Competing with the NYSE

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Abstract

The NYSE's recent mergers with Archipelago and Euronext raise many questions about the effects of competition between stock exchanges. We examine the largely forgotten, but unparalleled episode of competition between the New York Stock Exchange (NYSE) and the Consolidated Stock Exchange of New York (Consolidated) from 1885 to 1926. The Consolidated averaged 23 percent of NYSE volume for approximately 40 years by operating a second market for the most liquid securities that traded on the Big Board. Our results suggest that NYSE bid-ask spreads fell by more than 10 percent when the Consolidated began to trade NYSE stocks and subsequently increased when the Consolidated ceased operations. The empirical analysis suggests that this historical episode of stock market competition improved consumer welfare by an amount equivalent to seven billion US dollars today.

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"The [New York] Stock Exchange is frightened. It may seem strange that an institution which has always assumed to be invulnerable should be frightened, but it is merely a big fool of the air at which the king bird is picking with such success as to threaten its life. The king bird is the Consolidated Stock Exchange." (*Washington Post*, July 24, 1887, p. 3)

Competing with the NYSE

For a significant part of its 215-year history, the New York Stock Exchange (NYSE) has reigned as the leading stock exchange of the world. Recently, technological changes and globalization have given rise to a number of competitors that could threaten the NYSE's preeminent position. Technological change has played an important role in fostering the development of alternative trading systems (Macey and O'Hara, 1999) while globalization may have large and significant effects on financial markets (Ramos, 2003). Indeed, in the July 21, 2005, S-4 filing related to its proposed merger with Archipelago, a rival exchange, the NYSE identifies the growth of global capital markets and the emergence of electronic communications networks as a significant threat to its dominant market share (p. 141). The NYSE has responded to this challenge by merging with a leader in new technology (Archipelago) and with world's leading cross border exchange (Euronext).

These mergers raise many questions about the effects of stock market competition on the cost of transacting and consumer welfare. Unfortunately, prior empirical evidence offers little insight into this important public policy question. Research focusing on past (e.g., Branch and Freed (1977), Hamilton (1976, 1979, 1987), Tinic (1972)) and more recent episodes (e.g., Barclay, Hendershott, and McCormick (2003), Battalio (1997), Battalio, Greene and Jennings (1997)) of direct trading competition with the NYSE has studied relatively minor magnitudes of off-exchange trading by regional exchanges and/or the third market. Much of this competition was limited in both scale and scope and often related to regulatory mandates by the Securities and Exchange Commission (See Jarrell (1984) and Arnold, Hersch, Mulherin and Netter (1999)).

In this paper, we provide new evidence on both the viability and nature of direct trading competition with the NYSE. We study the largely forgotten Consolidated Stock Exchange, a rival

stock exchange that competed directly with the "Big Board" from 1885 to 1926. For almost 42 years, the Consolidated was an important competitor and garnered an average annual market share reaching as high as 60 percent of NYSE trading volume. This sustained incidence of competition with the NYSE came at a time of significant technological change in securities trading and thereby has direct relevance to the current competitive forces confronting the NYSE today.

Although the Consolidated has been noted in historical research by Nelson (1907), Garvy (1944), and Sobel (1972) and in more recent analysis of the property rights to price quotations by Mulherin, Netter and Overdahl (1991), there is little or no systematic analysis of this exchange's impact on the NYSE. Indeed, in an otherwise insightful and comprehensive analysis, Doede (1967) discounts the importance of the rival exchange due to the absence of reported data on Consolidated trading volume (p. 27). We fill the historical and empirical void of this important episode of stock exchange competition with newly collected data from *The New York Times* and other sources.

Our analysis focuses on the effects of competition on NYSE bid-ask spreads and consumer welfare. We first study the impact of competition on bid-ask spreads when the Consolidated began to trade NYSE stocks in 1885. Then we analyze the effects of competition on bid-ask spreads for approximately 40 years of the stock exchange rivalry. Our results suggest that NYSE bid-ask spreads fell by more than 10 percent when the Consolidated began to trade NYSE stocks. We find that the presence of competition significantly reduced bid-ask spreads over the entire 42-year period of head-to-head competition. Bid-ask spreads then increased after the rival exchange closed its doors in 1926 following a series of scandals and investigations. Finally, we estimate that the Consolidated improved consumer welfare by an amount equivalent to seven billion US dollars today.

The remainder of the paper proceeds as follows. Section 1 describes the trading environment on the NYSE in the years prior to the onset of competition by the Consolidated in

1885. Section 2 reports data on the magnitude and nature of the stock market competition provided by the rival exchange over the period 1885 to 1926. Section 3 analyzes the short and long-run effects of competition on NYSE bid-ask quotes. This is followed by an analysis of the effect of the stock market rivalry on consumer welfare. Section 4 summarizes the results and concludes the paper with a discussion of the implications of our findings for future studies of stock market competition.

1. The Trading Environment at the Onset of Competition

The Consolidated Stock Exchange was formed in early 1885 by the merger of the New York Mining Stock and Petroleum Exchange, the New York Petroleum Exchange and Stock Board and the Miscellaneous Securities Board. These exchanges initially specialized in mining and petroleum securities that were not traded on the NYSE. Soon after the merger, however, the Consolidated began trading railroad stocks and other securities listed on the NYSE. *The New York Times* reported that the Consolidated decided to trade NYSE listed securities in news articles dated January 21, 1885 and February 14, 1885. The newspapers began reporting Consolidated trading volume of NYSE listed securities February 17, 1885.[1]

The onset of competition from the Consolidated occurred during a period of rapid growth in the depth and the breadth of trading on the NYSE. In the ten years prior to the formation of the Consolidated, trading volume steadily rose and was, on average, twice as high in the 1880-1884 period compared to the 1875-1879 period. The growth in volume was accompanied by an increase in listings on the NYSE, as listings doubled on the exchange between 1875 and 1884. (See, e.g., the 1940 New York Stock Exchange Yearbook, p.49.). We sampled bid-ask spreads from *The New York Times* for one day of each year and found the median bid-ask spread increased across all NYSE stocks as the number of securities reported in *The New York Times*

[1] For background on the formation of the Consolidated Stock Exchange, see Nelson (1907), Garvy (1944), Sobel (1972), and Mulherin, Netter and Overdahl (1991). An appendix of relevant news stories is available from the authors.

rose over time. However, the median spread for firms with reported trading volume remained at 0.25 for most of the period. Railroads or Western Union were the most active security for the sampled day in a given year. These securities always traded at the minimum tick of one-eighth.

Garvy (1944), Michie (1986), and Mulherin, Netter and Overdahl (1991) link the growth in the depth and breadth of NYSE trading activity to various technological innovations. The transatlantic cable was completed in 1866 and the stock ticker was invented in 1867. Telephones came to the exchange floor in 1878. Garbade and Silber (1978) report that financial markets readily adopted these new technologies. Field (1998) details how the telegraph and ticker revolutionized the flow of information and trading in securities markets. Accompanying organizational innovations such as the movement from call to continuous markets enhanced the available market for NYSE listings as well as the capacity for the exchange to trade. Sylla (1993) argues that many important elements of the modern financial markets were developed during the late nineteenth and early twentieth century.

The innovations that enhanced the potential of the NYSE also increased the probability of competition from existing and rival exchanges (e.g., Garvy (1944), Michie (1986), and Mulherin, Netter and Overdahl (1991)). The Consolidated's more than 2,000 members conducted trading on a floor in a building a few blocks from Wall Street at the corner of Broad and Beaver Streets. Because the NYSE, the New York Mining Stock and Petroleum Exchange and other predecessors had gentlemen's agreements not to engage in direct trading competition, the Consolidated at its inception possessed stock tickers linked to the NYSE and thereby had ready access to the information required to engage in the trading of NYSE listings.

The proximity of the Consolidated to the NYSE distinguished the rival exchange from regional stock markets located in other major cities in the U.S. As discussed in Arnold et al. (1999), stocks of local securities tended to trade in the same city in which they were financed and owned in the late nineteenth and early twentieth century. For example, companies tied to the auto industry went public and traded on the Detroit Stock Exchange while western oil companies

traded on the Los Angeles Stock Exchange. American Bell, a local Boston firm, listed on the regional exchange in 1878 two years after the invention of the phone. The company did not begin trading on the NYSE until 1901 when it changed its name to American Telephone and Telegraph and moved its headquarters to New York City (Garnet (1985)). Arnold et al. (1999) attribute the specialized trading on the regional exchanges to the underdeveloped communications technology of the time. This same communications technology provides one reason why the regional exchanges did not compete head-to-head with the NYSE.

Using its location to gain access to the latest information on Wall Street, the Consolidated attracted trading in NYSE listings by charging lower commissions, offering odd lot trading, and allowing a longer settlement period. The rival exchange even functioned as the primary New York market when it opened one-half hour before the NYSE for a period beginning in July 1912. Commission rates on the Consolidated averaged 1/16th of the par value of a stock or half the brokerage commission charged by the NYSE. However, the NYSE had several loopholes that allowed members to bypass its high brokerage fees. Members that bought and sold stock between each other were charged rates as low as 1/32nd of par value and deals between brokers on the floor of the exchange could go as low as 1/50th percent of a stock's par value. The discount on commissions was extended to all partners of an NYSE firm even if they did not own a seat on the exchange. The discount policy led to the creation of ever larger stockbroking firms (Michie, 1986). The Consolidated also dealt in odd lots, executing trades of only 10 shares as opposed to the NYSE that required an order size of at least 100 shares.[2] In addition, the Consolidated had a two-week settlement period (that was later changed to one-week) as opposed to the daily settlement period for the NYSE.

The New York Stock Exchange immediately responded to the Consolidated's decision to trade Big Board stocks. The NYSE implemented a series of measures in 1885 and 1886 to limit

[2] Ott (2004) shows that odd lot trading accounted for as much as 40 percent of the business of NYSE members by 1921. She also provides historical evidence that NYSE member firms often sold odd lots to retail customers at stale prices and that such trading was a highly profitable business for NYSE members.

the Consolidated's ability to gain market share. The NYSE passed a resolution mandating that 400 of its members drop their affiliation with the Consolidated (Mulherin, Netter, and Overdahl, 1991) and later amended this resolution to prohibit clerks in member firms from joining the Consolidated. In 1888, the New York Stock Exchange even suspended one of its members for conducting business with the rival exchange, although this measure did not eliminate trading between the two rivals as some brokers continued to conduct business and arbitrage price differences on the two exchanges. *The New York Times* often printed articles that discussed various aspects of competition between the two exchanges. In a February 27, 1891 article "A Wall Street Quarantine," the newspaper reported that the NYSE passed a resolution to limit competition from the Consolidated.

"After a lull, the old battle between the Stock Exchange and its youthful neighbor on the other side of New Street has broken out again... At the meeting of its Governors Tuesday a resolution was passed which was not made public until yesterday. It is a stringent order, and it reads in this way: Resolved, That all communications between this Exchange and the Consolidated Stock and Petroleum Exchange, or any part of the building thereof, by means of messengers or clerks, or in any other manner, directly or indirectly, is detrimental to the interests and welfare of this Exchange, and is hereby prohibited."

The NYSE also established an unlisted department that traded only "speculative" stocks listed on the Consolidated. Although this measure primarily covered mining and other less important securities, it signaled the NYSE's intention to limit competition from the rival exchange. The Big Board also vigorously challenged the Consolidated's use of its ticker. Mulherin, Netter and Overdahl (1991) detail this battle over property rights and the ticker. For our purposes, it is important to note the Consolidated maintained access to the ticker for the length of its history.

