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Are the Stock Markets "Rigged"? An Empirical Analysis of Regulatory Change

Stephen F. Diamond
Santa Clara University School of Law, sdiamond@scu.edu

Jennifer W. Kuan
Tulane University

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Stephen F. Diamond
Santa Clara University

Jennifer W. Kuan
Tulane University

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Abstract: Volatile events in the stock market such as the 2010 Flash Crash have sparked concern that financial markets are "rigged" in favor of trading firms that use high frequency trading ("HFT") systems. We analyze a regulatory change implemented by the SEC in 2007 by examining its effect on a key market metric, the bid-ask spread, an investor cost, and find that the regulatory shift, indeed, disadvantages investors. We link the implementation of this change to a shift in the volume of trades from a low-cost venue to a high-cost venue. We argue that this outcome is predicted by the incentives of the venues, non-profit stock exchanges owned by different types of members. The less-volatile, lower-cost New York Stock Exchange was owned by underwriters and included a specialist system that is less vulnerable to HFT tactics that can disadvantage investors.

Key words: stock market, high frequency trading, flash crashes, non-profit, SEC

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I. Introduction

On May 6, 2010, a dramatic price drop, now known widely as the "Flash Crash," shocked major stock indices in the United States. Within five minutes nearly 1000 points had been wiped off the Dow Jones Index - approximately $1 trillion or 9% of its value. Yet, within the following fifteen minutes, the Index regained the bulk of those losses. Such an extreme volatility event should be exceptionally rare, if not impossible, and yet it happened. Smaller versions of the Flash Crash now occur on a regular basis in the capital markets typically hitting individual stocks. One study discovered more than 5,000 such "mini flash crashes" during a four-month period (Golub et al. 2012). Coincident with the appearance of incidents of extreme market volatility is the new dominance of so-called high frequency trading ("HFT") systems. Firms deploying these computerized order systems are now responsible for more than 60% of the trading volume in U.S. listed stocks. HFTs engage in a range of complex trading tactics that take advantage of the new equally complex structure of the capital markets. There is some evidence that the mechanisms used by HFTs contribute to flash crashes. This has led some to charge that the stock markets are now "rigged." (Lewis 2014) We trace the emergence of extreme volatility and concerns about HFTs to an important regulatory change implemented by the Securities and Exchange Commission ("SEC") in 2007. We measure the impact of this change empirically by examining its effect on a key market metric, the bid-ask spread, and find that the regulatory shift, indeed, disadvantages investors.

Until relatively recently, U.S. stock exchanges shared much in common with other regulated utilities. Exchanges were private firms that served an important public function but could have monopolistic tendencies. Indeed, from its founding in the late

18th century until approximately 2007, the New York Stock Exchange (NYSE) enjoyed near-monopoly status, listing a set of stocks and executing the vast majority of trades for those stocks. The Nasdaq, once it emerged in the 1970s, also achieved a near monopoly for a separate set of stocks that it listed.

Now, however, less than one-fifth of the trades of NYSE-listed stocks take place on the NYSE. The bulk of trading is now spread across as many as a dozen different trading venues, including so-called "dark pools" which do not share pricing data with other venues. This complex trading architecture enables HFTs to jump ahead of other investor orders or to create a false impression about the level of demand for certain stocks that can lead to trading profits for the HFT firms.

However, these stock exchanges differed from typical regulated utilities in two ways that have important implications for regulation beyond this narrow context. Specifically, both were member-owned nonprofit organizations and both contained self-regulatory functions. Nonprofit ownership raises analytical challenges in characterizing the incentives of an organization (Hansmann, 1980) and self-regulation complicates the effect of public regulation, which could either be a complement or a substitute for private ordering (DeMarzo et al., 2005). More broadly, while nonprofits might seem rare targets of regulation, they appear surprisingly often in such diverse settings as energy markets, health care, education, professional associations, industry trade groups and more.

How does nonprofit ownership affect self-regulation and public regulation? The stock market and a 2007 regulatory change, Regulation NMS (Reg. NMS), provide an opportunity to show how nonprofit incentives can be analyzed and understood in a regulatory context. Previous studies have explored the nonprofit organization of stock

exchanges[2] but focused on their stock-trading function, such that the NYSE and Nasdaq were assumed to have identical objectives. However, an important finding of the nonprofit literature is that nonprofits can have heterogeneous objective functions even within the same industry or market (Hansmann, 1980; Gertler and Kuan, 2008). Existing models also overlook the fact that exchanges are two-sided markets (Parker and Van Alstyne, 2005; Rochet and Tirole, 2003), serving not just investors but also firms that list their shares. Combining these two observations, we posit an NYSE owned by underwriters who service listed firms (and therefore investors, as well), and a Nasdaq owned by broker-dealers who service only investors.[3]

The incentives of two such exchanges differ substantially from each other. The agency problem between a broker-dealer and investors in a broker-dealer-owned exchange is modeled in the literature (DeMarzo et al., 2005). By contrast, an underwriter-owned exchange involves the vertical integration of an input (Kuan, 2001). That is, underwriters operate a marketplace to increase the value of their underwriting services. (Below, we describe in some detail how orderliness in trading can attract investors, i.e., customers for underwriters' clients). The resulting incentive difference thus leads to a predictable performance difference between the two exchanges. A broker-dealer-owned

[2] Pirrong (2000) and Hart and Moore (1996) examine the reasons for nonprofit organization; and a literature on demutualization explores the role of technology in exchanges demutualization (Aggarwal, 2002; Steil, 2002; Stoll, 2002)

