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What happened to liquidity when World War l shut the NYSE?

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Abstract

This paper examines how financial markets responded to the longest circuit breaker in American financial history: the four-month suspension of trading on the New York Stock Exchange following the outbreak of World War I. The suspension that began on July 31, 1914 fostered a substitute trading forum called the New Street market. Trading on New Street began almost immediately and offered economically meaningful liquidity services despite its impaired price transparency. A simple cross-sectional model of bid-ask spreads on New Street demonstrates that New Street liquidity responded to economic incentives. New Street's success implies that, from a public policy perspective, expensive back-up trading facilities are not required to preserve liquidity during a trading suspension in established markets. Back-up records of share ownership and transfer facilities, however, are crucial to maintaining liquidity.

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1. Introduction

It is not surprising that the New York Stock Exchange (NYSE) closed at the outbreak of World War I. Exchange officials maintained that the threat of European liquidation of US securities justified a suspension in trading as a circuit-breaker. However, the exchange remained shuttered for more than four months, from July 31, 1914 to December 12, 1914. Closing the Exchange for more than four months would be unthinkable today. It was also unthinkable in 1914.[1]

How could the New York Stock Exchange be closed for more than four months? The Wilson administration succeeded in keeping the exchange closed, in part, because a substitute market emerged on New Street, a small roadway behind the NYSE, to accommodate trading. This paper examines two related questions about New Street: (1) How quickly did the market emerge in response to closing the New York Stock Exchange? (2) How liquid was the market?

This particular historical episode merits special attention because it was the longest circuit-breaker in American financial markets, one that occurred at a crucial time in US financial history.[2] Moreover, the experience at the outbreak of World War I carries a message for current public policy.

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[1] Noble (1915, p. 87) says: "If at any time up to July, 1914, any Wall Street man had asserted that the stock exchange could be kept closed continually for four and one-half months he would have been laughed to scorn."

[2] According to Silber (forthcoming), the Wilson administration worried that a stock market crash and gold outflow, triggered by European investors liquidating their holdings of US securities on the NYSE, would cause a financial panic and economic collapse similar to 1907. The crisis called for central bank intervention. The problem was that President Woodrow Wilson's nominations to the Federal Reserve Board were still in progress and the regional Federal Reserve banks had not yet been organized. The Federal Reserve Act, signed into law on December 23, 1913, required that gold be held as backing for Federal Reserve Notes. The Fed would not be effective if it were rushed into existence without sufficient gold. Closing the Exchange on July 31, and keeping it

Efforts to circumvent the trading ban in 1914 began a day after the NYSE's closure, and a flourishing substitute market emerged in less than eight trading days. The absence of a delay in circumventing the trading ban occurred, in part, because the government promoted the immediate expectation of a lengthy closure. The long duration of the expected shutdown encouraged traders to innovate. It should have also attracted considerable order flow to the new trading forum. Yet the contemporaneous commentary disparaged New Street as a viable market. The *Wall Street Journal* (January 7, 1915) said: "The quotations that were made in New Street were no more legitimate than the quotations that were made in Belgium, where people with securities in their pockets, and fleeing from war and starvation, sold them for cash at thirty and forty percent discount to some itinerant peddler." More recently, Friedman and Schwartz (1963, p. 172fn) referred to New Street as an "outlaw" market and Sobel (1968 p. 344) called it a "gutter" market.

New Street has been discredited largely out of ignorance. That ignorance stems from an effective campaign by the New York Stock Exchange during the trading suspension to suppress New Street prices. Academics perpetuated the misrepresentation because price data were unavailable publicly to refute the allegations.

The exchange committee established to oversee NYSE business during the trading suspension closely monitored the New Street market. Its records

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closed until after the Federal Reserve Banks were organized, would help restrain the gold outflow and pave the way for the new currency system. President Wilson succeeded in getting the Federal Reserve Board in place by August 10 but it took until November 16 for the regional banks to open for business.

provide bid and ask prices on stocks traded there. I examined those quotes and found that New Street provided economically meaningful liquidity services despite somewhat wider bid-ask spreads on New Street compared with the NYSE. The liquidity of New Street explains why the New York Stock Exchange itself violated the trading ban by sponsoring an alternative trade-matching service at the NYSE Clearing House.

