Inc. The exchange itself became the New York Stock Exchange LLC, a wholly owned subsidiary of NYSE Group. NYSE Group became NYSE Euronext when it merged with Euronext, itself a merger of several European exchanges, in 2007. (NYSE Euronext Annual Report on Form 10K, Feb. 27, 2009)

² The NASDAQ demutualized, too, first selling shares to the public in 2002, but broker-dealers retained effective control until the end of 2006. The exchange was nominally publicly traded from mid-2002, but the National Association of Securities Dealers owned preferred stock that gave it voting control over the exchange until the end of 2006. Our analysis predicts no changes in its objective function with a change in governance structure or demutualization. (The Nasdaq Stock Market, Inc. Annual Reports on Form 10K, Mar. 28, 2002 and Feb. 28, 2007)

A question naturally arises in consideration of this issue: if a non-profit NYSE was, in fact, so beneficial for members, issuing firms and participating investors, why would its members vote to demutualize? We argue that regulation-induced competition eliminated the NYSE's monopoly on trading, which undermined its ability to manage volatility so important to keeping small investors engaged. And while the introduction of competition may have been well intentioned, it was also misguided. Liquidity is a positive externality associated with a single market because pricing is more efficient when all buyers and sellers are in one place. Once the market for securities dispersed among multiple venues that externality is impacted. The emergence of a demutualized NYSE thus provides a powerful counterfactual that allows us to observe the hazards the non-profit NYSE was designed to mitigate. In addition to the statistical analysis of stock data mentioned above, we also interpret recent market events, including the "flash crash" of May 2010, a revived market for initial public offerings, and the rise of private resale markets.

II. Background and Literature Review

The economics literature on the design and governance of exchanges has tended to view stock exchanges like traditional marketplaces, where goods are bought and sold on a spot market. Attention has therefore mainly focused on trading, with work on trading costs³, and more recently, technology adoption or electronic trading.⁴ When governance questions are considered, the focus has been on how best to deter trading

³ See Huang and Stoll, 1996; Venkataraman, 2001; Pagano and Roell, 1996; Christie and Huang, 1994; and Handa, Schwartz and Tiwari, 2004.

⁴ See Cantillon and Yin, 2007; Stoll, 2005; Aggarwal, 2002; Domowitz, 1990; and Hasan, Malkamaki and Schmiedel, 2003.

infractions, such as inter-positioning (where the trader profits by buying at one price and selling at another instead of giving his client the lower buying price), or otherwise managing the monopoly “specialist” firms that execute trades.⁵ Some research has also analyzed differences in incentives between non-profits and for-profits, but with the exception of Macey and O’Hara (1999), this research largely assumes trading is the primary function of exchanges.⁶

Trading activity among many small buyers and sellers is also an important feature in the literature on market efficiency. Indeed the NYSE’s pricing history has always been closely associated with the “efficient market hypothesis” (EMH), inspiring the idea that available information about a capital asset is fully reflected in the price of that asset (as expressed by Fama, 1970, among others⁷). Data from the NYSE has also been used to test the EMH⁸ and the EMH continues to serve as the basis of regulatory policy,⁹ academic research¹⁰ and investment strategy.

⁵ See Benveniste, Marcus and Wilhelm, 1992; Corwin, 1999, Madhavan and Panchapagesan, 2000; and Battalio, Ellul and Jennings, 2007.

⁶ See Serifsoy (2007), Saloner (1985), Pirrong (2000), Hart and Moore (1996), Domowitz and Steil (1999), and DeMarzo, Fishman and Hagerty (2005).

⁷ Fama (1965) states that “many of the ideas in [his] paper arose out of the work of Benoit Mandelbrot.” In addition to Mandelbrot, key figures included Samuelson, Kendall, Roberts and Cootner. The much older work of Bachelier (1900) is also now understood to have been important to the modern development of the EMH.

⁸ See Fama (1970), Jensen (1978), and Malkiel (2003).

⁹ The modern securities regulation regime, particularly its federally imposed mandatory disclosure obligations, is built upon acceptance of the EMH. The EMH also underpins the grounds upon which securities class action lawsuits are filed. See *Basic Inc. v. Levinson*, 485 U.S. 224 (1988).

¹⁰ For example, informational efficiency allows for event studies—which are too numerous to cite—in which the market’s reaction to an announcement or action by a publicly traded firm can be gauged by changes in stock price.

However, trading is only the most visible aspect of a stock exchange. An equally important, but often ignored, part of the functioning of a stock exchange is the listing and underwriting process. Behind the scenes of a noisy and active trading floor is a complex decision about precisely which firms' securities are to be traded on that floor in the first place. Superficially, each exchange has published listing requirements, standards that must be met before a stock can be listed, including size of the float of company shares and financial health.¹¹ But in addition to applying these formal standards, NYSE members served as gatekeepers who carried out a "due diligence" process and a market testing process known as a "road show" in order to decide which securities would be listed and at what price. In fact, these additional hurdles¹² led to the exclusion of most firms from the Exchange's trading floor (Diamond and Kuan, 2007; Harris, 2006). Thus, the underwriting process involves several steps: evaluating firms according to formal and informal listing and diligence requirements, securing indications of interest in the securities, and then underwriting the issue (in which a banker initially buys the entire issue and then re-sells it to the investors whose interest has been cataloged during the road show).

Thus, while the literature has examined governance implications for trading, the less visible underwriting side of exchange activity has gone relatively unexplored. To address this, we offer the following model, which shows how underwriters influence the most prominent features of the NYSE's institutional design.

¹¹ See, for example, The Listed Company Manual, New York Stock Exchange.

¹² Just as the NYSE would to a large extent eschew the volatile firms that emerged in Silicon Valley in the 1980s and 1990s, it sidestepped in the 1850s firms that depended on mining and other highly speculative activities where effective "due diligence" investigations were extremely difficult to carry out (Sobel, 1965).

III. Conceptual Model

For our model of a stock exchange, we consider traders and underwriters separately, modeling a single representative of each.