[3] Institutional details are informative. Prior to its 2006 IPO, underwriters dominated the NYSE (Gasparino, 2007; Harris, 2010; NYSE, 2006) and listed only those firms that met stringent, formal listing requirements. Long before the federal regulation of disclosures to investors, the NYSE mandated disclosures by their listed firms, following the "due diligence" practices developed by underwriting banks (Loss and Seligman 2001; Carrosso 1970). By contrast, the Nasdaq - an acronym for the National Association of Securities Dealers Automated Quotation system - is a computer network that knits together a loose confederation of broker-dealers. The Nasdaq evolved out of the older over-the-counter market, which traded unlisted securities. Once established as a venue for listing, its culture of trading weaker firms continued, with minimal listing standards.

exchange would maximize profits from investors' trades, while a vertically integrated exchange would offer trading services at a lower cost, possibly even below cost in a two-sided market (Rochet and Tirole, 2003). In short, the Nasdaq would provide higher-cost services than the NYSE.

Reg. NMS allows for a test of this hypothesis. Before 2007, a "best price rule" required brokers to route trades to the venue with the best posted price. For NYSE-listed stocks, this was typically the NYSE, so 80% or more of NYSE-listed stock trades took place on the NYSE, with the other 20% performed by smaller, regional exchanges and the Nasdaq.[4] Reg. NMS replaced this rule and allowed brokers to route orders to the Nasdaq despite a better price on the manual trading floor of the NYSE.[5] Only orders placed on automated exchanges would now be protected against "trade throughs."

This regulatory change accommodates a difference-in-differences analysis. In the pre-change period, any Nasdaq trading of NYSE-listed stocks had to be at the NYSE price or better. Thus, prices were constrained by regulation to be equal, while post-change prices are de-constrained. We predict higher investor costs for the de-constrained, post-Reg. NMS Nasdaq trades in NYSE-listed stocks. Using stock trade data from a sample of over 200 NYSE-listed stocks 30 days before and after Reg. NMS, we show that spreads, a commonly used measure of investor cost, increase for trades on the Nasdaq relative to the NYSE.[6]

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[4] The best price rule explains, in large part, why the NYSE so long dominated trading of NYSE stocks. Nasdaq had a monopoly in trading Nasdaq stocks because the NYSE did no trading of Nasdaq stocks.

[5] Specifically, the trade-through provisions of Reg. NMS require brokers to route orders to the automated venue posting the best price. The floor of the NYSE is not automated as are the Nasdaq and the newest entrants, electronic communications networks (ECNs). The rule change was intended to give investors a choice, allowing them to choose the faster trade execution enabled by automation even though it might come at the expense of a better price.

[6] An important question is why investors would choose a high-cost venue over a low-cost venue. While some of the shift in volume was perhaps due to investors choosing faster execution over better prices,

The literature offers several alternate hypotheses about the impact of Reg. NMS. First, regulators predicted that competition would lead to *lower* costs for investors (SEC, 2005b). Second, "cream-skimming" could occur in which an entrant, the Nasdaq, siphons off high-profit, uninformed, trades leaving lower-profit trades with the incumbent NYSE. This would *raise* investor costs at the NYSE (Bessembinder and Kaufman 1997; Easley et al. 1996; Battalio et al 1997).[7] Third, auction (dealer) markets might be better than dealer (auction) markets, in general (Huang and Stoll 1996; Affleck-Graves et al. 1994; SEC 2004). Our test does not quite address this last hypothesis because the design details of any auction or dealer market influence performance so significantly that we cannot claim to compare these two mechanisms in the abstract. Rather, we argue that owners make design choices based on their incentives and our analysis compares two realized sets of design decisions.

The dramatic changes in stock market structure since our period of analysis might suggest that this analysis is of historical interest only. Exchanges have proliferated, technology has made floor trading seem more archaic than in 2007, and neither the NYSE nor the Nasdaq is, any longer, a nonprofit. However, while a complete analysis of the current industry structure is beyond the scope of this paper, we would argue that our analysis actually helps explain today's often bewildering stock market by reinterpreting the institutional design and self-regulation of the NYSE as part of a vertically integrated

earlier "cream-skimming" studies predict that volume would shift to electronic trading venues that pay brokers to route uninformed trades to their higher-cost venues, i.e., "payment for order flow." An "arms race" among high frequency traders (HFTs) emerged to profit from this "cream," contributing additional trading volume to the automated venues (Budish et. al, 2015).

[7] SEC Rule 19c-3 allowed dealers to pay to shift profitable "uninformed" trades to non-NYSE venues but only applied to certain NYSE stocks. This restriction makes a difference in differences comparison possible. Battalio et al. (1997) find that after the profitable, small-sized, uninformed trades moved to alternative venues, spreads increased for the NYSE stocks that were included in the Rule, but the analysis did not decompose the trades by venue to identify which trades had caused the increase.

system where private incentives generated a low-cost, orderly market that attracted investors and listings. More broadly, our study suggests that the incentives of nonprofits should be carefully considered because they may differ from those of for-profits and even other nonprofits in the same market, and that these incentives, which are susceptible to analysis, can affect self-regulation and the effectiveness of public regulation.