2. The Magnitude and Nature of the Stock Market Rivalry

The rivalry between the Consolidated and the NYSE lasted from 1885 to 1926. Figure 1 provides estimates of the magnitude of the 42-year rivalry between the NYSE and the

Consolidated Stock Exchange from 1885-1925. We report the annual volume of common stocks on the NYSE, the annual volume of NYSE-listed stocks on the Consolidated, and the ratio of Consolidated volume to NYSE volume. (See the Data Appendix for data sources.) The data show that the Consolidated quickly gained a significant share of the trading volume of NYSE-listed securities. In the first ten years of its existence, the ratio of Consolidated to NYSE volume averaged 40 percent. By 1894, the Consolidated traded as much as 60 percent of NYSE volume.[3] Over the course of the stock exchange rivalry, the Consolidated averaged 23.48 percent of NYSE volume. As late as 1921, the ratio of Consolidated to NYSE volume was 25.87 percent.

The rivalry ended in February 1926 with the demise of the Consolidated. Garvy (1944) and Sobel (1972) point to accusations of fraud and the prosecution of the Consolidated by the Attorney General of the State of New York under the auspices of the Martin Act of 1921.[4] William Silkworth, President of the Consolidated Stock Exchange in the early 1920s, allegedly misused a rescue fund in early 1922 for his own personal gain after asking member firms of the exchange to contribute to the fund. A few months later, one of the Consolidated's leading and most respected brokerage houses, Edward M. Fuller & Company declared bankruptcy. Silkworth was accused of embezzling funds from the brokerage house even though he denied any wrong-doing. Although Silkworth was subsequently exonerated of the charges, a Fuller executive pleaded guilty to fraud. The Consolidated continued to trade securities after the scandals and even introduced reforms to eliminate corruption on the exchange.[5] However, the historical evidence

[3] Although the data collected from *The New York Times* contains total volume for listed and unlisted securities, the volume data from the NYSE website only reports data for listed securities. As a result, our total volume data for the NYSE undercounts total volume for the period between 1888 and 1910 for the Big Board, when the NYSE closed its unlisted securities department. The total volume of unlisted securities is relatively small with the exception of American Sugar, which was a component of the Dow Industrial Average. We have NYSE volume data for American Sugar for the last day of the month from April 1894 until 1926. These data suggest that Figure 1 may overstate the Consolidated's total volume relative to the NYSE by three percent to eight percent from 1893 to 1902 when American Sugar was among the most actively traded securities on both exchanges. This discrepancy does not affect our formal analyses which are conducted on individual securities where we have the actual data from both exchanges.

[4] The Martin Act was recently been used New York Attorney General Eliot Spitzer to indict Wall Street brokers and executives in the recent wave of corporate scandals.

[5] Ott (2004) shows that politics played an important role in the collapse of the Consolidated. She argues that the NYSE engaged in a public relations campaign from 1913 until 1929 and captured the New York

suggests that the reputation of the exchange had been irreparably damaged. News reports at the time indicate that attempts to revive the rival exchange ended with the revelation that the Consolidated did not possess the right to the tickers transmitting NYSE price quotes in early 1927. Doede (1967) also notes that the emergence of the New York Curb Exchange in the early twentieth century (later the American Stock Exchange), which adopted a more amicable and non-competitive relation with the NYSE, also led to a weakening of the Consolidated's position after 1909.

Figure 2 provides evidence that the Consolidated tended to trade the relatively liquid NYSE listings. For a single day in each year between 1885 and 1926, the figure reports the median bid-ask spread on the NYSE. While the median absolute (relative) bid-ask spread for all NYSE stocks with quotes averages $1.00 (2.08 percent) over the entire time period, the median absolute (relative) spread of the NYSE listings that also traded on the Consolidated averages $0.25 (0.53 percent). This is also lower than the average absolute (relative) spread of $0.75 (1.60 percent) for stocks with volume on the NYSE but not on the Consolidated. The tendency for a rival exchange to trade relatively more liquid NYSE listings resembles the results found from studies of modern-day markets (e.g., Easley, Kiefer and O'Hara (1996), Battalio (1997)).

Table 1 provides additional evidence that the Consolidated tended to trade relatively liquid NYSE listings. For a single day in each of the sample years, the table reports the most heavily traded security on both the NYSE and the Consolidated. For 21 of the 42 years (50 percent of the time), the most heavily traded security on the NYSE was also the most heavily traded on the Consolidated. In only five of the 42 years was the most heavily traded security on the NYSE not in the top five in trading on the Consolidated. The most heavily traded security on both exchanges tended to trade at the minimum bid-ask spread of one-eighth, providing further evidence that the Consolidated emphasized relatively liquid NYSE listings.

State Attorney General's Office which investigated the Consolidated for stock fraud and wash sales. Ott concludes that a public relations campaign by the NYSE was successful and that the Big Board managed to avoid significant federal and state regulation until the New Deal.

The fact that the Consolidated, like many current-day NYSE competitors, tended to trade relatively more liquid securities poses some complications in identifying the effect of competition on the NYSE. As noted in the initial research on bid-ask spreads by Demsetz (1968, p. 45), measures of competition are likely to be associated with the rate of transactions across securities. Similarly, Tinic (1972, p. 88) notes that any measure of inter-exchange competition might also proxy for long-run trading activity. Such concerns were certainly present in the early analysis of NYSE bid-ask spreads and exchange competition that tended to be cross-sectional studies over a short time interval.

To estimate the effect of stock market competition initiated by the Consolidated, we perform a series of complementary tests. We begin with a natural experiment in which we study the effect of the onset of competition on NYSE bid-ask spreads. This experiment implicitly treats the onset of the Consolidated as an exogenous event. Boehmer and Boehmer (2003) have a similar research design in their recent study of the NYSE entry into the market of Exchange Traded Funds (ETFs). We then perform a panel study of the effect of the Consolidated on NYSE bid-ask spreads over the entire 42-year rivalry of the two exchanges. Such analysis resembles Wahal's (1997) recent work on the effects of dealer competition on NASDAQ and avoids the critique of the early studies of the NYSE that focused on short periods of time.

3. Empirical Evidence

A. The Onset of Stock Market Competition

Our empirical analysis of stock market competition begins with the Consolidated's decision to trade NYSE stocks. This event provides a natural experiment to study the behavior of bid-ask spreads in the period before and after the rival exchange directly competed with the NYSE. To investigate this question, we estimate a series of regressions using NYSE bid ask-spreads as the dependent variable for a one-year period before and after the initiation of trading in NYSE listings by the Consolidated in February 1885. The regression analysis controls for firm-

specific factors such as trading volume, price level, and return volatility that prior studies have found to affect bid-ask spreads (Demsetz 1968, Tinic 1972, Branch and Freed, 1977).[6] The basic model can be written as:

$$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \varepsilon_{it}, \quad (1)$$

where $SPREAD_{it}$ is either the natural log of the absolute bid-ask spread or relative spread [(ask-bid)/((bid+ask)/2)] for security i on day t. The volume and closing price variables, VOL_{it} and $CLOSE_{it}$, are measured as the natural log of the NYSE daily volume and closing price for security i on day t. $STDEV_i$, is defined as the standard deviation of the natural log of security i's return over the entire sample period. To determine the effect of stock market competition, $COMP_t$ is a dummy variable that takes the value of one in the period beginning with the initiation of trading of NYSE listed stocks by the Consolidated on February 17, 1885. The white noise error term is given by ε_{it}. Bid-ask spreads for the empirical analysis are collected from *The New York Times*. The newspaper also reported trading volume, but not information on bid-ask spreads for the Consolidated. Silber (2005) reports a similar non-reporting of data on NYSE competitors by major financial newspapers in his analysis of the closure of stock markets from the end of July to December 1914 following the outbreak of World War I.

The time period for the analysis is 60 weeks before and 60 weeks after the onset of stock market competition. This time interval is determined in part by data availability. As noted in the Data Appendix, our firm-level data on volume and bid-ask spreads come from *The New York Times*. The newspaper temporarily discontinued reporting NYSE bid-ask spreads in mid-April 1886. To have a continuous database, we use the interval from February 17, 1885, to April 9,

[6] In addition, we estimated the baseline models including a market capitalization variable that is also interacted with a dummy variable that captures the effect of competition. The results are robust to the inclusion of the market capitalization and interaction variables. Although we find some evidence that the interaction variable between firm size (market capitalization) and competition reduces bid-ask spreads, we do not report the result because of the difficulty in interpreting the coefficient on firm size given the significant multicollinearity between market capitalization, closing price and security volume (see Harris, 1994).

1886, for the Consolidated period. We use a comparable interval prior to the onset of off-exchange trading of NYSE listings as our pre-Consolidated time period.

We sampled data from Friday trading in each of the 60 weeks before and the 60 weeks after the onset of competition by the Consolidated. If Friday was not a trading day, we sampled from an adjacent day. For each day, we collected data on the closing price, volume, and bid-ask spreads of all NYSE common stocks reported in *The New York Times*. Our analysis focuses on NYSE-listed firms with non-zero trading volume, although our results are robust to including NYSE firms with zero trading volume on a given business day.[7] For the same time interval, we also collected control variables reflecting aggregate market conditions such as aggregate NYSE volume, the concentration of NYSE trading, and broker call rates.

The first panel in Table 2 provides summary statistics for the pre- and Consolidated periods. The sample contains 7,036 observations. This includes all companies with at least 12 observations of reported trading volume and bid-ask spreads on the NYSE. The mean absolute bid-ask spread and relative bid-ask spread are 0.685 and 2.78 percent respectively. The individual daily security volume ranges from five shares to 171,516 shares and averages 5,251 shares. The mean closing price is $52.89. The standard deviation of returns for the average security is 7.10 percent per week over the sample period. The number of observations that occur in the Consolidated period accounts for 53.4 percent of the total observations.

Table 2 also reports summary data on the control variables that we use in our robustness analysis. The mean aggregate weekly trading volume for all securities on the NYSE during the week is 1,990,360 shares. The mean share of total volume was 1.69 percent for securities with NYSE volume and the average concentration ratio for the four highest volume NYSE securities is 55.5 percent, indicating that NYSE volume was highly concentrated among the most active securities over the sample period. The concentration of trading in securities markets has been noted in modern day markets by Easley, Kiefer, O'Hara and Paperman (1996).

[7] The robustness checks are available from the authors upon request.

The second and third panels in Table 2 separately report the data for the pre- and Consolidated periods. The data suggest an average decline in both absolute and relative bid-ask spreads. For the remaining firm specific and market-wide variables, there does not appear to be a discernible trend or pattern in the data. For example, the average of individual NYSE security volume declines while the average NYSE stock price is relatively flat. The average of NYSE total weekly volume rises while the average broker call rate falls

Figure 3 graphs the average weekly bid-ask spread over the sample period for the NYSE and a group of the leading regional exchanges (Baltimore, Boston and Philadelphia).[8] The graph is suggestive in two important ways. First, the decline in bid-ask spread is not part of a larger trend of lower bid-ask spreads on the NYSE but is specific to the post-Consolidated period. Secondly, the lower bid-ask spread seems to be confined to the NYSE and not the regional exchanges. It is important to note that while the regional exchanges did trade some NYSE listed securities at this time, the majority of stocks trading on these exchanges were not listed on the Big Board and did not face direct competition from the Consolidated.