Traders

Suppose a trader provides trading services to a single client. His profit is:

$$\Pi_t = p_t(x) - c_t(x) + x * \text{spread}$$

where x is the number of shares to be traded for the customer, p_t is the price charged to the customer for the service of executing trades, c_t is the trader's cost to execute trades, and *spread* is the bid-ask spread, or the difference between the price the trader pays for a stock and the price he receives when selling the stock. The spread is set by the market for buyers and sellers and is thus exogenous to the trader. For the moment, we consider the case of perfect competition,¹³ so that $\Pi_t = 0$. However, because we assume $p_t(x) \geq 0$, $\Pi_t = x * \text{spread}$, as *spread* is exogenous to the trader. Traders thus benefit from competition: while their profits from service provision are driven down by competition, spreads increase with competition, as liquidity becomes distributed among a greater number trading venues.¹⁴

¹³ Under NASDAQ rules, initially an issuer must have at least 3 traders willing to make a market in its shares (Rule 4310(c)(1) Nasdaq Marketplace Rules). Ostensibly, this rule ensures liquidity, since there are multiple market makers. On the other hand, it also ensures that liquidity is diffuse rather than concentrated in a single market, and that there is competition among traders.

¹⁴ During the “flash crash” in May 2010, prices varied significantly on different trading venues, especially after the NYSE “circuit breaker” went into effect. “For example, P&G was bought on the NYSE floor at \$56 while a trade for it at \$39.37 went through on the Nasdaq,” (Yesalavich, 2010).

Underwriters

A representative underwriter would have the following profit function for servicing a single client:

$$\Pi_u = p_u(\text{spread}) - c_u(\text{spread})$$

where p_u is the price charged to the client and c_u is the cost of servicing the client. If, for the moment, we assume that the underwriter has market power, then he maximizes profit subject to client demand, which is also a function of the spread. In particular, a wider spread, or price range for an asset, implies greater uncertainty about the asset's true value, so a client prefers—and is willing to pay for—lower spreads. The underwriter thus chooses the profit-maximizing spread based upon the cost of reducing the spread and the willingness to pay of the client for a lower spread.

Member organization, incentives, and mechanisms

In this set up, with oligopoly underwriters and competitive traders, underwriters and traders have opposing incentives vis-à-vis spreads: underwriters profit from lower spreads while traders profit from higher spreads. In order for underwriters to control spreads, and resolve the conflict with traders, we posit an institution in which underwriters form a member organization that is exclusive enough maintain collusion and that assigns monopoly rights to traders. The trader then earns monopoly profits from service provision rather than trading profits from high spreads. That is, $p_t(x) - c_t(x) > 0$,

while x^* spread falls with declining spreads. The trading monopoly also has the effect of aggregating liquidity in one place, which also reduces spreads.

This underwriter-organized exchange is consistent with the non-profit organization of the NYSE in broad strokes as well as in smaller, more nuanced ways, especially in attracting small investors who provide the liquidity that reduces spreads and volatility. To see how small investors improve pricing and volatility, we need only observe the large discontinuous price jumps—sometimes 20% or more between trades—on trading platforms such as SharesPost and SecondMarket, which exclude small investors.¹⁵ To address the wide price swings that can scare away investors, as occurred after the recent “flash crash,”¹⁶ the NYSE instituted a number of rules and industry practices, some of which seem arcane or outdated. The elimination of some of these mechanisms after demutualization provides counterfactuals that highlight their original purpose.

For example, to address the problem of price volatility, and thus make the NYSE more attractive to small investors, the non-profit era NYSE granted monopoly trading-rights to a “specialist” who operated an open-outcry auction on the Exchange floor with buyers and sellers. While this arrangement, with its appearance of a shouting “flash mob” on the trading floor, appears antiquated, it smoothly accommodated electronic

¹⁵ SharesPost and SecondMarket are platforms that facilitate the secondary trading of securities issued by privately held firms. As Section 12(g) of the Securities Exchange Act of 1934 requires the public filing of financial and other information by any firm with 500 or more shareholders, the number of buyers and sellers on such venues has an inherent limit. Employees of the firms largely provide the initial supply of shares and then those shares trade among accredited investors or institutions that meet certain minimum wealth and sophistication requirements.

¹⁶ On May 6, 2010, a variety of stocks dropped rapidly in price within a few minutes at around 2:40 p.m., including some that fell to just pennies a share. The Dow Jones Industrial Average as a whole fell nearly 1,000 points. The extreme volatility scared off small investors. (*USA Today*, 2011).

orders and effectively approximated the theoretical “Walrasian auctioneer” who sets prices based on total supply and demand. Such a “Walrasian auctioneer” mechanism helped deter specious bidding by traders trying to gain or game information about supply and demand.¹⁷

The assignment of a monopolist specialist also gave the NYSE the power to impose restrictions that would further attract small investors. The specialist must maintain a “continuous” and “fair and orderly” market,¹⁸ which helps make for the small, “random walk” price movements that have been analogized with Brownian motion in the physical world and that inspired the efficient market hypothesis. The NYSE’s market wide “circuit breaker” is a related rule instituted in the wake of the 1987 market meltdown. It enables the Exchange to halt trading briefly when prices decline significantly. During the “flash crash” on May 6, 2010, for example, “the exchange stopped its own electronic trading...to go into ‘slow’ mode [where] the ‘designated market makers’¹⁹ on the NYSE floor are given an opportunity to come in on the other side of an order at a price they have time to think about. On May 6, trading in stocks such as Procter and Gamble, 3M and Accenture went into that mode on the NYSE floor,” but were traded on ECN’s freely where wild price swings took hold (Yesalavich, 2010).

In an attempt to deal with the impact of dispersed trading venues on pricing volatility, the

¹⁷ In the absence of a “Walrasian auctioneer,” traders can more easily employ algorithm-based, or “algo,” strategies that “deliberately seek to fool other” traders. “An example is ‘layering’ or ‘spoofing.’ A spoofer might, for instance, buy a block of shares and then issue a large number of buy orders for the same shares at prices just below the current market price. Other algorithms and human traders would then see far more orders to buy the shares in question than orders to sell them, and be likely to conclude that their price was going to rise. They might then buy the shares themselves, causing the price to rise. When it did so, the spoofer would cancel its buy orders and sell the shares it held at a profit.” (MacKenzie, 2011).