What are the lessons of this historical episode in market innovation? New Street shows that alternative trading facilities emerge quickly to provide liquidity, even under adverse circumstances, when traders expect an extended market closure. This suggests that spending by exchanges on back-up trading facilities, which is in the interest of the members of the particular exchange, is not required from a pubic policy perspective. For example, if the NYSE had been forced to close for the foreseeable future after the September 11, 2001 terrorist attacks, other liquid trading mechanisms would likely have developed in short order.

Although the NYSE utilizes more sophisticated communications technology today than it did in 1914, a de novo market would have more than enough technology to provide an alternative liquid trading forum. The Internet has allowed Electronic Communication Networks (ECNs) to communicate trading interests with great efficiency. The International Securities Exchange, a fully electronic equity options trading forum launched in May 2000, traded more than one million options within the first three months, successfully competing against the Chicago Board Options Exchange and the American Stock Exchange. In the event of an NYSE closure, a substitute market would not have to compete with

the NYSE but would merely have to replace its liquidity services. New Street shows that this could be accomplished.

Substitute markets cannot flourish without reliable data on share ownership to permit settlement of trades. People trading on New Street needed physical securities in their possession. Given that most securities currently exist in electronic form, preserving liquidity during a trading suspension requires expenditure on back-up records of share ownership and transfer facilities, such as provided by the Depository Trust Company. Fleming and Garbade (2002, p. 45) cite settlement problems following the September 11 attacks that threatened "the price discovery process and the smooth operating of the Treasury bond market."

This paper is organized as follows. Section 2 explains the origins of New Street and its battle with the establishment to avoid suppression. Section 3 measures New Street's liquidity and shows that it dominated the New York Stock Exchange's Clearing House more than 60% of the time. Section 4 presents a simple cross-sectional model of bid-ask spreads on New Street that demonstrates how New Street liquidity responded to economic incentives. Section 5 shows that NYSE prices reflected the information embedded in New Street quotes when the New York Stock Exchange reopened for business. Section 6 offers some conclusions.

2. The Birth of New Street

The Governing Board of the New York Stock Exchange voted to suspend trading less than 15 minutes before the scheduled 10 a.m. opening bell on Friday, July 31, 1914 (Noble, pp.11-12). On that same day, Henry Noble, president of the NYSE, established the Committee of Five to oversee exchange business during the suspension.[3] Formal approval of the Committee of Five came in a vote by the NYSE Governing Board on August 3. The committee had to confront the immediate problem of securities trading outside of the exchange.

The *New York Times* carried an advertisement on Monday, August 3 announcing: "Emergency Stock Market: Pending the resumption of trading on the New York Stock Exchange . . . we are prepared to buy and sell all classes of securities." It was signed: "New York Curb."[4] Evidently traders refused to tolerate more than two days of no trading (Friday, July 31 and Saturday, August 1). This particular challenge dissipated on August 4 when the *Wall Street Journal* carried the following retraction: "No Dealings on the Curb: Advertisements which appeared in papers . . . are herewith absolutely repudiated." It was signed: "E. R. McCormick, Chairman, New York Curb Association."

The regional stock exchanges were another logical venue for trading NYSE listed securities. Back then nearly every major city had a stock exchange of its own, trading securities of local companies as well as NYSE-listed stocks.

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[3] Noble (p.12) says that he appointed exchange members "H. K. Pomroy, Ernest Groesbeck, Donald G. Geddes, Samuel F. Streit, with himself, to constitute the Committee."

[4] The New York Curb Market Association normally traded securities not listed on the NYSE (referred to as unseasoned securities) outdoors on Broad Street, near the New York Stock Exchange. In 1921 it became the American Stock Exchange and moved indoors (see Sobel, 1972).