II. Background

The NYSE formed over 200 years ago when traders began gathering informally near what is today Wall Street in New York City. Michie (1987) and Geisst (1997) detail the long historical process of institutional change at the Exchange, which included moving trading activity indoors, formal incorporation, competition with a variety of formal and informal exchanges, and the adoption and adaptation of mechanisms, rules, and procedures, including restrictive membership and listing requirements. Thus, trading on the Exchange was limited to the carefully vetted owners of 1,366 "seats," a number that was set in the mid-20th century and remained the same until the Exchange's demutualization in 2006. Its listing standards meant that only a limited subset of publicly traded firms could sell their shares on the Exchange.

Emerging from a longstanding but informal over the counter ("OTC") trading market, the Nasdaq began formal operation in 1971 with the expectation that it could compete with the NYSE if the barriers between OTC and exchange-listed securities were removed. The Nasdaq comprises broker-dealers connected initially by telephone and later by a computer network. It was immediately more inclusive than the clubby NYSE. Thus, even unprofitable firms could trade on this market, and dealers needed only be members of the NASD to participate in that trading. By the mid-1990s the NASD had 5,400 firms

with more than 57,000 branch offices and "nearly 500,000 registered securities professionals." (NASD Report cited in Loss and Seligman 2006 at 703) With more than 5,500 listed companies, Nasdaq dealers in the mid-1990s traded in the stocks of more than twice as many firms as the NYSE. The Nasdaq's listing standards were far laxer than those at the NYSE, which reflected the entity's origins in the weakly regulated OTC market. One study, for example, found the NASDAQ's standards to be "partially responsible for the influx of poorly-performing IPOs during the Nasdaq market bubble of the late 1990s." (Klein and Mohanram 2008)

While the original goal of the Nasdaq to engage as a direct competitor in trading of NYSE listed securities was long delayed, the Nasdaq served as a useful complement to the NYSE. The two exchanges differed in several ways in addition to the significantly larger number of listings on the Nasdaq. Quality seemed to be lower at the Nasdaq, where the total market capitalization was less than that of the NYSE despite the much greater number of listed firms. Different trading mechanisms were chosen by each exchange. Using the computer network that is the foundation of the Nasdaq, dealers take part in both sides of every trade, buying from sellers and selling to buyers. The NYSE employs a manual floor trading process that *appears* to be the outdated holdover of a centuries-old institution. However, our proposition that trading is an input to underwriting calls for a closer examination of this key institutional difference from the Nasdaq.

For each listed firm, the NYSE assigns a specialist who conducts trades at a single trading post where trades in that firm's shares are executed. The specialist (called a "designated market maker" in the post-Reg. NMS environment) is subject to rules that ensure an orderly price discovery process. Under the NYSE's continuous "double-sided"

auction mechanism, the specialist continuously gathers all buy and sell orders and sets a quote for bids and asks. This quote, by rule, must be close to the previous bids and asks (NYSE, Rule 104). Buyers are then matched to sellers by the specialist acting as a broker (or agent). Any unmatched residual is bought (sold) by the specialist acting as a dealer (or principal) if necessary to maintain a "fair and orderly" market (Exchange Act Sec. 11(b) and Rule 11b-1; NYSE Rule 104). Note that this differs from the Nasdaq's pure dealer mechanism, in which the dealer is the counter-party on both sides of every transaction. The Nasdaq dealer buys from third party sellers, resells to third party buyers, and thus profits from a wider spread while not being required to enter the market to ensure orderliness.

While the privileged information that a specialist enjoys is potentially valuable, rules and enforcement minimize its exploitation (Mann and Seijas 1991 and Dutta and Madhavan 1995; Battalio et al. 2007; Madhavan and Panchapagesan 2000, 655; but see SEC 2005a). If trading is viewed as an input to underwriting, specialists are best understood as having been, prior to the implementation of Reg. NMS, agents of the underwriter-owners of the NYSE and rule enforcement can be modeled as the outcome of a (metaphorical) principal-agent relationship. This is notably different from self-regulation by Nasdaq members who are peers (SEC, 1996).

An empirical literature has tried to measure the effects of different exchange features. Bid-ask spreads, for example, a measure of investor cost and disorderliness, are higher for Nasdaq stocks, but these could be the result of the underlying risk of the stocks or because of the Nasdaq's dealer mechanism. Because each exchange long monopolized trading of (an almost) disjoint sets of stocks, however, direct comparisons of trading

mechanisms have been impossible.[8] Reg. NMS allows for a better test, as NYSE stocks now trade freely at different prices on both exchanges.

In replacing the old "best price" rule with what is now known as the "trade through" rule, Reg. NMS initiated substantial structural changes to the stock market. But even before Reg. NMS was implemented, change had already begun. The final regulation was adopted in August 2005; six months later, the NYSE demutualized via a merger with the publicly traded Archipelago, an ECN (Diamond and Kuan 2006). NYSE members, thereby, agreed to convert their nonprofit into a publicly traded, investor-owned for-profit corporation. While Reg. NMS and demutualization might seem to be two unrelated events, our model of vertical integration suggests otherwise. If underwriters who were vertically integrated with trading could no longer produce orderliness, they would sell their trading operation. The loss of control over orderliness was predictable; the NYSE's share of trading volume in NYSE listed stocks began a steep decline to 25% (see Figure 1) so that prices of those stocks were no longer set solely by the NYSE.