¹⁸ NYSE Rule 104.

¹⁹ “Designated Market Makers,” or DMM’s, is the new name given to the organizations that serve the “specialist” role in the now public NYSE.

SEC implemented a trial program that obligated stock exchanges, but not ECN's, to halt trading if the price of any stock in the S&P 500 or Russell 1000 moved 10% or more in a five-minute period.²⁰ The SEC is also considering a "limit up-limit down" rule that would replace the circuit breaker approach with a moving trading band to constrain discontinuous price jumps.²¹ In some ways, this effort mimics what the NYSE was able to accomplish when it executed a majority of trades on its own floor.

A second problem, after trading volatility, is reliable information about firms. In the extreme, the absence of trustworthy information could prevent a market from forming, as is the case in a market that allows "lemons" to push high quality goods out of trade (Akerlof, 1970). Underwriters address this problem in a number of ways. The non-profit NYSE facilitated oligopoly power through member exclusivity, giving rise to it much criticized "clubbiness."²² The resulting market power allowed members to limit output, in this case the number of firms listed on the exchange. Limiting output boosted profits for each underwriter, but also had the effect of selecting only the best firms for listing. Thus exclusivity helped keep listing quality high.

Underwriters also provided investors with costly "analyst research" on listed firms, which also improves pricing and reduces uncertainty.²³ The costliness of

²⁰ SEC, Press Release, SEC Approves Stock-by-Stock Circuit Breaker Rules, Jun. 10, 2010.

²¹ SEC, Press Release, SEC Announces Filing of Limit Up-Limit Down Proposal to Address Extraordinary Market Volatility, Apr. 5, 2011.

²² As long ago as 1940, former SEC Chairman, and later Supreme Court Justice, William O. Douglas wrote: "Operating as private-membership associations, exchanges have always administered their affairs in much the same manner as private clubs. For a business so vested with the public interest, this traditional method has become archaic," (Douglas (1940) cited in Loss and Seligman (2006)).

²³ We take as evidence of this, advice from the Motley Fool, a popular investment web site, "when analysts watch a stock, they don't just watch it - they scrutinize every detail of its quarterly statements, inspect footnotes, and have the luxury of meeting with management to get the inside scoop. In other words, they know the stock inside and out. And with so many analysts tearing through company news and reports, it's

information, as well as its importance to investors and listed firms, of credible information is evidenced by the NASDAQ's somewhat counterfactual experience. In 2010, the NASDAQ joined with independent research firm Morningstar Inc. to provide minimal, less-than-analyst-report information on the approximately 900 NASDAQ-listed firms lacking analyst coverage. NASDAQ Vice President Bruce Aust said, "We in the financial industry owe it to investors to continue to try to find a way to create a solution for better research coverage. But until we can make it economical for everyone that's providing it, it's going to be a problem," (Welsh, 2010). As conflicted as underwriter-produced research may appear, it nevertheless withstood attempts at regulatory improvements. During the dot-com boom of the late 1990s, research analysts were accused of overstating the value of stocks that their firms were also underwriting. This conflict of interest was thought to help fuel the boom in shares of Internet stocks. In late 2002, underwriters entered into a "global settlement" with, among others, the SEC and the New York State Attorney General, agreeing to spend \$450 million on research produced by independent analysts, but underwriters found few consumers for this research and planned to discontinue outsourcing research when the settlement expired.²⁴ Separately, in 2000, the SEC instituted Regulation Fair Disclosure, prohibiting executives at listed firms from disclosing selectively information to favored analysts, another practice common during the dot-com bubble. In response to this new dearth of private information, independent consultants have arisen to connect investors with lower-level managers within listed firms, resulting in possible insider trading violations (Zuckerman

hard to find a large cap that's undervalued in a normal market...The fewer people evaluating a stock, the better chance you have to find - and benefit from - mispricing," (DiPietro, 2009).

²⁴ Press Release, Office of the Attorney General, State of New York, Dec. 20, 2002 (http://www.ag.ny.gov/media_center/2002/dec/dec20b_02.html).

and Pulliam, 2010).

In addition to selecting the best firms to list and serving as a conduit for information from listed firms to investors, underwriters also ensured a steady flow of truthful disclosures from listed firms by exploiting their position as listings gatekeeper. By controlling the public offering process, and refusing to list shares they deemed unfit even if they met nominal listing requirements, underwriters extracted “hostages” from managers at listing firms to incentivize periodic disclosure of material information on a continuous basis. Diamond and Kuan (2007) describe common underwriter practices in the IPO process and explain how these practices apply pressure on individual executives (rather than the firm itself) to disclose relevant, material information about their firms.

IV. Empirical Analysis

We present a favorable picture of the non-profit NYSE because, despite its exclusivity and monopoly position, it was incentivized to produce a fair and efficient marketplace for stocks. The firms that were listed were an elite group, but this elitism created a safe place for small investors to invest and a source of low-cost capital for large, well-run firms. However, that exclusivity touched deep and longstanding concerns in Congress about concentrations of economic power.²⁵ This led the NYSE’s regulator, the SEC, to look for ways to encourage competition with the NYSE including, first, support for the formation of the NASDAQ as well as, second, efforts to organize, finally,

²⁵ See Roe (1994) and Seligman (1982), but see also Macey and Haddock (1985).

the long cherished goal of a “national market system.”²⁶ An “over the counter” (“OTC”) market had long existed as a poorly regarded, alternative trading venue to the NYSE. In 1971 the National Association of Securities Dealers (“NASD”) launched its computer terminal linked “automated quotation” (hence, the “AQ” in NASDAQ) system that connected hundreds of broker-dealers across the country. Within a decade, it had cut into NYSE business in significant ways with approximately 500 securities that were otherwise eligible for a listing on the NYSE “solely traded in the NASDAQ system” at the end of 1980 (Seligman, 1982 at 491).²⁷