The *New York Times* reported on August 1 that all regional exchanges voted to close along with the NYSE.[5] In addition, the Consolidated Stock Exchange, located in New York and trading primarily odd-lots of NYSE-listed stocks, also closed on the morning of July 31.[6]

According to Noble (1915, pp. 34ff), a flood of communications inundated the Committee of Five to modify the trading prohibition. On August 5 the Baltimore Stock Exchange reported to the committee that a member of the NYSE had "been guilty of going directly to the trust companies and making offerings of bonds." The committee responded (Noble 1915, pp. 34-37) that it would like the name of the member so that it could take appropriate action. Instead, on August 7 the Baltimore Stock Exchange urged the committee to reopen the exchange for bond trading.

What caused the immediate demands to modify the trading ban? Investors complained because they expected a lengthy suspension after the government signaled that the exchange would remain shut for the foreseeable future. On August 1 the *New York Times* reported: "The closing of the New York Stock Exchange was approved at the White House and the Treasury Department." The next day the *Times* added: "It would not surprise officials in Washington if [Treasury secretary William G.] McAdoo used his influence in New York to keep

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[5] The *Times* reports that Baltimore, Boston, Chicago, Cincinnati, Columbus, Detroit, Indianapolis, Philadelphia, Pittsburgh, St. Louis, San Francisco and Washington, all voted to close along with the NYSE, while Cleveland remained open (on July 31), but no business was done. Curiously, an announcement in the *Wall Street Journal* on September 4, 1914 states: "Cincinnati Stock Exchange: Did Not Suspend on August 1, But is Closed Now Until Further Notice."

[6] The Consolidated Stock Exchange opened (as usual) at 9:30 a.m. on July 31 but then closed at 10 a.m. when the NYSE voted to close (see Silber, forthcoming). For the origin of the Consolidated Exchange, see Nelson (1907). Its demise in 1926 is discussed in Sobel (1972).

the New York Stock Exchange closed for some time. No direct proposal of this kind may be made but he is expected to show that the Government does not look kindly upon the reopening of the exchange at this time."[7] In addition, the *Times* reported an immediate interest in trading. A headline on August 2 said: "Shorts Eager to Buy." The shorts (traders who had sold stock earlier at high prices but did not own the shares they sold) wanted to buy at low prices so that they could deliver the stock they sold. The *Times* emphasized their anxiety by adding: "They [the shorts] feared that the Stock Exchange would not reopen until stock prices rose again."

How quickly did an alternative trading market emerge? Noble (1915, p. 38) admits that, by August 11, eight trading days after the suspension, "the growth of an unregulated outside market began to force itself upon the attention of the Committee." He refers to the participants as "a group of mysterious individuals… seen loitering in New Street behind the Exchange." Trading on New Street clearly began well before August 11 because Noble added (p. 39): "[T]his furtive little group developed into a good sized crowd of men who assembled at ten o'clock in the morning and continued in session until three o'clock in the afternoon."

2.1. The NYSE retaliates

The Committee of Five took a number of steps to restrain the New Street market (see Noble, 1915, p. 40ff). It barred the practice of some stock exchange members, who refrained from trading on New Street, but who cleared stocks for those who traded there. The NYSE ticker did not disseminate New Street

[7] On August 1, 1914 the *New York Times* explained why the Wilson Administration wanted the Exchange shut: "the closing of the Exchange put an additional barrier in the way of gold export, and perhaps it was the only means to that end which was at hand." Also see footnote 2.

transactions. The committee successfully persuaded the press to resist regular publication of New Street prices.[8] But the most important step to counter the New Street market occurred on August 12 when the committee authorized trading through the New York Stock Exchange Clearing House at prices "no less than the closing prices of Thursday, July 30, 1914."

Noble reports (1915, p. 43): "A very considerable amount of business began at once . . . [but] a little later this 'Clearing House Market' fell to the arbitrary minimum of the [July 30] closing prices . . . and the New Street market grew in proportion. During the darkest days of depression in prices . . . in the Street . . . business in the Clearing House almost ceased. [When] New Street prices rose again to the Clearing House level a relatively small business on the 'outlaw' market was transformed into a relatively large business conducted under the supervision of the Exchange."

Noble's observations are what one would expect. A wide spread between market-clearing prices and officially sanctioned prices stimulates trading in black markets. And New Street was a black market. But how did Noble observe the relationship he describes between the relative trading volume on the two markets and relative prices without knowing what New Street prices were? Was he simply speculating based on 'first principles' or did he follow New Street quotations more closely than he admits?