Final implementation of Reg. NMS took an additional year and a half after NYSE demutualization, so that at the time of our empirical study, the NYSE and Nasdaq were both for-profit firms.[9] We nevertheless interpret our results as reflecting the incentives of two different ownership interests, each of which instituted long-lasting mechanisms and structures that take time to dismantle. So, while a merger might reduce the NYSE's self-

[8] Empirical strategies for comparing mechanisms include using matched pairs of stocks from the NYSE and Nasdaq. This is challenging because NYSE-listed firms have much bigger market capitalizations, which is a match dimension (Huang and Stoll 1996; Affleck-Graves et al. 1994). An alternative uses the relatively few firms that move their listings from the Nasdaq to the NYSE as the basis of comparison (Christie and Huang 1994; Barclay et al. 1998; SEC 2004). The studies find lower bid-ask spreads at the NYSE but are problematic because of selection issues.

[9] The NASD began the process of divesting and demutualizing the Nasdaq in 2000, well before Reg. NMS, and finally completed that process at the end of 2006.

regulatory activity, the dealer and auction mechanisms, which are of particular relevance for our study, would remain. Moreover, if the NYSE's low-cost mechanism degraded towards a higher-cost mechanism, it would only work against our hypothesis and weaken our results.

III. Hypotheses

The interpretation of the bid-ask spread as an investor cost is well established in the literature, but is particularly appropriate in our case because heterogeneous ownership generates a hypothesis about differential spreads. Dealers profit directly from spreads, buying low and selling high from their customers, while underwriters have the opposite incentive, to reduce spreads to attract investors for their underwriting clients. Thus, we hypothesize that before Reg. NMS, spreads for NYSE-listed stocks are the same on both exchanges by rule, but increase for trades on the Nasdaq after Reg. NMS. Competing hypotheses are presented in the literature, as mentioned above.

We estimate a fixed effects difference-in-differences model using panel data:

$$s_{ijt} = a + b_1 nasdaq_{ijt} + b_2 after_{ijt} + b_3 trend_{ijt} + b_4 nasdaq_{ijt} * after_{ijt} + b_5 trend_{ijt} * after_{ijt} + e_{it} \quad (1)$$

where the dependent variable, s_{ijt}, is the bid-ask spread for stock *i* on exchange *j* at time *t*. *Nasdaq* is 1 for Nasdaq spreads and the omitted category is NYSE. *After* is 1 if time *t* is after Reg. NMS implementation. The explanatory variable is the interaction between *nasdaq* and *after*. We hypothesize that this interaction will be positive, as spreads on Nasdaq trades increase relative to NYSE trades.

As a robustness check, we include a time trend variable, *trend*, the time period in days. The interaction term *trend*after*, interacts the time trend with "after Reg. NMS" to detect whether our results are driven by a general time trend or only begin after the regulation.

IV. Data

We follow the literature on several dimensions of our empirical strategy. In addition to measuring daily bid-ask spreads (Corwin and Schultz, 2012) in a differences-in-differences design, we also use a broad cross section of stocks, decompose the spread by venue (Bessembinder and Kaufman 1997), and use a 30-day event window. Also, we use transaction data from the Wharton Research Data Services (WRDS) Trade and Quote (TAQ) dataset, which provides the timing and size of each trade, the price for each transaction, and the exchange where the trade took place.

A. Sample

We restrict our attention to NYSE-listed stocks because Reg. NMS affects the NYSE's monopoly position in trading, not the Nasdaq. Recall that the Nasdaq's monopoly in trading is the result of the NYSE's organizational design, which provides no mechanism for trading Nasdaq-listed stocks. We selected a sample of 222 stocks from a variety of industries in the top quartile of trading volume and market capitalization. Together, they account for about 15% of the industrial firms listed on the NYSE.

We selected actively traded stocks because of the endogeneity of trading volume and spreads: on the one hand, liquidity is associated with smaller spreads; on the other hand, lower spreads might encourage people to trade, thus increasing liquidity. So, if Reg. NMS caused spreads to decrease, as some of the alternate hypotheses predict, we

might worry that the measured decline in spreads was conflating the effect of Reg. NMS with increased liquidity as lower spreads attracted more investors. By restricting our attention to stocks that always trade heavily, we minimize the effect of liquidity changes on spread, and thus also do not control for volume in the regressions. Selecting only heavily traded stocks addresses a second liquidity problem, as well. If the share of trading shifted significantly away from the NYSE to the Nasdaq, the decrease in liquidity causes an identification problem. However, because "liquidity can obtain in fragmented trading, at least for the most active securities" (O'Hara 2004, 43), we use only heavily traded stocks to avoid falling below a liquidity threshold.

B. Spread decomposition

For each stock in our sample, we calculate the spread twice for each day: once using Nasdaq transactions and once using NYSE transactions. Recall that although we have described the NYSE as having a near-monopoly, 20% of trades of NYSE-listed stocks had traded on the Nasdaq long before Reg. NMS. So, for each stock on each day, we can separate Nasdaq transactions from NYSE transactions and calculate a separate spread for each exchange's transactions. In this way, we can compare the spread generated by trading activity on the Nasdaq with the spread generated by trading activity on the NYSE for the same stock on the same day. We follow Bessembinder and Kaufman (1997) in decomposing spreads in this manner.

C. Event window

Our time window for analysis is the 30 trading days before and after the implementation of Reg. NMS, which began on July 9, 2007. While 30 days is a relatively short time in which to see large changes in market outcomes, the time window is

intentionally small in order to isolate the effects of regulatory change from other changes in the market. Again, to select the size of our event window, we follow existing studies including Easley et al. (1996), Battalio et al. (1998), Foucault and Menkveld (2008), and Chung and Chuwonganat (2012) who also study Reg. NMS and find a decline in other indicators of market quality after its implementation. The SEC also applied a 60-day event window to its pilot study for Reg. NMS.[10]

Figures 2 and 3 plot descriptive statistics for our sample over the event window. Figure 2 shows no appreciable shift in average trading volume for our sample stocks over the event window—certainly nothing as great as the eventual shift in trading volume seen in Figure 1. Figure 3 shows our metric of interest, the average spread differentials for NYSE and Nasdaq transactions for our sample (i.e., Nasdaq spread – NYSE spread). A slightly higher level after Reg. NMS may be discernable, as is a positive differential even before Reg. NMS.