In addition, we present summary statistics in Table 2 for securities with volume on the NYSE. The descriptive statistics are broken down into two groups: stocks traded by the Consolidated and securities not traded by the rival exchange. For the entire sample period, companies that the Consolidated traded accounted for 4,823 out of the 7,036 observations or 68.5 percent of the sample. However, the average volume of securities traded by the Consolidated was over 17 times higher than the NYSE listings that they did not trade. The companies that the Consolidated traded accounted for over 97 percent of the total trading volume over the full sample period. In addition to having lower volumes and lower bid-ask spreads in both the full

[8] *The Commercial and Financial Chronicle* reported bid-ask spreads for some stocks on the regional exchanges that did not have trading volume for that particular day. For consistency, the average bid-ask spread for the NYSE is the average for all securities and includes some stocks that did not have any trading volume so the data in this figure are not directly comparable to those in later tables. For a couple of weeks when *The Commercial and Financial Chronicle* did not report bid-ask spreads for the regional markets, we interpolated the average bid-ask spread using the week before and after the missing observations. The Boston Exchange accounts for over 90 percent of the observations in Figure 3. For our formal analysis, we are forced to focus on the Boston Exchange due to the lack of sufficient observations with trading volume on the other regional exchanges.

period and the pre-Consolidated securities, the securities traded by the Consolidated tended to have lower average closing prices and higher volatility.

If we examine the change from the pre-Consolidated period to the Consolidated period for each group, then it is clear that the absolute and relative bid-ask spreads fall for each group. The decline in spreads for the group with Consolidated trading is consistent with competition and the decline in the group without Consolidated trading is consistent with potential competition. On the other hand, the mean bid-ask spread for the regional exchanges did not experience a similar decline with the onset of stock market competition between the two New York exchanges. In addition, the group with Consolidated trading experienced a decline in the average NYSE volume of almost 15 percent (8,102 shares vs. 6,883 shares) while the volume for those without Consolidated trading increased by 25 percent in the period of competition (382 shares vs. 478 shares). Table 3 reports the results for the estimation of our basic model over the pre- and Consolidated period. We report four specifications that examine the determinants of the absolute and relative bid-ask spreads that omit and include company fixed effects. Column A of Table 3 reports the model with the absolute bid-ask spread as the dependent variable. The results indicate that the absolute spread is positively related to the closing price, negatively related to individual security volume, and positively related to the standard deviation of returns. All coefficients are significant at the one percent level of significance.

The dummy variable for the presence of Consolidated trading indicates that absolute spreads are negatively related to the onset of competition from the Consolidated exchange. The coefficient on the Consolidated dummy is also significant at the one percent level. The results suggest that the bid-ask spreads were approximately 11.6 percent lower in the Consolidated period.[9]

[9] The 11.6 percent decline is the calculated as follows $e^{-.123}-1$ where 0.123 is the coefficient on the presence of consolidated trading variable in the regression of the natural log of bid-ask spreads on the presence of consolidated trading and control variables.

In Column B of Table 3, we include company specific fixed effects to capture unobserved heterogeneity across firms. This necessitates excluding the standard deviation variable because it does not vary by observation across an individual security. The coefficients on security volume and the Consolidated dummy remain negative and significant at the one percent level and the coefficient estimate rises to 14.3 percent. The closing price is now negatively and significantly related to absolute spreads after controlling for fixed effects.

Column C of Table 3 reports the results using the relative spread as the dependent variable. Higher security volume, higher closing prices, and higher volatility are all negatively and significantly related to the relative spread. The presence of competition from the Consolidated results in a reduction in relative spreads of approximately 11.3 percent. We obtain similar results when we control for company specific fixed effects in Column D.

The ideal test of the effects of the Consolidated would be to have a control group of actively traded securities on the NYSE that had some prohibition on Consolidated trading. Without such a control group, we estimate models similar to those presented in Table 3 for the Boston Stock Exchange in order to determine whether or not the results are driven by overall changes in equity markets during this time period. The Boston Stock Exchange serves the purpose as a quasi-control group because it predominantly traded different stocks in the same industry --railroad and telephone stocks-- that did not trade on the Big Board. As noted above, Arnold et al. (1999) provide evidence that regional stock exchanges, such as Boston, tended to trade regional securities that were financed and owned by local investors. Active stocks listed on the Boston market included the following railroads: Atchison, Topeka & Santa Fe, Boston & Albany, Boston & Lowell, Boston & Maine, Boston & Providence, Chicago, Burlington & Quincy, Mexican National and New York & New England.

The New York financial press regularly printed stock prices for companies trading on the Boston Stock Exchange. The regional exchange therefore provides a test of whether a railroad or telephone specific shock can account for the statistically significant decline in NYSE bid-ask

spreads with the Consolidated's decision to trade NYSE listed stocks. The empirical results for Boston, presented in Table 3A, indicate a similar relationship between spreads and control variables. However, the dummy variable for the presence of Consolidated trading is never significantly different than zero. Although the coefficient for competition is negative for Boston, it is less than half the size of the competition coefficient for the NYSE. This suggests that the observed relationship between Consolidated trading and NYSE spreads was the result of competition.

While the analysis in Table 3 controls for individual security effects across the pre- and Consolidated time periods, it is possible that changes in overall market conditions rather than the existence of the Consolidated led to lower bid-ask spreads. We control for overall market conditions with several variables including aggregate NYSE volume, the concentration of trading volume, and the broker call rate. Our measure of aggregate volume, $WVOL_t$, is NYSE weekly volume for a given observation (the sum of total NYSE volume for the day included in the sample and the five previous days of trading). Davis, Neal and White (2005) find that higher total volume on the NYSE increases bid-ask spreads if the "Big Board" has reached its capacity constraint for trading stocks. We also include the concentration ratio of volume for the four highest volume firms, $CONC_t$, to account for the fact that high volume securities have lower bid-ask spreads – if trading becomes more concentrated in high volume securities, then bid-ask spreads should fall. We also include the ratio of a security's NYSE volume to total NYSE volume on that day, $SHARE_{it}$, to control for the extent to which the Consolidated was trading only the most active NYSE securities. Finally, we include the broker's call rate as a measure of the cost of carrying an inventory of securities. The white noise error term is given by ε_{it}. The extended model can be written as:

$$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \beta_5 WVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it} \quad (2)$$

In Table 4 we report the results of estimating the model with the additional control variables. While each of these additional variables is generally significant in the regression, they have little effect on the other variables or the overall fit of the model. The exception is the individual security volume measure. Individual security volume is no longer significantly different from zero because the variable is highly correlated with total NYSE volume.

In all the specifications reported in Table 4, the presence of competition from the Consolidated is associated with a reduction in absolute and relative spreads of approximately 13 percent. The Consolidated dummy is significant at the one percent level in the four different specifications. Moreover, the impact of the Consolidated on spreads is remarkably consistent across the specifications presented in Tables 3 and 4 and indicates that the introduction of the Consolidated is associated with a non-trivial reduction in bid-ask spreads on the NYSE. Table 4A reports an analysis of bid-ask spreads for the Boston Exchange using additional control variables. Again, we find that bid-ask spreads on the regional exchange did not significantly decline when the Consolidated Stock Exchange began to trade NYSE-listed stocks.

The baseline results are also consistent across a series of robustness checks not reported. We have focused on a longer period using one day a week for 120 weeks surrounding the event to insure that any impact of the Consolidated was not short run around the beginning of trading. An alternative concern is that this longer window is capturing an unexplained trend in bid-ask spreads. To that end, we have also collected daily data for the 76 trading days surrounding the initiation of trading by the Consolidated. The results using daily data are similar to those reported in the tables with the impact of the Consolidated trading always being associated with declines in spreads that are actually significant and slightly larger in magnitude. We obtained similar findings when we included every security from *The New York Times* rather than focusing only on securities with positive NYSE volume on a given day. We also estimated the model after excluding securities that appeared only in the pre- or Consolidated period and have also restricted the sample to only those firms that consistently traded in both periods, something akin to a

matched panel. The results are unaffected by these changes. The results are also robust to excluding securities with closing prices of $1 or less and $5 or less. Finally, we obtain similar results if we exclude securities trading at the binding spread of one-eighth.[10]

B. The Effects of Long-Run Competition

In order to study the long-run effect of competition on NYSE bid-ask spreads, we estimate a panel regression of NYSE bid-ask spreads on variables proxying for competition from the Consolidated, firm-specific variables that affect spreads, and other variables that control for market conditions over time. *The New York Times'* brief lapse in reporting trading volume of NYSE stocks on the Consolidated from April through August 1886 limits our long-run analysis to the period September 1886 to February 1926. We sampled data from the last trading day of each month and collected firm-specific information on bid-ask spreads, trading volume on the NYSE, and trading volume of NYSE stocks bought and sold on the Consolidated Stock Exchange (if any). We also collected data on NYSE total monthly volume and the closing monthly broker call rate as additional control variables for the empirical analysis.

We focus our analysis on the common stocks in the Dow Jones Indices. We use the original Dow Jones Index with 12 stocks from September 1886 until October 1896, when the index is divided into the 20 stock Dow Jones Railroad Index and the 12 stock Industrial Index. We collected data from *The New York Times* for each security in the index at a given point in time and rely on Farrell (1972) for changes in the composition of the indices.

We employ the same empirical analysis used in Section 2 where the natural log of the absolute or relative spread is a function of a security's volume, its closing price, individual security volatility and competition. The only difference in the specification is that we now employ two different measures for the competition variable. The first is an estimate of the

[10] We also find evidence that NYSE seat prices declined 20 percent in the first six months that the Consolidated began to trade NYSE listed stocks. We are unable to formally test this hypothesis given that the NYSE did not report any trades in the seat market in the three-year period before the Consolidated began to compete head-to-head with the Big Board. We also do not have Consolidated seat prices from this period.

Consolidated's fraction of the volume of trading in a given NYSE listing, defined as [Consolidated Volume/(NYSE Volume + Consolidated Volume)]. Since this variable is measured in logs, we replace all zeros with a small positive value before taking the natural log for the observations where the Consolidated's share is zero. The basic tenor of the results remains unchanged by including shares with a zero value. The second measure of competition is a dummy variable that takes a value of one if a security traded on the Consolidated on a given day. The two measures of competition have a pair wise correlation of 0.95, so we do not use them in the same regression.

Table 5 reports the summary statistics for the data used in the analysis of the effects of the Consolidated over time. The absolute bid-ask spread averages 0.414 and the relative bid-ask spread averages 0.627 percent. These bid-ask spread values are lower than those reported for all NYSE stocks in Figure 2, which reflects the fact that the firms in the Dow Jones Indices are relatively liquid. Individual daily security volume on the NYSE averages 10,626 shares, the closing price averages $88.239, and individual security return volatility over the entire sample period averages 11.348.

The Consolidated's share of total volume per security averages 11.21 percent, but ranges from zero to 99.5 percent. For the dataset of firms from the Dow Jones Index, the Consolidated traded in an average of 74.8 percent of the sample on a given day. Table 5 also reports summary statistics on the control variables used in the analysis. NYSE total monthly volume averages 14.7 million shares. A security's share of trading volume averages 3.742 percent and the concentration of trading in the four most heavily traded securities averages 63 percent. The broker's call rate averages four percent.

Table 6 reports the estimates of the basic model of the effects of the Consolidated over time. The first two columns report the models with the absolute bid-ask spread as the dependent variable. The first column has the natural log of the Consolidated's share as the measure of competition, while the second column has the simple Consolidated dummy as the measure of

competition. Both the Consolidated share variable and the dummy variable for the presence of Consolidated trading are negatively and significantly related to bid-ask spreads at the one percent level. A one percent increase in the share of Consolidated volume results in a 3.6 percent decline in the absolute and relative bid-ask spreads and the presence of Consolidated trading reduces the bid-ask spread by about 20 percent. The coefficients of volume, price level, and security volatility all have the expected signs and are significantly different from zero. The next two columns report the basic model with the relative bid-ask spread as the dependent variable. Again, the two measures of competition are negatively and significantly related to bid-ask spreads on the NYSE. The coefficients of the other variables have the expected signs and are significantly different from zero.