[8] The *Wall Street Journal* (August 4, 1914) published Henry Noble's denunciation of any attempt to establish quotations: "I must ask the newspapers of New York to cooperate with the officials of the Exchange in preventing these practices." Noble (1915, p. 26) congratulates the press on their cooperation.

It turns out that Noble knew much more about New Street prices than he lets on. An examination of the *Records of the Committee of Five* reveals a collection of news clippings from the *Morning Telegraph*, normally a "theater and turf paper," giving price quotations from the New Street market.[9] Although the NYSE successfully restrained the *New York Times*, the *Wall Street Journal* and the *Commercial and Financial Chronicle*, it could not muzzle the *Morning Telegraph*, which did not depend on *Wall Street* for regular news.

3. Liquidity on New Street: an overview

The contemporaneous commentary differs over the quality of New Street's liquidity services. The *Wall Street Journal*, dismissed New Street by comparing it with trading in Belgium. At the other extreme, Noble observed that as early as August 11 New Street trading had become sufficiently important to force the New York Stock Exchange to defend itself.

The *New York Times* (January 3, 1915) reviewed the activities of the New Street market in some detail: "It furnished a market where stocks could be bought and sold by those who had especial need of liquidating their holdings or had money to invest . . . . At the height of its activity, the New Street market consisted of about thirty-five brokers who dealt for cash only. In the downward slant of prices in October, it was estimated that fully 40,000 shares a day were handled for a number of days, fairly well divided between 100 share lots and

[9] I would like to thank Steven Wheeler, archivist at the New York Stock Exchange, for help in locating the records and for providing copies of some of the entries. The records total four binders, each of which is about one inch thick. They contain all of the public releases issued by the committee but do not describe any of its deliberations. In addition to the published price quotations, the records contain news clippings reporting on the committee's activities. I would like to thank Mitchell Stephens of New York University's Journalism Department for the reference to Frank Luther Mott (1950, p. 658) which has a passing mention of the *New York Morning Telegraph.*

fractional amounts of stock. The average daily turnover during September, October and November was placed…between 8,000 and 12,000 shares." During the month prior to the trading suspension, the stocks that traded on New Street averaged about 250,000 shares per day on the NYSE.

The bid-ask quotes reported by the *Morning Telegraph* and preserved in the *Records of the Committee of Five* provide an opportunity to examine New Street liquidity more formally. Quotations are available in the committee's records for a total of 28 days between August 25 and October 26. I constructed a sample of 71 stocks that had ten days or more of bid-ask observations and had data available from the NYSE prior to the suspension of trading. The *Telegraph* did not report any trading data or the size of transaction that could be accommodated at the quoted bid and ask. Thus I focus on the immediate execution dimension to liquidity as measured by the spread between bid and ask quotes. (See Stoll, 2000, for a discussion of the quoted spread and other dimensions to liquidity.) Narrow spreads imply a more liquid market.

PLEASE INSERT TABLE 1 ABOUT HERE

Table 1 displays data for 20 of the 71 stocks in the sample. The first ten stocks have the lowest average bid-ask spread in New Street over the sample period and the last ten stocks have the highest average spread. The spread is measured in percent:

$$[(P^a - P^b) / (P^a + P^b)/2] * 100, \qquad (1)$$

where P^a is the ask price and P^b is the bid price.

Column 1 of Table 1 shows the stock's average daily spread on New Street. For example, the first entry in Column 1 shows that the average spread for Reading Railroad was 0.437% during the period. Column 2 provides the average daily spread for the same companies when they traded on the NYSE during a 28-day period ending with July 29, 1914. (The NYSE sample ends on July 29, excluding the day before trading was suspended. July 30 was abnormally active and might have distorted the pre-suspension sample.)

For the entire sample of 71 securities, the average spread on New Street is 2.47% compared with a spread of 1.34% on the NYSE.[10] Fig.1 shows that the average daily spread on New Street declined with the passage of time. The model of bid-ask spreads on New Street presented in Section 4 examines this improvement in New Street's liquidity.