V. Results

Table 1 presents results from variations of the model in equation (1), where spread is measured in cents (i.e., calculated spread is multiplied by 100). Model 1 is the basic specification in equation (1). We find that the interaction term is positive and significant, indicating that Nasdaq spreads for NYSE-listed shares increase relative to NYSE spreads after Reg. NMS.

[10] The SEC ordered a pilot test of Reg. NMS and asked the NYSE to select 100 listings for a 30-day test, which began July 9, 2007. Appendix A lists the 99 pilots, the majority of which have large market capitalizations and are heavily traded. We constructed our sample by selecting all large-cap, heavily traded stocks in the same industries as the pilots. Because there were no technological barriers to implementing the new Order Protection Rule on July 9 for all listings, we tested whether trades for pilot stocks were routed differently than other NYSE stocks and found that they were not. We therefore take July 9 to be the start date for Reg. NMS generally for all NYSE listings.

We also find that Nasdaq spreads are higher overall than NYSE spreads. One explanation for this is that Nasdaq trades met the posted NYSE quote, while NYSE transactions occurred inside the quote, i.e., at a better price. This would be consistent with Petersen and Fialkowski's (1994) findings that actual spreads are half the size of posted spreads for trades on the NYSE.

Model 1 also shows a secular increase in spreads after Reg. NMS. Models 2 and 3 present our robustness check, by adding a control for a time trend. The results show a positive and significant effect of time. However, Model 3, which interacts the time trend with *after NMS,* shows that the time trend begins after Reg. NMS, with no trend before Reg. NMS. This suggests that the effects of regulation might occur gradually.

The average spread in our sample is 0.53 cents for NYSE trades and 0.57 cents for Nasdaq trades. The coefficients, also reported in cents, suggest that spreads increase by 0.033 cents, or 6%, for Nasdaq trades relative to NYSE trades in the first month of the new regulation. This is in addition to higher spreads for Nasdaq trades generally of about 0.024 cents, or 4.5%. Thus, the first month of Reg. NMS saw a difference in spreads between NYSE and Nasdaq trades of 10%. The longer-term descriptive data in Figure 4 suggest that spreads increase substantially more over time.

Note that our results allow us to reject alternate hypotheses. The competitive outcome of lower spreads does not obtain, nor does the no-change outcome. Thus, heterogeneous incentives appear to affect market outcomes.

VI. Discussion & Conclusion

Nonprofits are not always strange animals. In fact, sometimes they do exactly what a for-profit would do, as was the case with the nonprofit and for-profit versions of

the Nasdaq. But nonprofits can behave differently than for-profits for predictable reasons and in predictable ways.

In this study, we provide an example of a nonprofit member organization vertically integrating into stock trading to enhance underwriting profits. While underwriting activity gets less attention than trading, it is a lucrative business in which a single initial public offering (IPO) can easily generate tens of millions - and even hundreds of millions - of dollars in fees for the lead underwriters (Ho and Demos 2014). To maximize that business, underwriters, which we posit have long dominated the NYSE, insured that trading was orderly, i.e., continuous and relatively smooth, by tightly regulating specialists. This helped prevent the development of a "lemons" problem at the NYSE (Akerlof 1970), which in turn enabled underwriters to generate higher IPO valuations and, therefore, higher underwriting profits. Our institutional analysis highlights the incentives behind mechanisms and outcomes that are often taken for granted, with recent problems serving as counterfactuals. Events such as the "flash crash" of 2010 and the allegations of market "rigging" in favor of so-called "high frequency traders" (Lewis 2014), can jeopardize investor participation while botched IPOs, such as that of Facebook on the Nasdaq and BATS on its own internal trading system, show how difficult and complex is the underwriting process.

The stock market is an economically important institution, but it is just one of many regulated industries. Nonprofits are frequently involved in providing public goods and often as monopolies. This study demonstrates the importance of carefully analyzing nonprofit incentives, including their potential heterogeneity.

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Table 1: Changes in bid-ask spread of trades before and during the pilot test

	(1)	(2)	(3)
Nasdaq (y=1)	0.024***	0.024***	0.024***
	(0.004)	(0.004)	(0.004)
After	0.163***	-0.054**	-0.550***
	(0.015)	(0.022)	(0.059)
Nasdaq*after	0.033***	0.033***	0.033***
	(0.007)	(0.007)	(0.007)
Trend		0.007***	0.001
		(0.001)	(0.001)
Trend*after			0.014***
			(0.001)
R2 (within)	0.013	0.020	0.026
R2 (between)	0.053	0.044	0.053
R2 (overall)	0.013	0.019	0.026
N	27,166	27,166	27,166

Figure 1: Trading Volume for all NYSE-listed stocks (Jan 2004 – Dec 2011)