With further technological advances in the 1990s, other alternative or “third market” trading systems such as electronic communications networks (“ECN’s”) arose to challenge both the NYSE and the NASDAQ. The SEC was moving closer to the emergence of a genuine national market system but trading continued to be dominated by the NYSE because the Exchange maintained an internal rule prohibiting its members from executing trades of NYSE-listed securities with OTC dealers²⁸ and because of the related long-standing “best price” or “trade through” rule that trades in exchange-listed securities take place at the venue with the best available price.²⁹ Thus, trades in NYSE-

²⁶ See 1975 Amendments to the 1934 Act. Pub. L. No. 29, 89 Stat. 97 (1975). Congress granted to the Commission authority in 1975 to adopt rules that promote (1) economically efficient execution of securities transactions, (2) fair competition, (3) transparency, (4) investor access to the best markets, and (5) the opportunity for investors' orders to be executed without the participation of a dealer. See S. Rep. No. 75, 94th Cong., 1st Sess. 8 (1975); H.R. Rep. No. 229, 94th Cong., 1st Sess 92 (1975). See also Section 11A(a)(1) of the Exchange Act, 15 U.S.C. §78k-1(a)(1).

²⁷ *NASDAQ News*, Dec. 1980 at 2.

²⁸ See Seligman 1982 at 509-10.

²⁹ The infamous “trade through rule” was actually part of the plan to establish the Intermarket Trading System or “ITS” approved by the SEC in the wake of the 1975 amendments to the Exchange Act (See 1975 Amendments to the 1934 Act. Pub. L. No. 29, 89 Stat. 97.)

listed stocks had to be executed at the best price, usually on the slower NYSE, or allow the NYSE the time to match the better price available on another venue. The Exchange was thereby protected against being “traded through” by executing on a quotation available on a third market ECN. The former, the NYSE’s Rule 390, was the first to go, repealed by its Board of Governors in 1999.³⁰

In 2005, the “trade through” rule was relaxed by the passage of Regulation National Market System (NMS), allowing trades to take place at less than the best price. Regulation NMS’s “Order Protection Rule” allowed investors to make a trade-off between price (assumed to be better at the NYSE) and speed of execution (typically faster on an ECN) by protecting only quotations that are “immediately accessible through automatic execution.”³¹ In other words, while the older Intermarket Trading System (ITS) rules threw a fence around the manual trading floors of registered exchanges, the new NMS rules remove that fence and instead place one around the automated trading

Section 8(d)(i) of the ITS Plan read: “Absent reasonable justification or excuse, a member located in an Exchange Market, or an ITS/CAES Market Maker, should not purchase any security that he is permitted to trade through the system at a price that is higher than the price at which that security, at the time of such purchase, is offered in one or more other Participant's Markets that trade the security through ITS as reflected by the offer furnished from such other Participant's Market(s) then being displayed on the trading floor of, or available in the quotation service used by, such member or available in the quotation service used by an ITS/CAES Market Maker.”

A similar provision was in place for trades below the posted price.

The ITS was established under the impetus of the 1975 Amendments to the 34 Act. The SEC described it as “an order routing network designed to facilitate intermarket trading in exchange-listed equity securities among participating SROs based on current quotation information emanating from their markets.” SEC Release 34-46428 (Aug. 28, 2002). The ITS was dominated by the NYSE before the establishment of the National Market System, or NMS, which now includes the NASDAQ, all regional exchanges as well as the network of alternative trading systems.

³⁰ Mulligan, 1999. One leading player in the third market crowed: “This will very quickly change the landscape positively by giving [brokerages] more flexibility to execute orders most efficiently for their customers. . . [The brokerages] don't need the NYSE to give them a conscience--they already have it.” His name was Bernard Madoff.

³¹ SEC Release 34-51808 (Jun. 9, 2005).

centers of both exchanges and the ECN's (Pirrong, 2005). Traders no longer have to "wait for a response from a manual market."³² Regulation NMS thus ushered in an end to the NYSE trading floor's monopoly over trading NYSE-listed stocks. Consequently, the underwriter-owners of the NYSE would be unable to provide all of the volatility controls its systems were designed for, as trading would no longer be conducted exclusively on its floor. The SEC said in its Release describing the new rule that it was designed to "eliminat[e] any potential advantage that the ITS trade-through provisions may have given manual markets over automated markets."³³ Indeed, since the adoption of Regulation NMS,³⁴ trading volume at the NYSE has fallen precipitously from nearly 80% of total trading in January 2005 to 25% in October 2009 (Figure 1). We believe that NYSE members voted to demutualize because pricing and volatility were no longer under their control and thus their business model, in place for two centuries, had been destroyed.³⁵

³² Id.

³³ Id.

³⁴ The SEC adopted the final rule implementing Regulation NMS in August 2005 and the rule itself went was phased in over time with the final phase in of the Order Protection Rule completed in October 2007. See SEC Release 34-51808 and NYSE, Regulation NMS Summary, Mar. 7, 2007 (http://www.nyse.com/pdfs/nms_summary.pdf).

³⁵ Our view of the NYSE demutualization differs from that of other observers. The worldwide process of stock market demutualization began in 1993 in Sweden. Since then, demutualizations have swept Europe and Asia (Aggarwal, 2002), ending in the United States with the NYSE as the last hold out. This thirteen-year "long march" of demutualizations and a lengthy, years-long debate within the NYSE about the process, have given observers and scholars time to consider the causes and implications of demutualization. For most, demutualization has been regarded as a long overdue modernization of "archaic" nonprofit clubs. In addition to being viewed as dated, non-profits are seen as capital-constrained and thus unable to finance the new technology needed by today's high speed trading strategies and increased liquidity (Aggarwal, 2002). Karmel (2002) argues that electronic trading challenged what was once the natural monopoly position of established exchanges. In short, the supposed advantages of demutualization became orthodoxy among most analysts.