PLEASE INSERT FIGURE 1 ABOUT HERE

3.1. Did New Street's wider spreads cause prices to decline?

The wider spreads on New Street compared with the NYSE are not surprising, given the impaired flow of New Street's price information and lower order flow. A key question is whether the increased spreads were large enough

[10] The averages in Table 1 are mean spreads. Median spreads are usually smaller for stocks on both New Street and the NYSE. For example, the median spread on New Street is 2.31% and the median spread on the NYSE is 1.18%. The qualitative comparisons between New Street and the NYSE are the same for mean and median spreads.

to cause a decline in stock price levels because of a liquidity discount (see Amihud and Mendelson, 1986, and Silber, 1991).

The liquidity discount could have been large because as early as August 2 investors expected Treasury secretary McAdoo to "use his influence in New York to keep the New York Stock Exchange closed for some time." On August 27 the *Wall Street Journal* reiterated the government's intentions: "[I]ntimations have been received from Washington to the effect that the opening of the Exchange would be considered undesirable by the Government officials who realize that . . . every effort should be made to relieve the strain on the country's monetary system." The same article quoted the head of a large banking house saying: "It looks to me like a long wait." Thus investors expected to incur wider bid-ask spreads for the indefinite future.

For each of the 28 days in the New Street sample I calculate the return for each stock compared with the closing price on July 30, the last day of trading before the suspension. (I used the midpoint of the bid-ask spread to represent a stock's price on each day of the New Street sample.) I then form a daily price index based on equally weighted returns for all stocks. Price levels relative to July 30 are plotted in Fig. 2. The figure shows a negligible price decline on New Street during the last few days in August. Prices fluctuated about 2.5% below the July 30 close during September. The decline reached a little less than 9% in the last half of October, primarily because the "war took on a more discouraging aspect" (Noble, 1915, p. 43).[11]

[11] The decline in price levels during October combined with discreteness in minimum quotes accounts for part of the increase in percentage spreads on New Street. Thus the recorded

PLEASE PUT FIGURE 2 ABOUT HERE

The failure of New Street prices to decline at the end of August, relative to the July 30 close on the NYSE, suggests that the decrease in liquidity on New Street was not large enough to cause an overall drop in price levels. [12] The absence of a decline cannot be attributed to favorable war news since the July 30 closing. If anything, the reverse is true. War among the great powers (Britain, France, Germany, and Russia) remained in doubt when the exchange suspended trading on Friday, July 31. The *New York Times'* August 1 main headline read: "Czar, Kaiser and King May Yet Arrange Peace." War erupted between Great Britain, France, Germany, and Russia the following week. However, stock prices probably received a boost from the emergency measures introduced by the Wilson administration during the first week of August.[13] Any liquidity discount was not large enough to dominate the combined impact on price levels.

3.2. Was New Street economically relevant?

The contemporary disagreement over New Street's importance raises the question of whether New Street offered economically relevant liquidity services

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increase in spreads probably overstates the decrease in liquidity on New Street. The regression equations in Section 4 control for this effect.

[12] The standard deviation of daily returns is 1.42% for the equally weighted portfolio for the sample period ending July 29. The price declines in late August (and early September) compared with July 30 are statistically insignificant.

[13] Treasury secretary McAdoo pushed an amendment through Congress on August 4, 1914 modifying the Aldrich-Vreeland Act of 1908. The amended act allowed banks to issue emergency currency to avoid a suspension of convertibility of deposits into lawful money. See Silber (2005, Chapter 4) for a discussion of emergency currency and stock prices.

despite the wider bid-ask spreads. Did New Street provide opportunities that would not have been otherwise available?

Starting August 12 investors had the opportunity to transact through the NYSE Clearing House at July 30 closing prices (or higher). The imprimatur of the New York Stock Exchange gave the Clearing House an important natural advantage over New Street. The problem with the Clearing House was that it did not always provide a two-sided market. It was always possible to buy immediately in the NYSE Clearing House from the available offers (either at or above July 30 closing prices), but it was not always possible to sell there because bids below July 30 were not permitted. Moreover, although a trader could always buy at the Clearing House from a seller at the July 30 close or above, the price would be too high if the market-clearing equilibrium were below that level.