Table 6 also presents the results when we control for security specific fixed effects and year effects. Here the variable for individual security volatility is omitted because it is estimated over the entire sample period for a given firm. The results are generally robust to changing the specification of the model with the Consolidated share variable producing a 2.8 percent to 3.0 percent reduction in spreads and the presence of Consolidated trading producing a decline in spreads of approximately 15 percent.

We also estimate the extended model --given in equation (2)-- that incorporates additional control variables to capture general market conditions. Table 7 presents the empirical results using the additional control variables with and without fixed effects. The competition variables always have a negative and statistically significant effect on spreads. Hence, both the presence and magnitude of competition by the Consolidated is associated with narrower bid-ask spreads on the NYSE over time.

As a complement to our long-run analysis, we also conducted an "event study" analysis of the effects of the initiation of trading by the Consolidated in a particular stock. To conduct this test, we searched for securities from our sample of Dow Index stocks that significantly traded on the NYSE before also trading on the Consolidated. We then estimated the change in bid-ask

spreads of the securities after the initiation of trading by the Consolidated. Unfortunately, most stocks that were in the Dow Indices tended to have heavy trading on both the NYSE and the Consolidated during the course of our sample period.

We identified four securities that fit our criterion: AT&T, Colorado Fuel & Iron, Northern Pacific and the Texas Company. We use these four stocks and estimate our baseline model where the dummy variable for the Consolidated is equal to one after the rival exchange initiates trading. The results are presented in Table 8 and indicate that the initiation of Consolidated trading is significantly related to a decline in spreads, which is consistent with our other analysis. However, the results are only suggestive given the small number of stocks in the sample.

Although the empirical analysis suggests that competition reduced bid-ask spreads, the panel regressions do not measure the effect of competition on consumer or investor welfare. To provide some perspective on this question, we calculated the transactions cost savings of buying stock on the Consolidated and NYSE using the coefficient estimates of the competition variables from the regression analysis. Given that competition reduced NYSE bid-ask spreads by approximately 11.6 percent, we multiplied this number by the average bid-ask spread for our sample of firms to calculate the decline in the bid-ask spread which is a measure of the cost savings resulting from stock market competition. We then multiplied the cost savings of buying a single share times the total number of shares traded on the Consolidated and NYSE for each year. We converted the cost savings for each year into current (2007) dollars using the consumer price index (CPI). The back of the envelope calculations suggest that competition saved NYSE investors about 5.8 billion dollars during the 42-year stock market rivalry. For the Consolidated exchange, consumer welfare increased approximately 1.2 billion dollars. This means that this episode of stock market competition increased consumer welfare by about seven billion dollars. This number is an upper bound estimate on the increase in consumer welfare given that we have assumed that competition lowered bid-ask spreads on all NYSE stocks and that stock transactions

on the Consolidated would have taken place on the Big Board in the absence of the rival exchange.[11]

C. The End of the Consolidated

Another test of the effects of stock market competition is to examine how bid-ask spreads changed when the Consolidated ceased to be an important competitor. However, the gradual decline of the rival exchange --as opposed to an abrupt halt of trading on the Consolidated-- makes it difficult to identify the effects of the removal of competition on bid-ask spreads. Nevertheless, we attempt to provide some insight into this question by using the last day of Consolidated trading as the final demise of the rival exchange.[12] We conduct a similar analysis of the end of the Consolidated as we do for the initiation of trading collecting data from one day per week for both 60 weeks before and 60 weeks after the event. Table 9 presents the summary statistics for the full 120 week period and the two 60 week sub-periods.[13] The mean bid-ask spread increases from $0.661 to $0.669 and the mean relative spread increases from 1.7 percent to 1.9 percent in the post-Consolidated period. However, the difference is only statistically significant for the relative spread.

We also estimated the baseline and extended models over the 120 week panel with a dummy variable that takes the value of one after the end of the Consolidated (February 16, 1926). The results presented in Table 10 indicate that bid-ask spreads increased after February 16, 1926. The results for the baseline model indicate a positive and significant coefficient on the post-Consolidated dummy for both absolute and relative spreads. The coefficient on the end-of-competition variable in the models without company fixed effects is smaller in size than we

[11] Given that the Consolidated traded the NYSE's most liquid and active stocks, it is unlikely that our welfare analysis would significantly change if we dropped the assumption that bid-ask spreads for all NYSE stocks declined.

[12] In an earlier version of this paper, we use the resignation of Consolidated president William Silkworth as the effective end of the Consolidated and examine the impact of that event on spreads for the securities in the Dow Jones Averages. Those result produce similar negative impacts on bid-ask spreads to those reported here suggesting that the Consolidated's demise was more gradual than abrupt.

[13] Data prior to 1926 come from the *New York Times* while data after December 31, 1925 comes from the CRSP tapes.

reported for the initiation of Consolidated trading indicating that the Consolidated was a less effective competitor at its end. The results with fixed effects produce similar relative coefficients and indicate that the demise of the Consolidated was accompanied by a statistically significant increase in bid-ask spreads.

As shown in Table 11, the results are not as robust for the extended model. The coefficient estimates are only statistically significant for the relative spread and not the absolute spread measure. However, it is important to note that these results are achieved without a well defined end date for the Consolidated. As noted earlier, the Consolidated's share of total volume was decreasing in the second half of the sample period and as such one would expect its end would produce smaller effects than its beginning. The fact that the onset of competition was associated with a large rise in the Consolidated's market share while the demise of the exchange coincided with a gradual decline in market share makes finding any result at the end of the exchange less likely.[14]

Overall, we interpret the empirical analysis as strong evidence that head-to-head competition between the Consolidated and the NYSE lowered bid-ask spreads on the Big Board. NYSE bid-ask spreads fell with the onset of competition and increased when the Consolidated ceased to be an important competitor. Moreover, the coefficients on the two competition variables in the 40-year panel models are quite consistent across the different specifications, suggesting that the analysis does not suffer from an omitted variable. For an omitted variable to explain the results, it would have to cause NYSE bid-ask spreads to suddenly fall in 1885, rise from 1923 until February 1926, and be uncorrelated with the two measures of competition in the 40-year panel model. This seems unlikely given the historical and empirical evidence.

[14] As with the initiation of trading, we also estimated the impact of the Consolidated using the window of 76 trading days around the end of Consolidated trading. These results using daily data, available on request, are much stronger with the post-Consolidated variable being statistically significant in all specifications and with coefficient estimates much more similar in magnitude to those reported for the initiation of Consolidated trading.

4. Summary and Conclusion

What are the effects of significant stock market competition on the cost of transacting and consumer welfare? To provide some insight into these questions, we examine the nature and magnitude of the largely forgotten stock market rivalry between the Consolidated Stock Exchange and the NYSE. The Consolidated competed directly with the Big Board and garnered an annual market share as high as 60 percent of the Big Board's listings. For more than forty years, the ratio of Consolidated to NYSE volume averaged more than 23 percent. Consistent with modern day competitors, the Consolidated focused its rivalry on the relatively more liquid listings of the NYSE (e.g., Easley, Kiefer and O'Hara (1996), Battalio (1997)). We find that the NYSE responded to competition by narrowing its bid-ask spreads. Our estimates indicate that the onset of head-to-head competition was associated with more than a 10 percent reduction in NYSE bid-ask spreads while bid-ask spreads for our quasi-control group of stocks on the Boston Stock Exchange did not significantly change. We find a comparable decline in spreads in during the extended period of rivalry between the NYSE and the Consolidated. By contrast, bid-ask spreads on the NYSE increased after a series of scandals and investigations led to the demise of the Consolidated.

The analysis also suggests that the presence of significant head-to-head competition was welfare improving for investors. We estimate that the stock market rivalry improved consumer welfare by an amount equivalent to seven billion dollars (measured in 2007 prices) over the 42-year period of head-to-head competition. About 80 percent of the increase in consumer welfare can be attributed to the reduction of bid-ask spreads on the Big Board caused by exchange market competition. Stock trading on the Consolidated, on the other hand, accounts for about 20 percent of the increase in consumer welfare. Overall, the results suggest that significant competition (or the potential for significant competition) has historically improved consumer welfare by forcing the NYSE to provide investors with better prices.

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Data Appendix

In this Appendix, we describe the sources for and the availability of the main variables in our analysis: Aggregate New York Stock Exchange trading volume, aggregate Consolidated Stock Exchange trading volume, average New York Stock Exchange bid-ask spreads, as well as firm-specific data on NYSE bid-ask spreads, NYSE volume, and the volume on the Consolidated Stock Exchange of NYSE listings.

Aggregate New York Stock Exchange Trading Volume

Aggregate trading volume for the New York Stock Exchange comes from two sources, the *New York Times* and the website of the NYSE. For the years 1875 through 1887, the data are hand collected on a daily basis from the *New York Times*. For 1888 to 1926, the data are taken from the website of the NYSE. The data for 1926 are for January and February only. The only interruption in the data is the period from July 31, 1914, through December 11, 1914, when the NYSE closed during World War 1.

Aggregate Consolidated Stock Exchange Trading Volume

Data on aggregate trading volume for the Consolidated Stock Exchange are hand collected from the *New York Times*. The data begin on February 17, 1885, when the *New York Times* separately reports NYSE-listed stocks within the volume for the New York Mining Exchange. As of Monday March 9, 1885, the *New York Times* reports the sales of NYSE-listed stocks under the name of the Consolidated Petroleum Exchange Board. For a brief time in 1886, the *New York Times* does not report the trading of NYSE-listed stocks on the Consolidated Exchange. The lapse in reporting occurs between April 15, 1886 and September 4, 1886. The last day the *New York Times* reports trading volume for the Consolidated Stock Exchange is February 16, 1926.

Average New York Stock Exchange Bid-Ask Spreads

Bid-ask spread data for the New York Stock Exchange are taken primarily from the *New York Times*. The *Commercial and Financial Chronicle* serves as a secondary source for certain years when the *New York Times* did not report bid-ask spreads.

Our analysis of NYSE bid-ask spreads reports average estimates for a single day for the years 1875 to 1926. The date chosen for analysis tended to be at the end of January or the beginning of February of a given year, although there were some exceptions based on data availability. For 1875 to 1881, the *New York Times* reports bid-ask spreads for Saturday trading on the following Monday. These data on spreads are matched with the data for Saturday trading volume that is reported in the Sunday *New York Times*.