Identification Strategy

We have described several ways in which the non-profit NYSE attempted to control pricing efficiency and volatility. Broadly, these can be categorized into, first, a set of “rules,” which we define to include such features as 1) the specialist’s monopoly position, 2) the specialist’s role as a Walrasian auctioneer, and 3) the specialist’s obligation to maintain a “continuous” and “fair and orderly” market, and 4) circuit breakers; and, second, “information,” by which we mean the process of selection of listed firms, analyst research, and hostage-taking during and after the IPO process to insure a flow of credible information from issuers to the Exchange. To examine the market implications of these mechanisms, we examine bid-ask data from the NYSE and NASDAQ and hypothesize the following:

(1) When the non-profit NYSE has a monopoly over trading NYSE-listed stocks, those stocks will have a smaller bid-ask spread than NASDAQ-listed stocks.

(2) After the NYSE loses its monopoly, shares of NYSE-listed firms begin trading on the NASDAQ. Thus, if NYSE rules or mechanisms account for lower volatility, then the bid-ask spreads of those firms will increase to approximate levels found on the NASDAQ.

(3) If information accounts for the NYSE’s lower spreads, however, then spreads for NYSE-listed firms should not increase. It is often observed, for example, that the bigger, more stable firms that list on the NYSE are less volatile than the young technology firms that list on the NASDAQ.

We also consider the anecdotal claim that trading of NYSE-listed stocks takes place almost exclusively on the NYSE.³⁶ By looking at closing bid-ask spreads, we can observe whether the rules and mechanisms established by the non-profit NYSE are still in place after demutualization. Hence,

(4) If the NYSE's mechanisms account for the behavior of prices and spreads, then spreads of NYSE-listed stocks at the close of trading should not converge with those of the NASDAQ. Or, put differently, if the NYSE's mechanisms collapsed after competition was introduced, then spreads for NYSE-listed stocks trading on the NYSE only (at the close) should converge with those of the NASDAQ.

While the bid-ask spread is commonly used as a measure of information quality,³⁷ here we suggest it can also be influenced by rules.³⁸

³⁶“Trading has become increasingly concentrated in the first and last hours of the session. Those two hours now make up more than half of the entire day's trading volume, according to an analysis of data provided by Thomson Reuters...Funds that track stock indexes often wait until the final hour to execute trades to better reflect the benchmark measures' last prices.” (Peterson, 2010)

³⁷ The bid-ask spread is used to measure information quality in a variety of markets, including electricity (Mansur and White, 2007) and used cars on eBay (Lewis, 2007), as well as in financial markets (including the effects of both early federal securities regulation (Daines and Jones, 2007; Mahoney and Mei, 2007) and the 2002 Sarbanes-Oxley Act (Jain et al., 2006). Bacidore and Sofianos (2002) also use bid-ask spreads to show that information asymmetry is greater for foreign stocks traded on the NYSE than for US-listed stocks. Bid-ask spreads contribute to the empirical financial literature that seeks to estimate the effects of disclosure regulation. Stigler (1964) and Bentson (1973) use stock price improvements to examine the Securities Exchange Act of 1934, Greenstone et al. (2006) use excess returns to measure the effects of the 1964 amendments to federal securities laws that required firms listed on the NASDAQ to meet the same disclosure requirements as those on the NYSE, and Begley et al. (2007) use variance in financial analyst forecasts to estimate the effects of the 2002 Sarbanes-Oxley Act.

³⁸ Huang and Stoll (1997) decompose the bid-ask spread into three components: inventory holding costs, transaction costs, and adverse selection. For our purposes, we compare bid-ask spreads before and after an event, where inventory holding costs would be unaffected by the event, and where transaction costs would remain unchanged or decline after the event (de Fontnouvelle, et al., 2003). Thus, we test for adverse selection, which we posit both “rules” and “information” should mitigate.

Data

We perform two estimations, both using daily information from all common stocks trading on the NYSE and NASDAQ. The sample is drawn from the first Tuesday of month to avoid Monday and Friday effects, and we plan to add data as it becomes available.

The bid-ask spread is calculated using the highest asking price and lowest bid price for each day, divided by the closing price that day; the closing bid and ask prices use the closing bid and ask prices. Thus the spread captures volatility as well as information quality.

Figure 2 plots the un-weighted averages of the NYSE and NASDAQ over the period 1995 to 2008. It shows that spreads on the NASDAQ are consistently higher than those on the NYSE. For a different view of the same data, Figure 3 plots the difference of the un-weighted averages. Note that because the spread is calculated from all transactions regardless of trading venue, highs and lows can come from both exchanges, indeed after adoption of Regulation NMS, the intra-day spread is most likely calculated from transactions on both exchanges.

Estimation and Results

Our first model is a “difference in differences” model comparing the NYSE with the NASDAQ before and after the NYSE’s loss of monopoly, approximately around the time of its demutualization. We estimate the fixed effects panel equation below:

$$\text{bid-ask spread}_{it} = a + b_1 (\text{exchange}_i) + b_2 (\text{after demutualization}_t) +$$

$$b_3 (\text{exchange}_t * \text{after demut.}) + b_4 (\text{trading volume}_{it}) + e_i. \quad (1)$$

In equation (1), i indexes for a stock or an industry;³⁹ we consider industry fixed effects because many observers note that the NASDAQ seems to specialize in technology firms, which many people believe are more volatile than other industries. Bid-ask spread is calculated two different ways: (1) the difference between the intra-day high asking price and the intra-day low bid price normalized by (divided by) the closing price, and (2) the difference between the closing ask and closing bid normalized by closing price.

Considering just the intra-day-high and -low estimations, Table 1 (Model 1 and Model 2) shows that the bid-ask spreads are lower for NYSE-listed stocks than for NASDAQ-listed firms, as predicted, and that the spreads *increase* at the NYSE after demutualization, suggesting greater price volatility after competition is introduced. This is the case for both firm fixed effects and industry fixed effects.

By performing a similar estimation using spreads at the close of trading, we find that NYSE spreads are not lower than NASDAQ spreads and are not higher at after demutualization (see Table 1, Models 1a and 1b). That is, the sign of the results is the opposite from spreads calculated using intra-day prices. Again, this is consistent with the prediction that at the close of trading, NYSE listed stocks trade mostly on the NYSE where an approximately Walrasian auction takes place, as it does before demutualization.