New Street quotes were always two-sided. Thus if there were sellers only at the Clearing House and no buyers, some of those potential sellers could dispose of their securities at the quoted bid prices on New Street. This disposal facility was an important liquidity service. However, potential sellers would be uncertain if the low bid price stemmed from a decline in the equilibrium price or was simply a reflection of the relatively wide bid-ask spreads on New Street.

When both the bid and offer on New Street were below the July 30 closing price, the New Street market dominated the NYSE Clearing House for both potential buyers and potential sellers. Moreover, under those circumstances the low bid prices gained credibility from the accompanying low offer prices.

I calculate the difference between the July 30 closing price and the ask price for each stock on every day of the sample. Both the bid and offer dominate the July 30 close when that difference is positive (because bids are always below offers). Days% measures for each stock the percentage of days in the sample for which the July 30 close minus the offer is positive. The average value of Days% for the entire sample is 63.57. Thus, New Street stocks provided a two-sided market that dominated the NYSE Clearing House about 63% of the time. Forty-six of the 71 stocks in the New Street sample had a value for Days% greater than 50%.

These results show that New Street offered liquidity services that were economically meaningful despite wider bid-ask spreads compared with the New York Stock Exchange. [14] New Street still had to overcome the NYSE trademark enjoyed by the Clearing House as well as the impaired dissemination of price information. Did New Street compete effectively by attracting order flow?

It is impossible to test this hypothesis directly because trading data on New Street do not exist. However, the economic incentive to trade on New Street should be greatest when a stock's bid and offer on New Street dominate the NYSE Clearing House. If New Street competed successfully, the structure of bid-ask spreads on New Street should be related to variables measuring New Street's dominance of the NYSE.

[14] The *New York Times* (August 2, 1914) reported that short sellers complained that the trading suspension would rob them of their profits if the NYSE were not reopened until after prices recovered. Shorts had the opportunity to close out their positions profitably when offer prices on New Street were below the July 30 close. Short sellers were, therefore, among the important beneficiaries of two-sided New Street liquidity.

4. A Model of bid-ask spreads on New Street

The Stoll (2000) review of the literature on bid-ask spreads provides a useful empirical framework for determining whether spreads on New Street responded to economic incentives. Stoll summarizes the most important relationships as follows: Inventory risk associated with market-making in securities implies that stocks with high trading volume should have narrow spreads because high volume permits traders to return quickly to a zero inventory position. Lower priced stocks should have wider percentage bid-ask spreads because of discreteness in price quotations. Stocks with large standard deviation of returns should have wider spreads because greater volatility means any nonzero inventory position is riskier.

More specifically, Stoll specifies that S_i , the average percentage bid-ask spread on stock *i,* should depend negatively on log V_i , the logarithm of the contemporaneous average dollar volume of trading in stock *i*; S_i should depend negatively on log P_i, the logarithm of the contemporaneous average price level of stock *i*; and S_i should be positively related to SD_i , the stock's historical standard deviation of returns.

My data set consists of 28 daily observations for 49 of the 71 stocks on New Street plus at least ten daily observations for each of the remaining 22 stocks. I can exploit all of the information by specifying a pooled cross–sectional time series relationship, as follows:

$$S_{it} = a_o + a_1 \text{Log } V_{it} + a_2 \text{Log } P_{it} + a_3 SD_i + e_{it} , \qquad (2)$$

where S_{it} is the percentage spread on stock *i* at time period *t*; V_{it} is the dollar volume of trading in stock *i* at time period *t*; P_{it} is the price level of stock *i* at time period *t*; SD_i is the historical standard deviation of stock *i*; and e_{it} is the error term.

Least squares estimation of Eq. (2) with contemporaneous cross-sectional data on V_{it} and S_{it} is inappropriate because volume of trading and spreads are simultaneously determined. Higher volume leads to lower spreads because of dealer inventory behavior, but lower spreads attract higher volume because of public investor behavior. It is also impossible to estimate Eq. (2) for New Street because the *Morning Telegraph* did not publish trading volume. One solution to the estimation problem is to replace volume on New Street with a set of exogenous instruments.