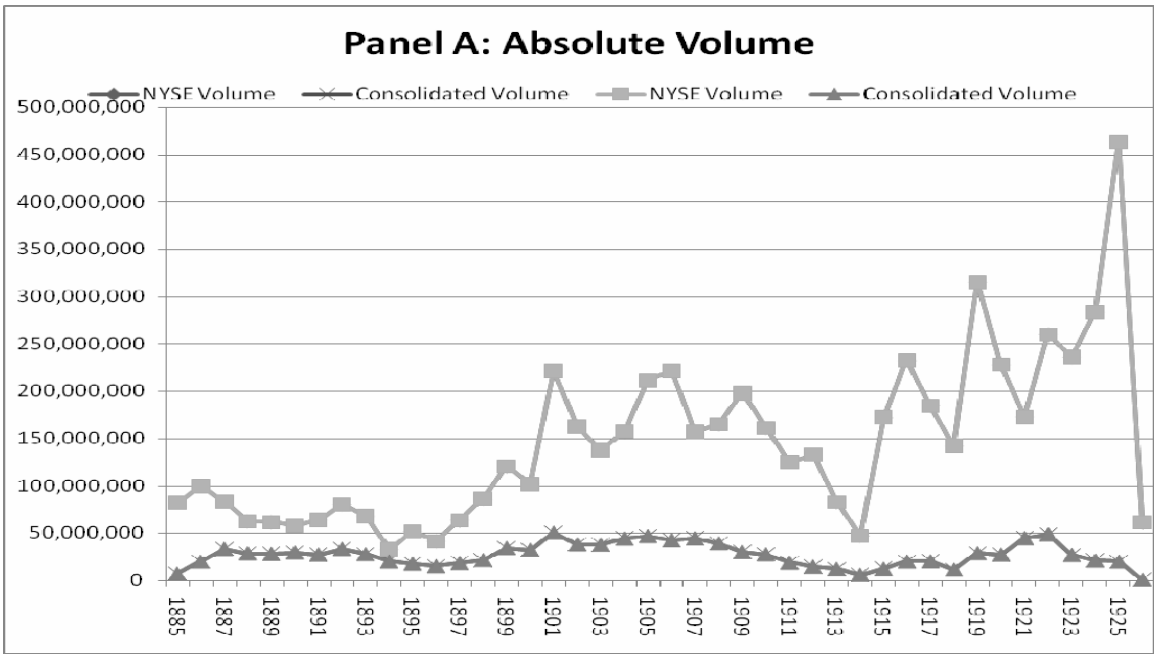
Beginning on May 24, 1882, the *New York Times* reports NYSE bid-ask spreads on a daily basis. The data on daily bid-ask spreads continue through April 14, 1886. Between April 15, 1886, and May 12, 1893, the *New York Times* does not report bid-ask spreads for the NYSE. In this time interval, we gather bid-ask spread data from the *Commercial and Financial Chronicle*. The bid-ask spread data are reported for Thursday trading and are matched with the appropriate trading volume data from the *New York Times*.

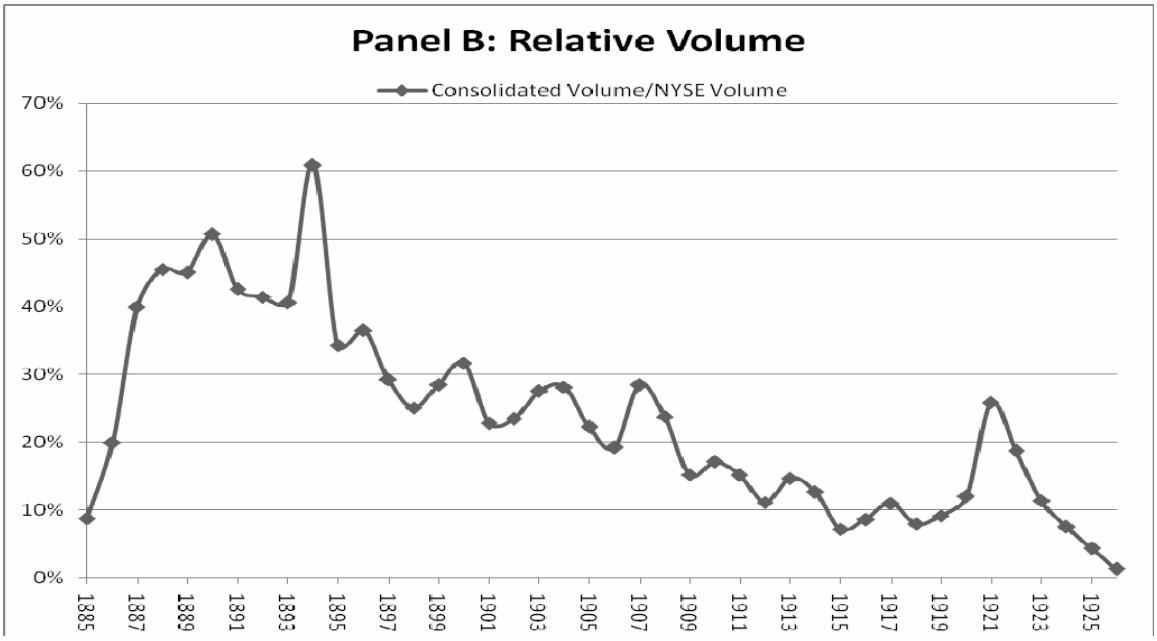
On May 13, 1893, the *New York Times* resumes reporting of NYSE bid-ask spreads on a daily basis. These data are used through February 1926.

Firm-Specific Data

We also employ firm specific data on NYSE bid-ask spreads, NYSE volume, and the volume of NYSE-listings on the Consolidated Stock Exchange. The data are taken from the *New York Times* for all periods prior to January 1, 1926. The individual security data used after December 31, 1925 comes from the CRSP tapes.

Figure 1: NYSE and Consolidated Trading Volume, 1885 to 1926



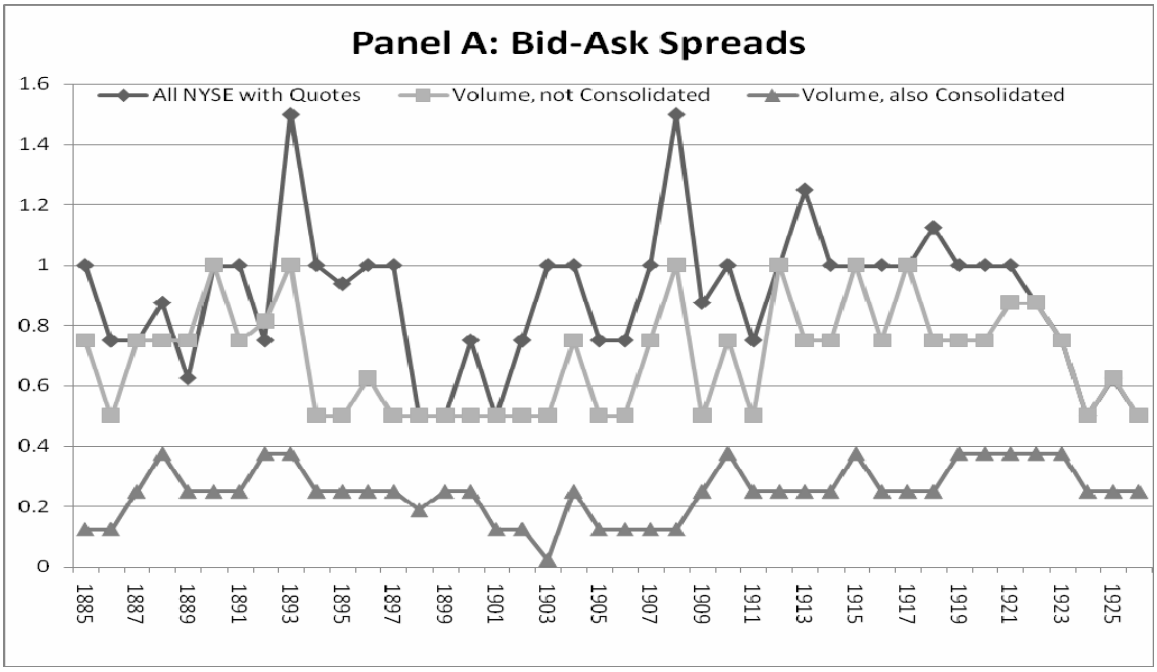


	NYSE Volume	Consolidated Volume	Consolidated/NYSE
mean	145,192,802	26,916,083	23.48%
median	135,203,167	27,504,210	22.50%
maximum	463,924,822	50,560,361	60.88%
minimum	33,052,099	783,494	1.27%

Notes: 1885 data begins February 17, 1914 markets closed from August until mid-December, 1926 January and February only.
Source: NYSE and *New York Times.*

Figure 2. NYSE Bid-Ask Spreads: 1885 to 1926.

This figure reports median bid-ask spreads for the NYSE for the 1885 to 1926 period. One day from each year is sampled. See the Data Appendix for specific dates and sources. *All NYSE with Quotes* is the spread for all NYSE listings with quotes on a given date. *Volume, not Consolidated* is the spread for NYSE listings with volume on the NYSE but not on the Consolidated Exchange. *Volume, also Consolidated* is the spread for NYSE listings with volume on both the NYSE and the Consolidated Exchange.



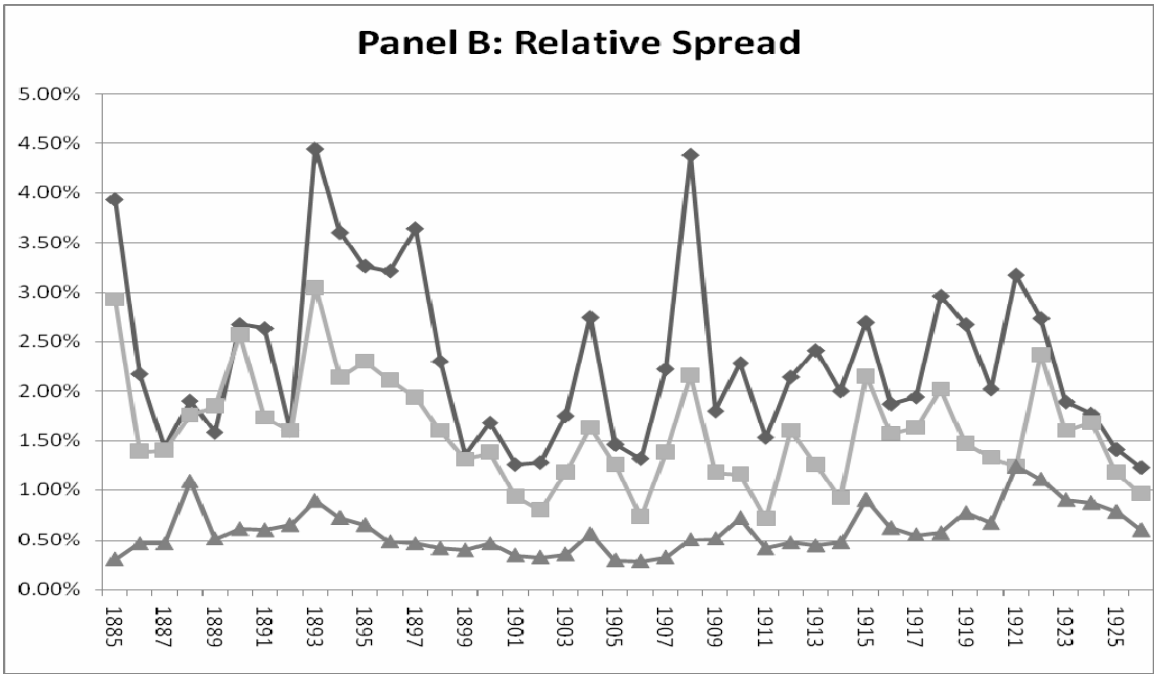


Figure 3: Absolute Bid-Ask Spreads on the NYSE and Regional Exchanges around the Initiation of Consolidated Trading (January 11, 1883 - April 9, 1886)

This figure reports the reported absolute bid-ask spreads for all securities on the New York Stock Exchange and the universe of stocks trading on a selected set of the leading regional exchanges (Baltimore, Boston, and Philadelphia) for the period from 1875 to 1884. *Absolute bid-ask spread* is the closing bid-ask spread for a given day. Data are taken from the *New York Times*.