Our second model is a trend analysis. For intuition, we plot the difference between NYSE and NASDAQ spreads in Figure 3. Figures 4 and 5 show the trend line

³⁹ We use the Global industry Classification Standard developed by Standard & Poor's and MSCI Barra. us GICS consists of 10 sectors, 24 industry groups, 68 industries and 154 sub-industries; we use the 2-digit sector level classification, which categorizes firms into 10 sectors including energy, materials, industrials consumer discretionary, consumer staples, health care, financials, information technology, telecommunication services, and utilities. <http://www.standardandpoors.com/indices/gics/en/>

excluding post-demutualization data and then *including* post-2006 data. Notice that the trend line changes from a positive to negative slope. Our regression estimates the following equation:

$$\text{bid-ask spread}_{it} = a + b_1 (\text{exchange}_i) + b_2 (\text{exchange}_i * \text{month}) + b_3 (\text{exchange}_i * \text{month} * \text{after demut.}) + b_4 (\text{trading vol}_{it}) + e_i. \quad (2)$$

Results, reported in Table 1 Model 3, show that the NYSE time trend is negative, but turns positive after demutualization, as predicted.

V. Discussion and Conclusion

The data are consistent with our hypothesis that something was working well on the old pre-IPO non-profit NYSE. Spreads were narrower against a long historical comparison with the NASDAQ. With the NYSE's IPO and the implementation of Regulation NMS, the NYSE's monopoly position eroded significantly providing us a natural experiment to carry out in order to see precisely what may have been lost. Now, since the end of 2006, despite being larger and more stable, blue chip NYSE-listed firms experience the same price volatility and pricing inefficiencies as younger, riskier NASDAQ-listed firms when traded on the NASDAQ and ECNs. The convergence in spreads to the wider NASDAQ band occurs even though NYSE-listed stocks still have more thorough analyst coverage and likely better quality disclosure. Thus, it appears the posited informational advantages of the NYSE do not appear to play a role in maintaining the historically narrower bid-ask spreads found for NYSE stocks when they traded

(almost) exclusively on the NYSE. When trades migrate off the Exchange, as they do throughout the trading day, spreads widen.

Yet, at the end of the trading day, spreads narrow back to the pre-IPO NYSE band. NYSE rules still provide Walrasian efficiency on the manual trading floor, when the market returns to the NYSE at the close of trading. In that last hour there is good anecdotal evidence that NYSE market share for NYSE listed securities spikes up (Peterson, 2010). While the information-based advantages are no longer enough to protect NYSE listed securities intraday, the Exchange's rule-based mechanisms, such as the "designated market maker" (nee "specialist") playing the role of Walrasian auctioneer, seem to provide the efficiencies associated with the pre-demutualization era.

But it is reasonable to ask if even that vestige of stable and narrow spreads will prevail for much longer. Rules must be enforced to be effective, and we would argue that the incentives for doing so, and thus maintaining market efficiency, have changed as competition has ended the non-profit structure of the NYSE. As owners of the pre-IPO Exchange, underwriters profited directly from its efficient functioning. As such, underwriters created rules, monitored specialists, and imposed fines on a regular basis. This self-regulatory process combined weaker standards of evidence with milder consequences and was thus arguably more effective than the system used by public regulators where enforcement is subject to political pressures (Paltrow, 2008) and focuses on complex high-profile cases that have a low probability of success (Gorman, 2009). A dealer- or shareholder-owned exchange would likely carry out enforcement at the pace or intensity of the NASDAQ, which has always had a much weaker record than the NYSE.⁴⁰

⁴⁰ An extensive examination of the NASD's oversight of manipulative trading practices on the NASDAQ in the early 1990s, for example, led the SEC to conclude "the NASD has been lax in enforcing rules

We therefore anticipate a decline in the impact of the rule-based mechanisms that have been so effective in minimizing spreads at the NYSE.

Additionally, as spreads become exogenous to the business model of underwriters, we expect informational mechanisms to decline in quality as well. Thus the selection of firms listing on the NYSE will expand to include smaller, less stable businesses, disclosure will become more suspect, and analyst coverage will shrink. Indeed, we see anecdotal evidence for all of these occurring at the present time. *The Wall Street Journal* reports “dozens of small Chinese companies are facing questions by regulators about accounting problems and mismanagement, and the Securities and Exchange Commission has established a task force to examine how lawyers, bankers and auditors are bringing these companies onto U.S. markets,” (Cowan, 2011). Not only are exchanges less selective, but post-IPO disclosure is poor. Moreover, the *Journal* notes, stocks of Chinese IPO’s listed in the United States perform much more poorly than those of American firms.

Finally, we note that our analysis of market behavior takes an institutional approach in an area that has long been dominated by the EMH. In particular, by applying a logic of non-profit member owned and governed organizations developed by Kuan (2001), we see that the EMH is a reasonable approximation of the behavior of prices on the stock market as long as the incentives of the non-profit organization are in place, generating the rules, rule enforcement, and information necessary for its efficient function. However, these incentives and organization have changed profoundly in recent

applicable to market makers and other significant constituents.” SEC, Appendix to Report Pursuant to Section 21(a) of the Securities Exchange Act of 1934 Regarding the NASD and the NASDAQ Market. (<http://www.sec.gov/litigation/investreport/nd21a-appx.txt> and <http://www.sec.gov/litigation/investreport/nd21a-report.txt>).

years, and we believe that an institutional analysis such as the one we provide can not only help to explain the apparent turmoil in the stock market but also predict changes to come.