Volume of trading on New Street should respond to the economic incentives to trade there versus in the NYSE Clearing House. The incentive to trade a stock on New Street on any given day should be greatest when New Street's two-sided market dominates the NYSE, i.e., when the ask price on New Street is below the July 30 closing price on the NYSE. $PminAsk_{it}$ measures, for each stock *i,* the value on day *t* of the July 30 closing price minus the ask price, expressed as a percent of the ask price. Order flow to New Street should be high whenever $Pminask_{it}$ is positive. I construct a dummy variable, D_{it}, equal to one when $Pminask_{it}$ is positive and zero otherwise to capture the on/off incentive to trade on New Street. Order flow to New Street might also respond to the magnitude of $PminAsk_{it}$. Large positive values for $PminAsk_{it}$ mean that New

Street's two-sided market clearly dominates the NYSE Clearing House, implying a greater incentive to trade on New Street. Thus both D_{it} and $PminAsk_{it}$ should be negatively related to bid-ask spreads.

Replacing log V_{it} in Eq. (2) with D_{it} and $PminAsk_{it}$ produces:

$$S_{it} = a_o + a_1 D_{it} + a_2 PminAsk_{it} + a_3 Log P_{it} + a_4 SD_i + e_{it} . \quad (3)$$

Column 1 of Table 2 shows the ordinary least squares estimates of the coefficients in Eq. (3) using 1,816 observations from the New Street sample. The *t*-statistics are calculated using Newey-West corrected (with five lags) standard errors. All of the variables have the correct signs and are statistically significant.

INSERT TABLE 2 ABOUT HERE

The statistically significant negative coefficients on D_{it} and $PminAsk_{it}$ confirm that New Street attracted order flow from the NYSE Clearing House, producing narrower bid-ask spreads. This result shows that New Street overcame the impaired dissemination of price information and the trademark of the NYSE Clearing House to successfully provide economically relevant liquidity services.

Fig. 1 shows a decline in the average bid-ask spread during the period covered by the New Street sample. I add a time trend to Eq. (2) reported in Table 1 to determine whether the passage of time had an independent effect on observed spreads. The time trend variable was not statistically significant (*t*-

statistic = 0.33), implying that the structural variables specified in the equation explain the narrowing of spreads during the period.

The impaired dissemination of price information on New Street suggests that other factors might also influence order flow to New Street. In particular, stocks that have a reputation for liquidity might also experience higher order flow. Reputation matters in the liquidity services business. Silber (1984, p. 941) describes how market-makers continuously quote a two-sided market to foster a reputation for liquidity so they can attract order flow. In our case, the impaired price transparency on New Street should make liquidity a function of an individual stock's reputation for liquidity.

A possible indicator of a stock's reputation for liquidity is persistently high historical trading volume. Thus average dollar volume of trading on the NYSE prior to the trading halt is an appropriate added instrument for New Street volume. An alternative interpretation of historical trading volume on the NYSE is that it simply proxies for actual trading volume on New Street as a cross-sectional scale variable.

Column 2 of Table 2 shows the results of a least squares estimation of Eq. (3) with Log V_i , the stock's average daily dollar volume on the NYSE during the 28-day period ending on July 29, 1914, added to the equation. All of the variables in Column 2 are significant, including Log V_i with the expected negative sign.

5. Price discovery role of New Street

On Saturday, December 12, 1914 the NYSE began trading stocks on the floor of the exchange and New Street ceased operations. An important indicator of the economic relevance of New Street is whether prices on December 12 on the New York Stock Exchange reflected the final price quotations on New Street. In particular, if New Street contributed to price discovery on the NYSE, then quotes on New Street should add information over and above what is embedded in the last transactions on the NYSE recorded on July 30, 1914.