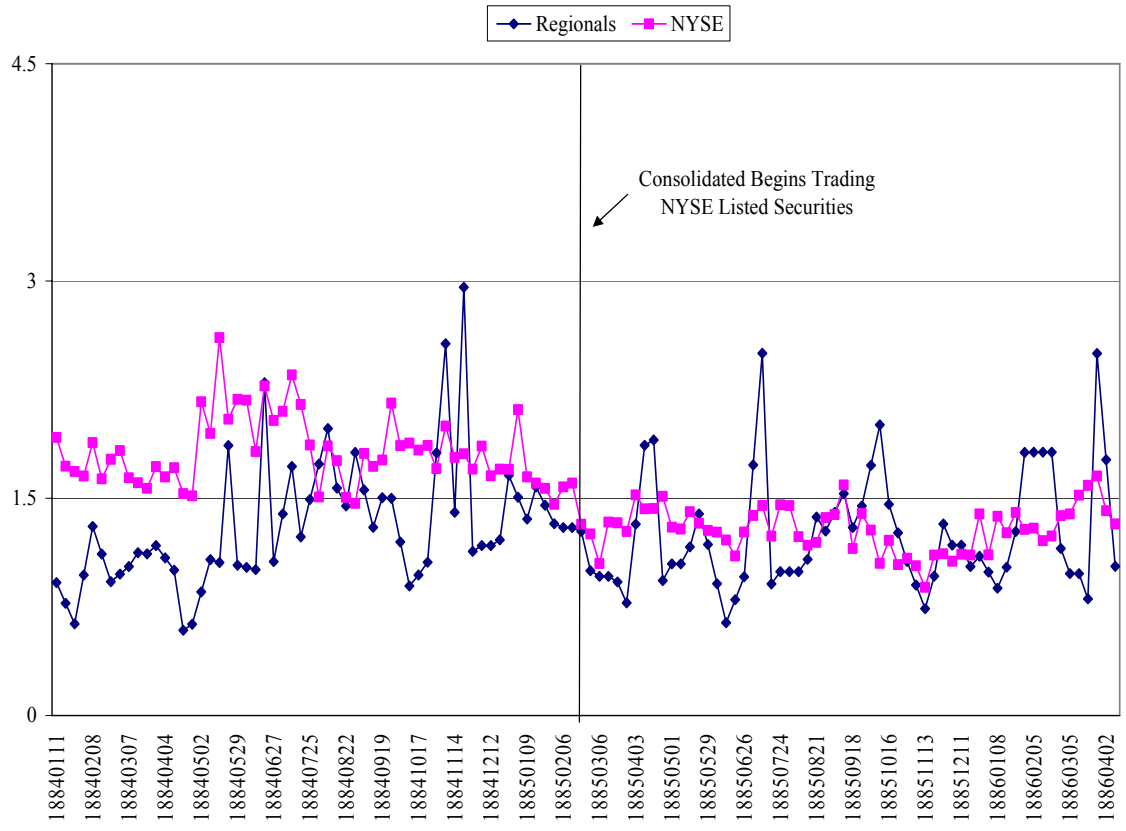


Table 1. Most Heavily Traded Stock: 1885 to 1926.

This table reports the most heavily traded stock on the NYSE and the Consolidated Exchange in the 1885 to 1926 period. One day from each year is sampled. See the Data Appendix for specific dates. For the most heavily traded stock on a given exchange, the table also reports the rank in volume on the rival exchange and the bid-ask spread of the stock on the NYSE.

Year	NYSE	Rank on Consol	NYSE Spread	Consolidated	Rank on NYSE	NYSE Spread
1885	Delaware Lackawanna	9	0.125	Chicago Milwaukee	8	0.125
1886	Delaware Lackawanna	3	0.125	Chicago Milwaukee	2	0.125
1887	Philadelphia & Reading	3	0.125	Lake Shore	6	0.25
1888	Chicago Milwaukee	2	0.125	Philadelphia & Reading	2	0.25
1889	Delaware Lackawanna	1	0.25	Delaware Lackawanna	1	0.25
1890	American Sugar	1	0.125	American Sugar	1	0.125
1891	Chicago Rock Island	1	0.25	Chicago Rock Island	1	0.25
1892	Philadelphia & Reading	2	0.125	NY & New England	7	0.125
1893	Louisville & Nashville	16	0.25	Chicago Milwaukee	2	0.125
1894	American Sugar	1	0.125	American Sugar	1	0.125
1895	Chicago Gas	2	0.125	Chicago Milwaukee	2	0.125
1896	Philadelphia & Reading	2	0.125	American Sugar	2	0.25
1897	Northern Pacific pref	7	0.125	American Sugar	2	0.125
1898	Chesapeake & Ohio	23	0.125	American Sugar	11	0.125
1899	American Sugar	1	0.125	American Sugar	1	0.125
1900	American Sugar	1	0.25	American Sugar	1	0.25
1901	Southern Pacific	1	0.125	Southern Pacific	1	0.125
1902	Southern Pacific	4	0.125	Amalgamated Copper	2	0.25
1903	Erie	1	0.125	Erie	1	0.125
1904	Pennsylvania	3	0.125	US Steel pref	2	0.25
1905	Union Pacific	3	0.125	US Steel pref	6	0.125
1906	Amalgamated Copper	1	0.125	Amalgamated Copper	1	0.125
1907	Reading	1	0.125	Reading	1	0.125
1908	Reading	1	0.125	Reading	1	0.125
1909	Reading	2	0.125	Union Pacific	3	0.125
1910	Reading	3	0.125	US Steel	2	0.125
1911	US Steel	1	0.125	US Steel	1	0.125
1912	US Steel	1	0.125	US Steel	1	0.125
1913	American Can	3	0.125	Reading	3	0.125
1914	US Steel	1	0.125	US Steel	1	0.125
1915	Reading	1	0.125	Reading	1	0.125
1916	US Steel	1	0.125	US Steel	1	0.125
1917	US Steel	1	0.125	US Steel	1	0.125
1918	US Steel	1	0.125	US Steel	1	0.125
1919	US Steel	1	0.125	US Steel	1	0.125
1920	Baldwin Locomotive	1	0.125	Baldwin Locomotive	1	0.125
1921	General Asphalt	2	0.125	Mexican Petroleum	3	0.50
1922	Studebaker Corp	2	0.125	Island Oil & Transport	17	0.25
1923	US Steel	4	0.125	California Petroleum	5	0.125
1924	General Motors	5	0.125	Studebaker Corp	3	0.125
1925	Independent Oil & Gas	37	0.25	Radio Corp of America	9	0.125
1926	Sinclair Oil	1	0.125	Sinclair Oil	1	0.125
	Median	1.5	0.125		1.5	0.125

Table 2. Summary Statistics of Pre- and Consolidated Period (December 28, 1883 - April 9, 1886)

This table reports the sample statistics for the trading data from the NYSE in the 120 weeks surrounding the initiation of trading of NYSE listed securities on the Consolidated Stock Exchange. One day, usually Friday, from each week is sampled. *Absolute bid-ask spread* is the closing bid-ask spread for a given day. The *relative bid-ask spread* is the closing bid-ask spread in percentage terms [(ask-bid)/((ask+bid)/2)]. The *individual security volume* is the total NYSE volume for the security for a given day. The *individual security closing price* is the NYSE closing price for that day. *Individual security volatility* is the standard deviation of a given security's return over the entire sample period. The *NYSE total weekly volume* is the total volume for all securities for a given day and the previous five days of trading. A *security's share of total volume* is that security's total NYSE volume for a given day divided by the total NYSE volume for that day. The *concentration ratio* is the sum of the volume for the four securities with the highest volume on a given day divided by the total NYSE volume for that day. The *broker's call rate* is the closing weekly call rate for the week for which other data are taken. The *presence of Consolidated trading* takes a value of one for all observations in the 60 weeks after February 17, 1885 and is zero for the observations in the 60 weeks before Feb 17, 1885.

	absolute bid-ask spread	relative bid-ask spread (%)	individual security volume	individual security closing price	individual security volatility (%)	NYSE total weekly volume (in millions)	Security's share of total volume (%)	concentration ratio (%)	broker's call rate (%)	Presence of Consolidated trading (%)
					Full Sample (n = 7,036)					
mean	0.685	2.776	5,251	52.893	7.099	1.990	1.689	55.516	2.040	53.681
median	0.375	1.067	600	41.375	6.303	1.920	0.192	56.507	2.000	100.000
standard dev.	0.936	5.004	13,032	40.133	4.759	0.715	4.064	9.821	1.086	49.867
Minimum	0.125	0.090	5	0.250	1.282	0.715	0.001	32.723	1.000	0.000
Maximum	20.000	133.333	171,516	150.000	24.887	4.500	45.729	80.66	9.500	100.000
					Pre-Consolidated Period (n = 3,259)					
mean	0.758	3.040	5,790	52.876	7.023	1.900	1.815	59.483	2.098	
median	0.375	1.130	550	42.500	6.126	1.876	0.183	58.949	1.750	
standard dev.	1.063	5.246	14,671	39.872	4.829	0.556	4.449	7.655	1.305	
Minimum	0.125	0.095	5	1.000	1.282	0.869	0.001	43.066	1.000	
Maximum	20.000	133.333	171,516	148.500	24.887	3.404	44.899	80.66	9.500	
					Consolidated Period (n = 3,777)					
mean	0.622	2.548	4,786	52.907	7.165	2.068	1.579	52.093	1.990	
median	0.375	1.036	600	40.125	6.383	1.933	0.204	53.551	2.000	
standard dev.	0.806	4.775	11,411	40.362	4.689	0.821	3.697	10.189	0.851	
minimum	0.125	0.090	5	0.250	1.282	0.715	0.001	32.723	1.000	
maximum	10.000	100.000	114,230	150.000	24.887	4.500	45.729	72.868	5.500	
					Difference in Means Test Pre-Consolidated and Consolidated Period					
T-Statistic	5.996	4.120	2.879	0.151	0.729	9.914	2.047	34.853	4.577	
P-Value	0.000	0.000	0.004	0.880	0.466	0.000	0.040	0.000	0.000	

(Table 2 continued)

	absolute bid-ask spread	relative bid-ask spread (%)	individual security volume	individual security closing price	individual security volatility (%)	absolute bid-ask spread	relative bid-ask spread (%)	individual security volume	individual security closing price	individual security volatility (%)
Full Period	*Firms without Consolidated Trading (n = 2,213)*					*Firms with Consolidated Trading (n = 4,823)*				
mean	1.292	0.039	436	63.626	0.066	0.407	0.023	7,460	47.969	0.073
median	1.000	0.020	200	52.000	0.064	0.250	0.008	1,200	38.875	0.061
standard dev.	1.329	0.060	843	44.810	0.046	0.473	0.044	15,229	36.765	0.048
minimum	0.125	0.001	5	1.000	0.013	0.125	0.001	5	0.250	0.017
maximum	20.000	1.333	12,710	150.000	0.164	7.000	1.000	171,516	139.375	0.249
Pre-Consolidated Period	*Firms without Consolidated Trading (n = 976)*					*Firms with Consolidated Trading (n = 2,283)*				
mean	1.505	0.046	382	66.101	0.063	0.439	0.024	8,102	47.223	0.073
median	1.000	0.023	200	62.000	0.040	0.250	0.008	1,200	38.500	0.061
standard dev.	1.526	0.074	723	44.476	0.047	0.528	0.038	17,006	36.301	0.049
minimum	0.125	0.001	5	1.000	0.013	0.125	0.001	5	1.125	0.017
maximum	20.000	1.333	12,710	148.500	0.164	6.500	0.435	171,516	131.5	0.249
Post-Consolidated Period	*Firms without Consolidated Trading (n = 1,237)*					*Firms with Consolidated Trading (n = 2,540)*				
mean	1.124	0.033	478	61.673	0.069	0.378	0.022	6,883	48.638	0.073
median	0.875	0.018	200	47.375	0.065	0.250	0.007	1,200	39.000	0.063
standard dev.	1.122	0.046	926	44.994	0.045	0.415	0.048	13,409	37.171	0.048
minimum	0.125	0.001	5	1.250	0.013	0.125	0.001	5	0.250	0.017
maximum	10.000	0.560	10,610	150.000	0.164	7.000	1.000	114,230	139.375	0.249
	Difference in Means Test Pre-Consolidated and Consolidated Period									
T-Statistic	6.765	5.040	2.650	2.310	3.104	4.425	1.581	2.776	1.335	0.305
P-Value	0.000	0.000	0.008	0.021	0.002	0.000	0.114	0.005	0.182	0.761