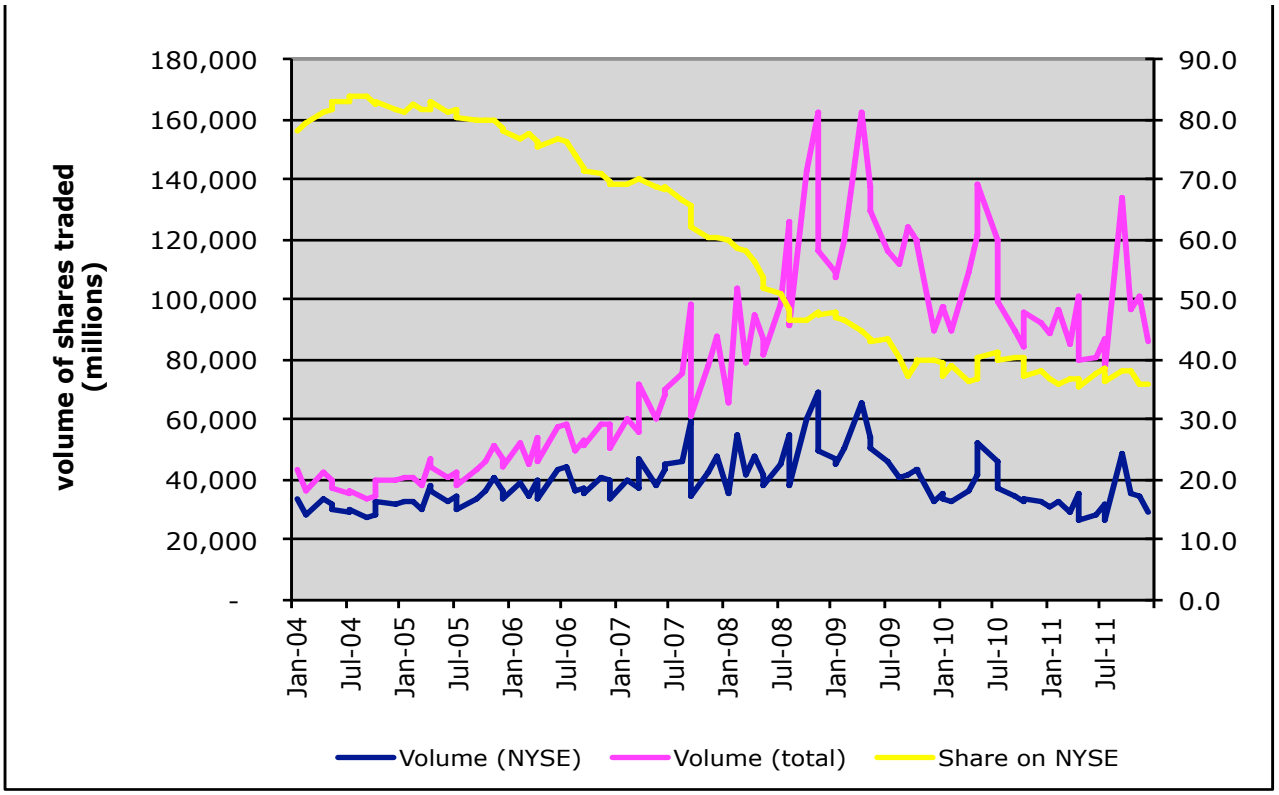
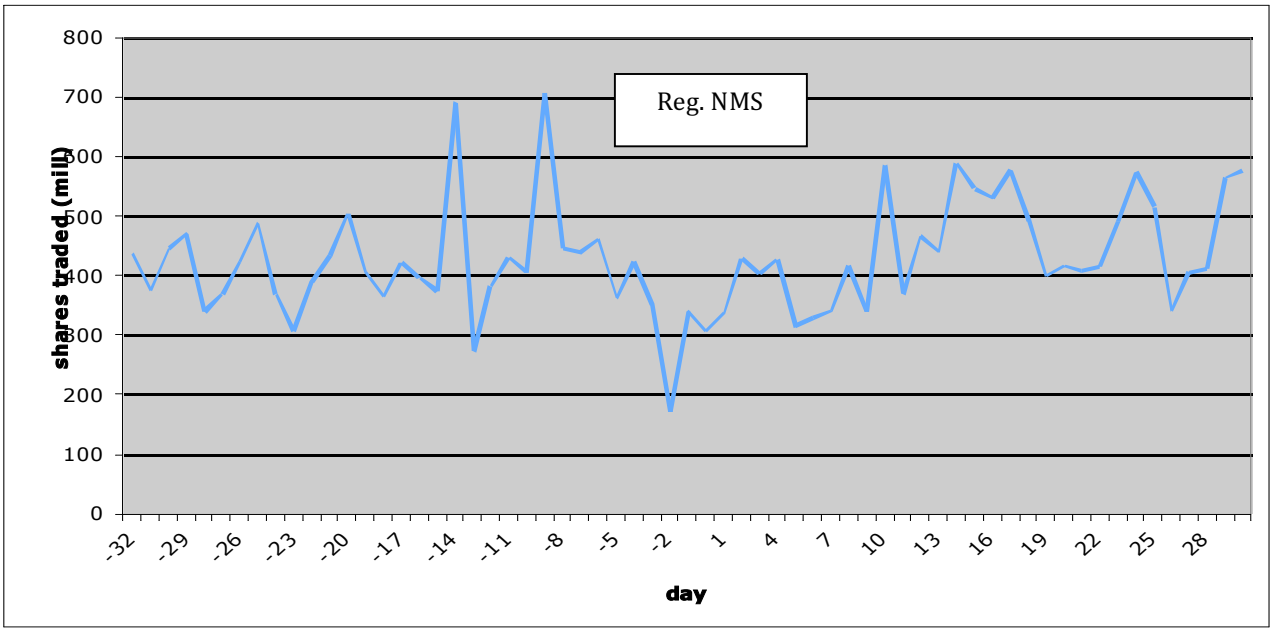