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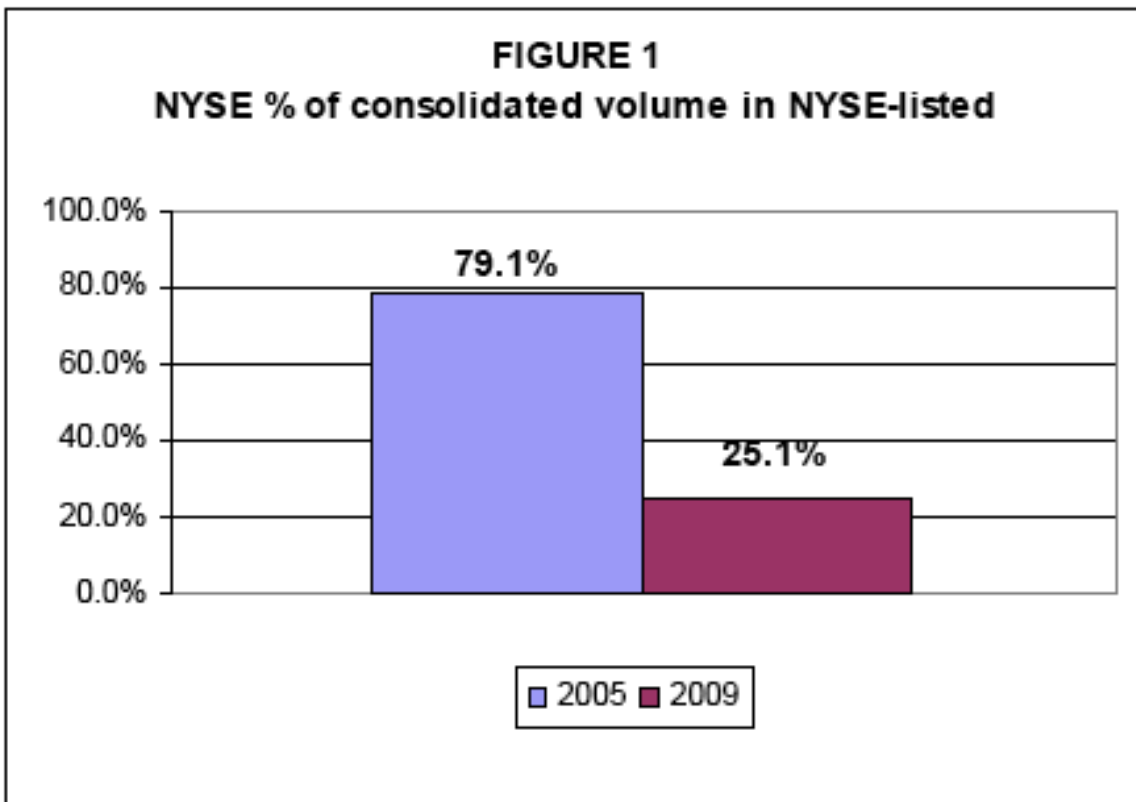
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Figure 2: Mean Bid-Ask Spread, NYSE and NASDAQ (1995-2008)