Table 3. The Effect of Consolidated Trading on the NYSE in the Pre- and Consolidated Period (December 28, 1883 - April 9, 1886)

This table reports the results from the estimation of the following model:

$SPREAD_{it} = \alpha + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \varepsilon_{it}$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 2. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 17, 1885 and the value of zero for the observations in the 60 weeks before Feb 17, 1885. The other variables are as defined as in Table 2 and are measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
	dependent variable			
	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.336* (0.012)	-0.129* (0.096)	-0.336* (0.012)	-0.133* (0.009)
natural log of individual security closing price	0.370* (0.049)	-0.186* (0.042)	-0.619* (0.048)	-1.150* (0.045)
natural log of individual security volatility	0.309* (0.086)		0.319* (0.084)	
presence of Consolidated trading	-0.123* (0.027)	-0.154* (0.026)	-0.120* (0.027)	-0.151* (0.026)
constant	0.943* (0.168)	0.695* (0.173)	0.931* (0.165)	0.585* (0.180)
Company fixed effects included	no	yes	no	yes
Number of fixed effects		97		97
Observations	7036	7036	7036	7036
R-squared	0.484	0.662	0.730	0.821
F-Statistic	210.9*	71.2*	166.4*	267.3*

Table 3A. Bid-Ask Spreads on the Boston Exchange in the Pre- and Consolidated Period (December 28, 1883 - April 9, 1886)

This table reports the results from the estimation of the following model:

$SPREAD_{it} = \alpha + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \varepsilon_{it}$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 2. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 17, 1885 and the value of zero for the observations in the 60 weeks before Feb 17, 1885. The other variables are as defined as in Table 2 and are measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A) natural log of absolute spread	(B) natural log of absolute spread	(C) natural log of relative spread	(D) natural log of relative spread
natural log of individual security volume	-0.153* (0.025)	-0.067* (0.013)	-0.153* (0.025)	-0.068* (0.013)
natural log of individual security closing price	0.260* (0.066)	-0.146 (0.092)	-0.740* (0.066)	-1.111* (0.089)
natural log of individual security volatility	0.187 (0.113)		0.187 (0.114)	
presence of Consolidated trading	0.026 (0.052)	-0.042 (0.038)	0.026 (0.052)	-0.045 (0.038)
constant	-0.872* (0.303)	-0.269 (0.308)	-0.890* (0.305)	-0.391 (0.294)
Company fixed effects included	no	yes	no	yes
Number of fixed effects		37		37
Observations	1490	1490	1490	1490
R-squared	0.321	0.555	0.676	0.788
F-Statistic	26.3*	16.4*	59.1*	116.8*

Table 4. The Effect of Consolidated Trading on the NYSE with Additional Control Variables in the Pre- and Consolidated Period (December 28, 1883 - April 9, 1886)

This table reports the results from the estimation of the following model:

$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \beta_5 WVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it}$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 2. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 17, 1885 and the value of zero for the observations in the 60 weeks before Feb 17, 1885. The other variables are as defined as in Table 2 but measured in natural logs. Robust standard errors are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
	dependent variable			
	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.030	-0.016	-0.033	-0.018
	(0.039)	(0.030)	(0.038)	(0.030)
natural log of individual security closing price	0.348*	-0.226*	-0.641*	-1.188*
	(0.049)	(0.047)	(0.048)	(0.050)
natural log of individual security volatility	0.269*		0.280*	
	(0.086)		(0.085)	
presence of Consolidated trading	-0.137*	-0.143*	-0.134*	-0.141*
	(0.029)	(0.027)	(0.029)	(0.027)
natural log of NYSE total weekly volume	-0.135*	-0.055	-0.133*	-0.058***
	(0.043)	(0.034)	(0.042)	(0.034)
natural log of broker's call rate	0.079*	0.101*	0.075*	0.096*
	(0.027)	(0.023)	(0.027)	(0.022)
natural log of security's share of total volume	-0.312*	-0.124*	-0.309*	-0.126*
	(0.040)	(0.030)	(0.039)	(0.031)
natural log of concentration ratio	-0.246*	-0.023	-0.247*	-0.026
	(0.070)	(0.053)	(0.070)	(0.053)
constant	-0.871***	0.520	-0.894***	0.406
	(0.521)	(0.387)	(0.519)	(0.387)
Company fixed effects included	no	yes	no	yes
Number of fixed effects		97		97
Observations	7036	7036	7036	7036
R-squared	0.497	0.665	0.737	0.823
F-Statistic	120.3*	36.5*	374.8*	121.3*

Table 4A. Bid-Ask Spreads on the Boston Exchange in the Pre- and Consolidated Period with Additional Control Variables (December 28, 1883 - April 9, 1886)

This table reports the results from the estimation of the following model:

$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \beta_5 WVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it}$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 2. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 17, 1885 and the value of zero for the observations in the 60 weeks before Feb 17, 1885. The other variables are as defined as in Table 2 but measured in natural logs. Robust standard errors are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
	dependent variable			
	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.080**	-0.060**	-0.081**	-0.064**
	(0.032)	(0.029)	(0.032)	(0.030)
natural log of individual security closing price	0.246*	-0.192**	-0.749*	-1.155*
	(0.067)	(0.091)	(0.068)	(0.087)
natural log of individual security volatility	0.170		0.171	
	(0.111)		(0.112)	
presence of Consolidated trading	-0.057	-0.058	-0.056	-0.059
	(0.052)	(0.050)	(0.052)	(0.050)
natural log of broker's call rate	0.158*	0.129*	0.160*	0.131*
	(0.046)	(0.038)	(0.046)	(0.039)
natural log of security's share of total volume	-0.083***	-0.012	-0.082***	-0.010
	(0.046)	(0.030)	(0.046)	(0.030)
natural log of concentration ratio	0.045	0.103***	0.046	0.104***
	(0.057)	(0.057)	(0.058)	(0.057)
constant	-0.867**	0.400***	-0.865**	0.298
	(0.401)	(0.402)	(0.400)	(0.396)
Company fixed effects included	no	yes	no	yes
Number of fixed effects		37		37
Observations	1490	1490	1490	1490
R-squared	0.337	0.561	0.684	0.790
F-Statistic	22.9*	17.9*	58.7*	84.0*

Table 5. Summary Statistics of Long-Term Competition between the Consolidated and NYSE (September 1886 – February 1926)

This table reports the sample statistics for the trading data for the firms in the Dow Jones Industrial Average beginning in September 1886, and the Dow Jones Railroad Index beginning in October 1896. One day, usually the last day of the month, from each month is sampled. *Absolute bid-ask spread* is the closing bid-ask spread for a given day. The *relative bid-ask spread* is the closing bid-ask spread in percentage terms [(ask-bid)/((ask+bid)/2)]. The *individual security volume* is the total NYSE volume for the security for a given day. The *individual security closing price* is the NYSE closing price for that day. *Individual security volatility* is the standard deviation of a given security's return over the entire sample period. *NYSE total monthly volume* is the total volume for all securities for a given month. A *security's share of total volume* is that security's total NYSE volume for a given day divided by the total NYSE volume for that day. The *concentration ratio* is the sum of the volume for the four securities with the highest volume on a given day divided by the total NYSE volume for that day. The *broker's call rate* is the closing monthly call rate for the month for which other data is taken. The *Consolidated share of total volume* is the total volume for security i on the Consolidated divided by the total volume on the Consolidated for security i plus the total volume on security i on the NYSE for a given day. The *presence of Consolidated volume* takes on a value of one for all observations where the Consolidated had trading volume and 0 otherwise. There are 12,389 observations for each variable.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
absolute bid-ask spread	0.414	0.250	0.453	0.125	10.500
relative bid-ask spread (%)	0.627	0.378	0.846	0.051	18.182
individual security volume	10,626	2,700	26,069	4	489,444
individual security closing price	88.239	87.000	45.867	1.250	400.000
individual security volatility (%)	11.348	7.314	13.053	2.634	76.841
NYSE total monthly volume	14,700,000	12,898,720	9,304,893	1,667,854	79,600,000
security's share of total volume (%)	3.742	1.071	7.070	0.001	79.004
concentration ratio (%)	63.010	63.017	13.348	29.036	94.550
broker's call rate (%)	4.023	3.500	3.499	0.875	40.000
consolidated share of total volume (%)	11.210	6.593	13.682	0.000	99.514
presence of Consolidated volume (%)	74.816	100.000	43.409	0.000	100.000

Table 6. Long-Term Effects of Consolidated Trading on the NYSE (Sept. 1886 – Feb. 1926)

This table reports the results from the estimation of the following model:

$$SPREAD_{it} = \alpha + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \varepsilon_{it}$$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 5. We measure competition, COMP, in two different ways. The *natural log of Consolidated share* is the total volume for security i on the Consolidated divided by the total volume on the Consolidated for security i plus the total volume on security i on the NYSE for a given day. The *Consolidated presence* takes on a value of one for all observations where the Consolidated had trading volume and 0 otherwise. The other variables are as defined as in Table 5 but measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
	dependent variable											
	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread
natural log of individual security volume	-0.217*	-0.219*	-0.219*	-0.222*	-0.183*	-0.184*	-0.186*	-0.187*	-0.161*	-0.160*	-0.165*	-0.165*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)
natural log of individual security closing price	0.272*	0.270*	-0.709*	-0.710*	0.219*	0.221*	-0.742*	-0.740*	0.177*	0.173*	-0.771*	-0.775*
	(0.047)	(0.046)	(0.046)	(0.046)	(0.059)	(0.059)	(0.059)	(0.060)	(0.054)	(0.055)	(0.055)	(0.056)
natural log of individual security volatility	0.053	0.046	0.061	0.053								
	(0.037)	(0.037)	(0.038)	(0.038)								
natural log of Consolidated Share	-0.036*		-0.036*		-0.023*		-0.029*		-0.028*		-0.028*	
	(0.005)		(0.005)		(0.005)		(0.005)		(0.003)		(0.003)	
Consolidated Presence		-0.225*		-0.221*		-0.167*		-0.163*		-0.167*		-0.164*
		(0.033)		(0.033)		(0.030)		(0.030)		(0.022)		(0.022)
Constant	-0.691*	-0.369**	-0.736*	-0.420*	-0.835*	-0.590*	-0.977*	-0.737*	-1.262*	-1.027*	-1.443*	-1.212*
	(0.152)	(0.152)	(0.150)	(0.150)	(0.209)	(0.216)	(0.216)	(0.224)	(0.231)	(0.241)	(0.242)	(0.253)
Company fixed effects	no	no	no	no	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	no	no	no	no	no	no	no	no	yes	yes	yes	yes
Number of fixed effects					83	83	83	83	124	124	124	124
Observations	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389
R-squared	0.353	0.349	0.545	0.543	0.430	0.427	0.599	0.597	0.470	0.469	0.626	0.625
F-Statistic	162.1*	158.0*	513.4*	483.0*	141.8*	130.9*	420.8*	364.2*	82.41*	49.2*	174.5*	161.0*

Table 7. Long-Term Effects of Consolidated Trading on the NYSE with Additional Control Variables