Figure 2: Average difference in trading volume for sample (mill shares): NYSE transactions – Nasdaq transactions



Day 0 = July 9, 2007

Figure 3 - Spread differential over event date

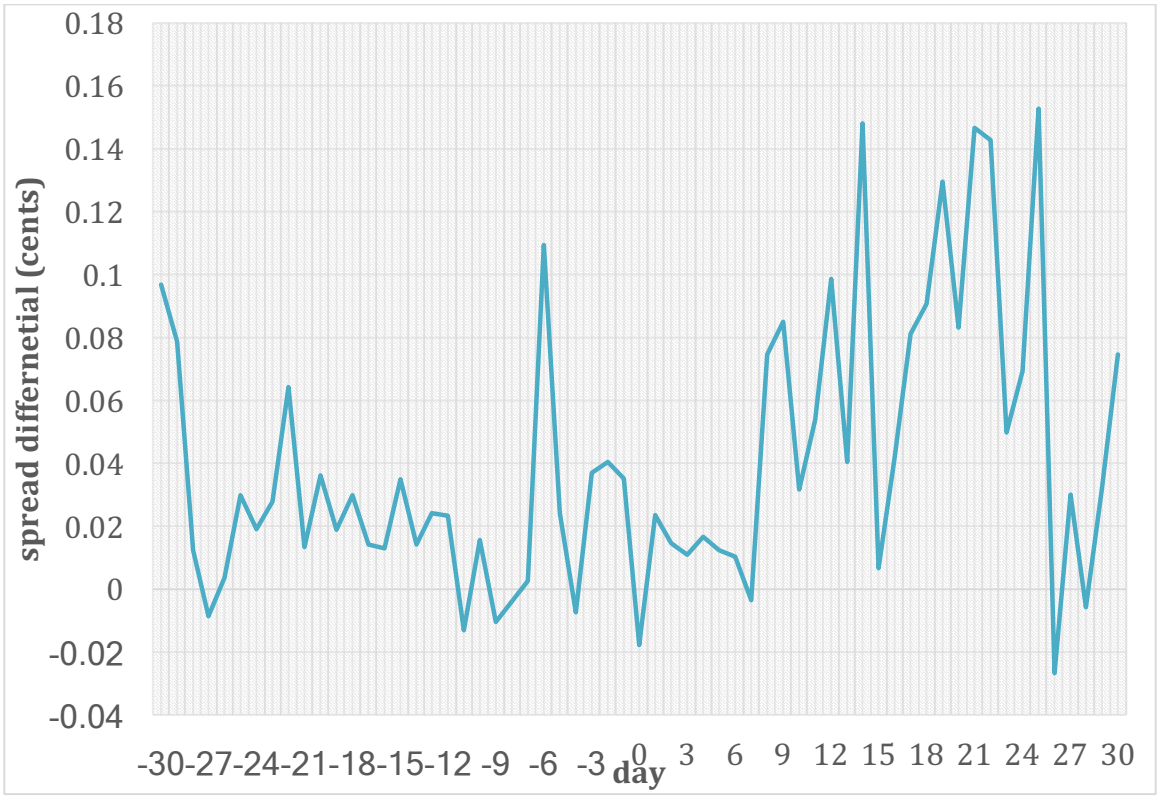
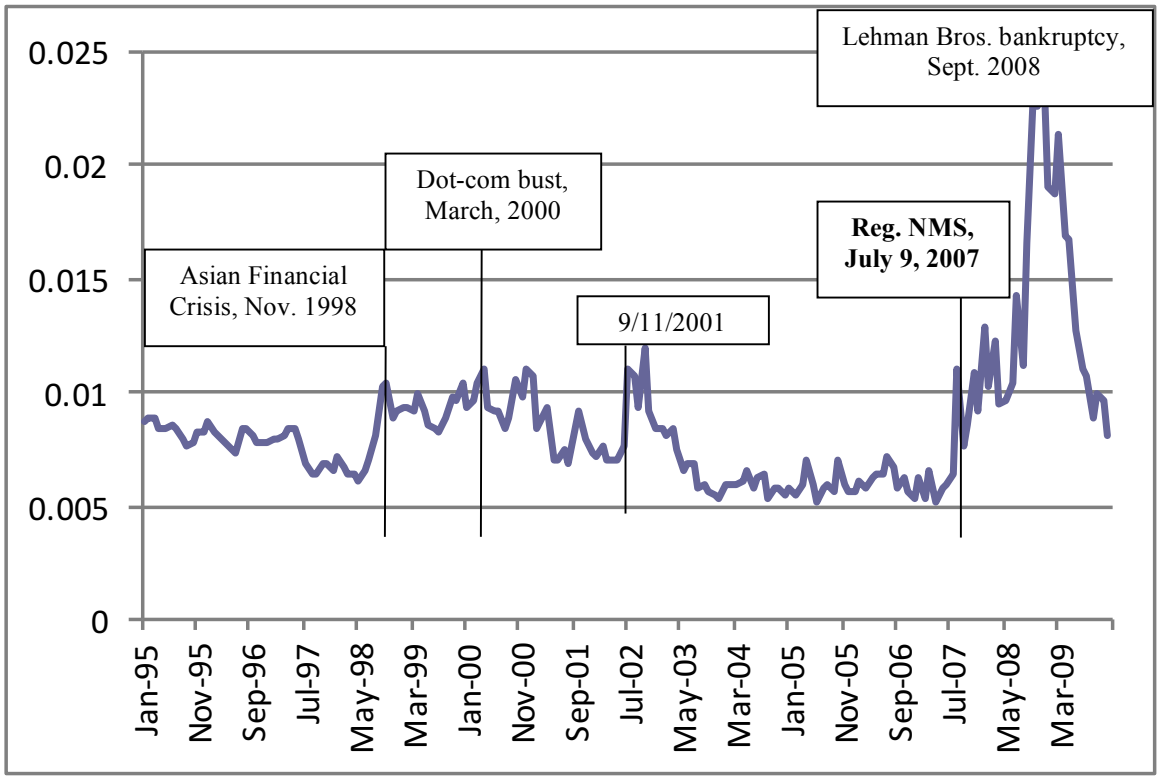