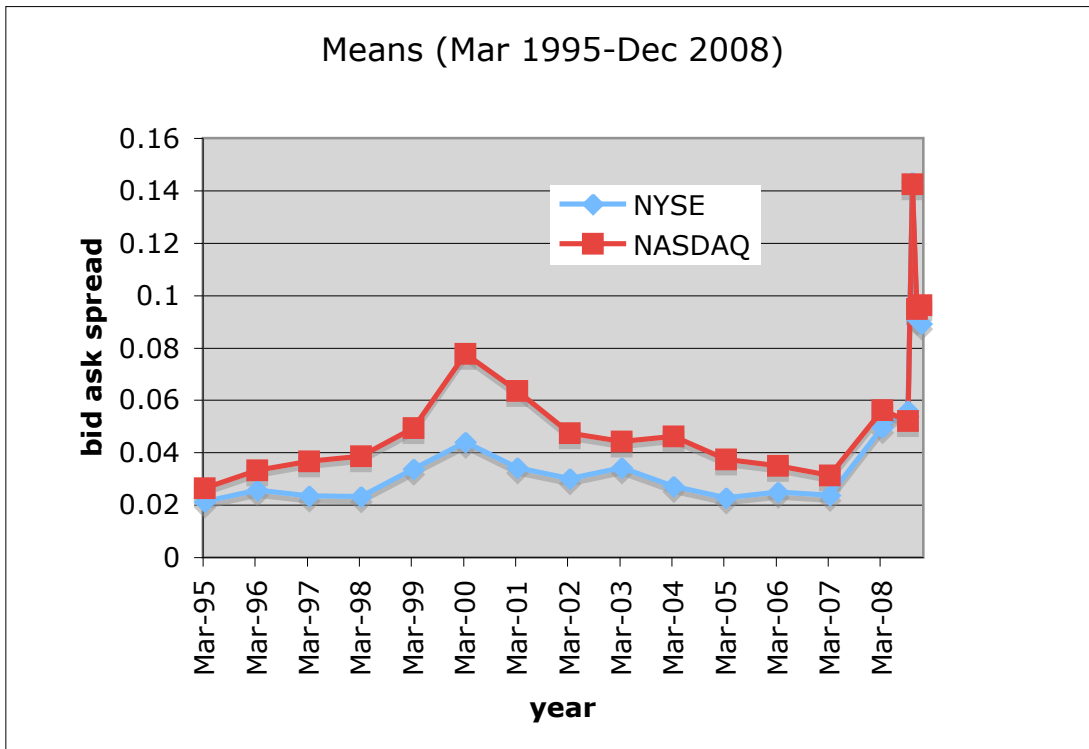


Figure 3: Difference in Bid-Ask Spreads (NASDAQ – NYSE), 1995-2008

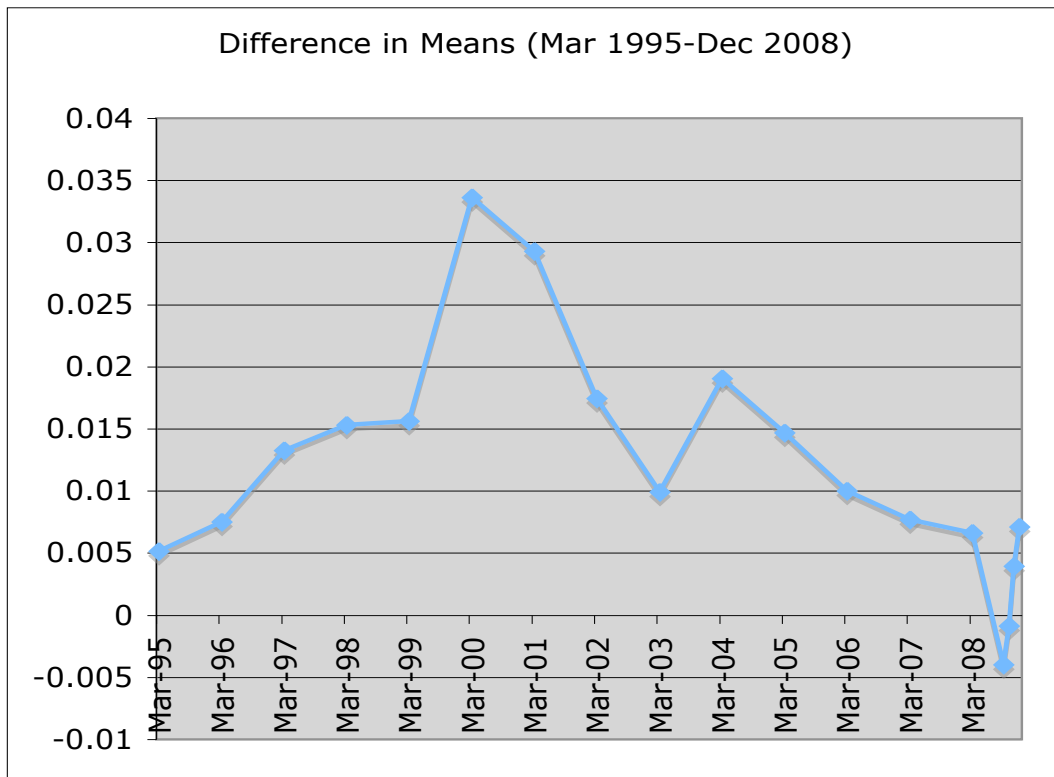


Figure 4: Trend in Difference in Pre-Demutualization Spreads (NASDAQ, NYSE), 96-08

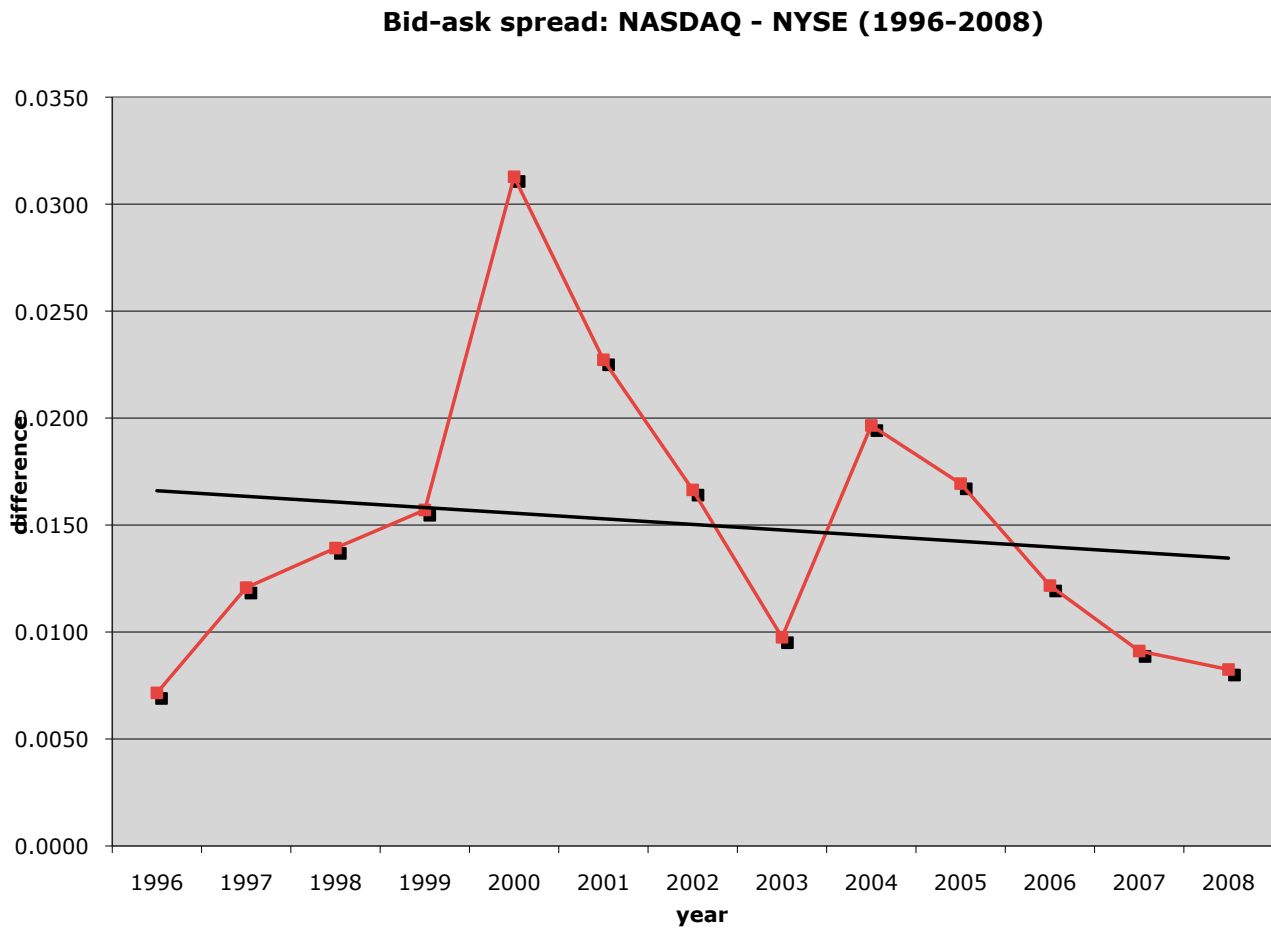


Figure 5: Trend in Difference in Pre-Demutualization Spreads (NASDAQ, NYSE), 95-06