This table reports the results from the estimation of the following model:
$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta 3 STDEVi + \beta_4 COMP_t + \beta_5 MVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it}$
where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 5. The *Consolidated share* is the total volume for security i on the Consolidated divided by the total volume on the Consolidated for security i plus the total volume on security i on the NYSE for a given day. The *Consolidated presence* takes on a value of one for all observations where the Consolidated had trading volume and 0 otherwise. The other variables are as defined as in Table 5 but measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
						dependent variable						
independent variable	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread	ln of absolute spread	ln of absolute spread	ln of relative spread	ln of relative spread
natural log of individual security volume	-0.172* (0.016)	-0.167* (0.016)	-0.173* (0.016)	-0.169* (0.015)	-0.121* (0.017)	-0.119* (0.017)	-0.125* (0.017)	-0.122* (0.017)	-0.038* (0.009)	-0.035* (0.009)	-0.037* (0.009)	-0.035* (0.009)
natural log of individual security closing price	0.257* (0.046)	0.253* (0.045)	-0.722* (0.045)	-0.726* (0.044)	0.171* (0.053)	0.170* (0.053)	-0.785* (0.055)	-0.786* (0.056)	0.185* (0.052)	0.182* (0.053)	-0.762* (0.053)	-0.766* (0.054)
natural log of individual security volatility	0.051 (0.037)	0.044 (0.038)	0.059 (0.039)	0.052 (0.038)								
natural log of Consolidated Share	-0.034* (0.004)		-0.033* (0.004)		-0.026* (0.004)		-0.026* (0.004)		-0.026* (0.003)		-0.025* (0.003)	
Consolidated Presence		-0.220* (0.031)		-0.215* (0.031)		-0.152* (0.025)		-0.148* (0.025)		-0.154* (0.020)		-0.150* (0.021)
natural log of NYSE total monthly volume	0.055** (0.025)	0.061** (0.025)	0.049** (0.025)	0.055** (0.024)	0.063* (0.022)	0.067* (0.023)	0.053** (0.022)	0.057** (0.023)	-0.022 (0.017)	-0.021 (0.017)	-0.025 (0.016)	-0.025 (0.017)
natural log of broker's call rate	0.116* (0.016)	0.115* (0.016)	0.116* (0.016)	0.115* (0.016)	0.093* (0.015)	0.092* (0.015)	0.093* (0.015)	0.093* (0.015)	0.032** (0.013)	0.033** (0.013)	0.033** (0.013)	0.033* (0.013)

natural log of security's share of total volume	-0.057* (0.016)	-0.063* (0.015)	-0.058* (0.016)	-0.064* (0.015)	-0.077* (0.017)	-0.081* (0.017)	-0.077* (0.017)	-0.080* (0.017)	-0.146* (0.013)	-0.148* (0.013)	-0.151* (0.012)	-0.153* (0.012)
natural log of concentration ratio	-0.100** (0.055)	-0.094** (0.055)	-0.111** (0.055)	-0.105** (0.054)	-0.078 (0.053)	-0.069 (0.053)	-0.091 (0.053)	-0.082 (0.052)	-0.175* (0.037)	-0.176* (0.037)	-0.175* (0.037)	-0.177* (0.037)
constant	-1.795* (0.370)	-1.646* (0.374)	-1.765* (0.369)	-1.619* (0.372)	-2.206* (0.365)	-2.078* (0.362)	-2.201* (0.365)	-2.075* (0.353)	-2.427* (0.338)	-2.253* (0.341)	-2.604* (0.343)	-2.433* (0.347)
company fixed effects	no	no	no	no	yes	yes	yes	yes	yes	yes	yes	yes
year fixed effects	no	no	no	no	no	no	no	no	yes	yes	yes	yes
Number of fixed effects					83	83	83	83	124	124	124	124
Observations	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389	12,389
R-squared	0.374	0.372	0.560	0.559	0.448	0.446	0.611	0.610	0.479	0.478	0.633	0.632
F-Statistic	94.5*	94.2*	318.4*	308.7*	79.21*	220.0*	76.1*	228.9*	148.5*	81.6*	185.5*	175.1*

Table 8. The Effect of Consolidated Trading on Four Dow Securities After the Consolidated Initiates Trading

This table reports the results from the estimation of the following model:

$$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \beta_5 MVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it}$$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 2. COMP is a dummy variable that takes on a value of one for all observations after the firm has entered the Dow Averages and the Consolidated initiates trading and the value of zero for the observations in the months after the security enters the Dow Averages but before the Consolidated initiates trading. The other variables are as defined as in Table 2. White-corrected standard errors are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
	dependent variable			
	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.184* (0.021)	-0.172* (0.056)	-0.181* (0.021)	-0.174* (0.055)
natural log of individual security closing price	0.434* (0.093)	-0.444* (0.096)	-0.505* (0.081)	-0.490* (0.242)
natural log of individual security volatility	0.213* (0.037)	0.228* (0.043)	0.224* (0.036)	0.242* (0.041)
presence of Consolidated trading	-0.272* (0.105)	-0.254* (0.107)	-0.239* (0.101)	-0.222** (0.103)
natural log of NYSE total weekly volume		-0.023 (0.073)		-0.028 (0.073)
natural log of broker's call rate		0.199* (0.058)		0.196* (0.057)
natural log of security's share of total volume		-0.020 (0.637)		-0.017 (0.064)
natural log of concentration ratio		0.072 (0.160)		0.030 (0.158)
constant	-0.901** (0.433)	- 0.035 (1.139)	-1.189* (0.383)	-0.250 (1.128)
company fixed effects included	no	no	no	no
Observations	564	564	564	564
R-squared	0.216	0.233	0.428	0.440

Table 9. Summary Statistics of Consolidated and Post-Consolidated Period (December 26, 1924 - April 8, 1926)

This table reports the sample statistics for the trading data from the NYSE in the 120 weeks surrounding the cessation of trading of NYSE listed securities on the Consolidated Stock Exchange. One day, usually Friday, from each week is sampled. The ab*sence of Consolidated trading* takes a value of one for all observations in the 60 weeks after February 16, 1926 and is zero for the observations in the 60 weeks before Feb 16, 1926. All other variables are as defined in Table 2.

	absolute bid-ask spread	relative bid-ask spread (%)	individual security volume	individual security closing price	individual security volatility (%)	NYSE total weekly volume (in millions)	security's share of total volume (%)	concentration ratio (%)	broker's call rate (%)	Absence of Consolidated trading (%)
					Full Sample (n = 46,280)					
Mean	0.665	1.824	3,952	58.434	0.053	8.955	0.002	0.178	0.044	0.512
Median	0.375	0.995	1,100	44.250	0.043	8.683	0.001	0.168	0.043	1.000
standard dev.	2.016	2.832	10,766	55.311	0.037	2.126	0.006	0.057	0.005	0.500
Minimum	0.125	0.039	1	0.210	0.010	4.782	0.000	0.101	0.031	0.000
Maximum	200.000	105.882	617,400	2,050.000	0.467	15.300	0.234	0.357	0.060	1.000
					Consolidated Period (n = 22,565)					
Mean	0.661	1.737	3,960	59.743	0.053	8.854	0.002	0.147	0.043	
Median	0.375	0.945	1,200	45.000	0.043	8.371	0.001	0.140	0.042	
standard dev.	1.668	2.807	8,932	54.262	0.036	2.139	0.005	0.032	0.006	
Minimum	0.125	0.039	5	0.210	0.010	4.782	0.000	0.101	0.031	
Maximum	75.250	85.714	221,100	885.000	0.467	15.300	0.099	0.236	0.060	
					Post-Consolidated Period (n = 23,715)					
Mean	0.669	1.906	3,944	57.188	0.053	9.051	0.002	0.207	0.044	
Median	0.500	1.047	1,000	43.625	0.043	8.764	0.001	0.189	0.045	
standard dev.	2.299	2.853	12,259	56.263	0.038	2.108	0.007	0.060	0.005	
Minimum	0.125	0.065	1	0.500	0.010	5.024	0.000	0.108	0.036	
Maximum	200.000	105.882	617,400	2,050.000	0.467	15.200	0.234	0.357	0.056	
					Difference in Means Test Consolidated and Post-Consolidated Period					
T-Statistic	-0.462	6.429	0.156	4.973	0.254	15.960	1.687	140.000	34.807	
P-Value	0.644	0.000	0.876	0.000	0.800	0.000	0.092	0.000	0.000	

Table 10. The Effect of the End of the Consolidated Trading on the NYSE (December 26, 1924 - April 8, 1926)

This table reports the results from the estimation of the following model:

$$SPREAD_{it} = \alpha + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \varepsilon_{it}$$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 7. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 16, 1926 and the value of zero for the observations in the 60 weeks before Feb 16, 1926. The other variables are as defined as in Table 2 and are measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
		dependent variable		
independent variable	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.250*	-0.127*	-0.250*	-0.127*
	(0.007)	(0.007)	(0.007)	(0.007)
natural log of individual security closing price	0.587*	0.373*	-0.412*	-0.623*
	(0.019)	(0.059)	(0.019)	(0.058)
natural log of individual security volatility	0.482*		0.482*	
	(0.035)		(0.035)	
absence of Consolidated trading	0.022**	0.056*	0.022**	0.055*
	(0.011)	(0.011)	(0.011)	(0.011)
constant	0.199**	-1.396*	0.190**	-1.414*
	(0.081)	(0.177)	(0.080)	(0.177)
Company fixed effects	no	yes	No	yes
Number of fixed effects		527		527
Observations	46,280	46,280	46,280	46,280
R-squared	0.429	0.537	0.590	0.667
F-Statistic	479.2*	191.7*	1665.2*	660.5*

Table 11. The Effect of the End of Consolidated Trading on the NYSE with Additional Control Variables in the Pre- and Consolidated Period (December 26, 1924 - April 8, 1926)

This table reports the results from the estimation of the following model:

$$SPREAD_{it} = \alpha_0 + \beta_1 VOL_{it} + \beta_2 CLOSE_{it} + \beta_3 STDEV_i + \beta_4 COMP_t + \beta_5 WVOL_{it} + \beta_6 CALL_t + \beta_7 SHARE_{it} + \beta_8 CONC_t + \varepsilon_{it}$$

where SPREAD is either the natural log of the absolute or the relative spread as defined in Table 7. COMP is a dummy variable that takes on a value of one for all observations in the 60 weeks after February 16, 1926 and the value of zero for the observations in the 60 weeks before Feb 16, 1926. The other variables are as defined as in Table 2 but measured in natural logs. Robust standard errors clustered by company are in parentheses. *** significant at 10%; ** significant at 5%; * significant at 1%.

	(A)	(B)	(C)	(D)
			dependent variable	
independent variable	natural log of absolute spread	natural log of absolute spread	natural log of relative spread	natural log of relative spread
natural log of individual security volume	-0.229*	-0.203*	-0.227*	-0.202*
	(0.016)	(0.016)	(0.016)	(0.016)
natural log of individual security closing price	0.586*	0.373*	-0.412*	-0.623*
	(0.019)	(0.059)	(0.019)	(0.059)
natural log of individual security volatility	0.480*		0.480*	
	(0.035)		(0.035)	
absence of Consolidated trading	0.017	0.041*	0.017	0.041*
	(0.011)	(0.011)	(0.011)	(0.011)
natural log of NYSE total monthly volume	0.067*	0.061*	0.066*	0.060*
	(0.017)	(0.017)	(0.017)	(0.017)
natural log of broker's call rate	0.002	0.062**	0.001	0.059**
	(0.028)	(0.028)	(0.028)	(0.028)
natural log of security's share of total volume	-0.023	0.078*	-0.024	0.077*
	(0.017)	(0.016)	(0.017)	(0.015)
natural log of concentration ratio	0.009	0.044*	0.008	0.043*
	(0.012)	(0.011)	(0.012)	(0.011)
constant	-1.160*	-0.991*	-1.182*	-1.021*
	(0.258)	(0.295)	(0.258)	(0.294)
Company fixed effects	no	yes	no	yes
Number of fixed effects		527		527
Observations	46,280	46,280	46,280	46,280
R-squared	0.430	0.537	0.590	0.668
F-Statistic	246.5	94.1	937.4	299.2