Figure 4: Average Bid-Ask Spread ($) for NYSE-listed stocks, Jan 1995 – Dec 2009



Appendix A: 98 NYSE Pilot Stocks

(*foreign-owned; **exchange traded fund; ***out of business)

ABI	APPLERA CORP
ABT	ABBOTT LABORATORIES
ABY	ABITIBI CONSOLIDATED INC**
ACI	ARCH COAL INC
AEO	AMERICAN EAGLE OUTFITTERS INC NE
AET	AETNA INC NEW
AG	AGCO CORP
AHM	AMERICAN HOME MORTGAGE INVT CORP ***
AIG	AMERICAN INTERNATIONAL GROUP INC
ANF	ABERCROMBIE & FITCH CO
AT	ALLTEL CORP
BR	BROADRIDGE FINANCIAL SOLUTNS INC
BTU	PEABODY ENERGY CORP
C	CITIGROUP INC
CAG	CONAGRA INC
CAH	CARDINAL HEALTH INC
CAL	CONTINENTAL AIRLINES INC
CCJ	CAMECO CORP **
CCU	CLEAR CHANNEL COMMUNICATIONS INC
CNP	CENTERPOINT ENERGY INC
CNQ	CANADIAN NATURAL RESOURCES LTD *
CPB	CAMPBELL SOUP CO
D	DOMINION RESOURCES INC VA NEW
DNA	GENENTECH INC
DOW	DOW CHEMICAL CO
DOX	AMDOCS LTD **
DRL	DORAL FINANCIAL CORP
ED	CONSOLIDATED EDISON INC
EEM	ISHARES TRUST **
EIX	EDISON INTERNATIONAL
EP	EL PASO CORP
EWT	ISHARES INC
FCS	FAIRCHILD SEMICONDUCTOR INTL INC
FMT	FREMONT GENERAL CORP
FRX	FOREST LABS INC
GCI	GANNETT INC
GD	GENERAL DYNAMICS CORP
GE	GENERAL ELECTRIC CO
GS	GOLDMAN SACHS GROUP INC
GSF	GLOBALSANTAFE CORP *
HC	HANOVER COMPRESSOR CO
HES	HESS CORP
HIG	HARTFORD FINANCIAL SVCS GRP INC
HK	PETROHAWK ENERGY CORP
HON	HONEYWELL INTERNATIONAL INC
HRB	BLOCK H & R INC
IBN	ICICI BANK LTD *
IGT	INTERNATIONAL GAME TECHNOLOGY
IMH	IMPAC MORTGAGE HOLDINGS INC **
IP	INTERNATIONAL PAPER CO
JNJ	JOHNSON & JOHNSON
JPM	JPMORGAN CHASE & CO
KG	KING PHARMACEUTICALS INC
KSS	KOHLS CORP
LM	LEGG MASON INC
LOW	LOWES COMPANIES INC
LTR	LOEWS CORP
MAS	MASCO CORP
MDT	MEDTRONIC INC
MO	ALTRIA GROUP INC
MRK	MERCK & CO INC
MRO	MARATHON OIL CORP
MS	MORGAN STANLEY DEAN WITTER & CO
MTG	M G I C INVESTMENT CORP WIS
NEM	NEWMONT MINING CORP
NFX	NEWFIELD EXPLORATION CO

NLY	ANNALY CAPITAL MANAGEMENT INC **
NRG	N R G ENERGY INC
NSM	NATIONAL SEMICONDUCTOR CORP
NWS	NEWS CORP
NYT	NEW YORK TIMES CO
PDP	POWERSHARES ETF TRUST**
PG	PROCTER & GAMBLE CO
PGR	PROGRESSIVE CORP OH
PHM	PULTE HOMES INC
PRU	PRUDENTIAL FINANCIAL INC
Q	QWEST COMMUNICATIONS INTL INC
RDC	ROWAN COMPANIES INC
RDN	RADIAN GROUP INC
RRI	RELIANT ENERGY INC
RYL	RYLAND GROUP INC
SAP	SAP AG*
SKM	S K TELECOM CO LTD *
SKS	SAKS INC
SLR	SOLECTRON CORP
STZ	CONSTELLATION BRANDS INC
SVM	SERVICEMASTER CO
T	AT &T INC
TIE	TITANIUM METALS CORP
TIN	TEMPLE INLAND INC
TOL	TOLL BROTHERS INC
TRI	TRIAD HOSPITALS INC
TV	GRUPO TELEVISA SA*
VG	VONAGE HOLDINGS CORP
VIA	VIACOM INC NEW
WCI	W C I COMMUNITIES INC