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Column 1 of Table 3 shows opening prices on 40 stocks on the New York Stock Exchange on December 12, Column 2 shows the midpoint of the bid-ask prices for these 40 stocks as quoted the previous day on New Street, and Column 3 records the July 30 NYSE closing prices for these stocks.[15] To determine whether New Street contributed to price discovery on the NYSE on December 12, I estimate the following cross-sectional equation with the data from Table 3:

$$P_{NYSE(12/12)} = \underset{(1.82)}{.475} + \underset{(37.1)}{.925}\, P_{New\ St\ (12/11)} + \underset{(3.11)}{.078}\, P_{NYSE\ (7/30)} \qquad (4)$$

[15] Data for the New Street quotes for December 11, 1914 come from the *New York Times* (January 4, 1915) in its annual review of financial developments of 1914. The *Times* prepared a table of "High, Low, and Last Prices" on New Street compiled with the help of "quotations supplied directly to the *Times* by George S. Crap, a dealer who participated in New Street trading." The 40 stocks came from the intersection of those stocks that traded on the NYSE on December 12 with those that were quoted on New Street on December 11. For 21 of the 40 stocks listed in Table 3 the opening price on the NYSE on December 12 fell within the bid-ask spread recorded for December 11 on New Street.

The regression coefficients in Eq. (4) are estimated with ordinary least squares, and the *t*-statistics, in parenthesis below each coefficient, are calculated using White's heteroskedasticity corrected standard errors. The R^2 of the equation is 0.999.

The statistically significant coefficient on $P_{New\ St\ (12/11)}$ in Eq. (4) allows us to reject the hypothesis that New Street provided no information for the December 12 opening on the NYSE. The statistically significant coefficient for $P_{NYSE\ (7/30)}$ shows that New Street did not make the July 30 closing price on the NYSE completely redundant, perhaps because New Street was less liquid than the NYSE. However, the coefficient of $P_{New\ St\ (12/11)}$ is more than 11 times larger than $P_{NYSE\ (7/30)}$, implying that New Street was far more important to the price discovery process when the New York Stock Exchange reopened than the previous NYSE close.

6. Conclusion

It is easy to understand why New Street emerged after the suspension of trading on the New York Stock Exchange following the outbreak of World War I. Few economic activities are as reliable as attempts to circumvent regulation. It is impressive, however, that the New Street market emerged quickly, despite extensive efforts to stifle its operations, and that it provided economically meaningful liquidity services for investors.

New Street's success outlasted competition from the NYSE Clearing House facility, it survived disparaging newspaper publicity that denigrated the

quality of its product, and it overcame efforts to muzzle the dissemination of crucial price information. It is disappointing that academics have perpetuated the myth of New Street's ineffectiveness by using pejoratives such as "gutter" and "outlaw" to describe the market. New Street's reputation should, at least, reflect the fact that its liquidity dominated the NYSE Clearing House more than 60% of the time and that it contributed to price discovery when the New York Stock Exchange reopened for business.

This episode in financial history shows that liquidity can survive a crisis even without extensive preparation. New Street's technological disadvantage relative to the NYSE in 1914 was substantial, perhaps more than what a substitute market would encounter today. New Street could not disseminate timely price information over the NYSE ticker, and it did not have access to private telephone lines utilized by NYSE member firms to communicate orders.[16] Nevertheless, liquidity on New Street flourished as a substitute for the NYSE. The fact that participants in New Street required physical securities to settle their trades implies that, in the age of electronic settlement, maintaining liquidity requires back-up records of share ownership and transfer facilities. Investors with clear title to securities can utilize the liquidity that emerges in the marketplace.

[16] Van Antwerp (1913, p. 289) and Michie (1987, p. 176-7)) describe the use of private telephone lines that remained open all day, allowing members of the NYSE to communicate continuously with the floor of the exchange as well as with customers throughout the country.

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Stock	New Street (1)	NYSE (2)
Reading Railroad	0.437	0.091
Union Pacific RR	0.490	0.100
Consolidated Gas Co.	0.504	0.705
Atchison Topeka & Santa Fe RR	0.570	0.315
Great Northern RR preferred	0.571	0.341
Norfolk & Western RR	0.591	0.561
American Tel & Tel	0.637	0.353
Chicago and Northwestern RR	0.640	1.061
Pennsylvania RR	0.641	0.258
Northern Pacific RR	0.659	0.248
Colorado Fuel & Iron	4.105	3.013
Distillers Securities Corp	4.358	5.304
Guggenheim Exploration	4.603	0.807
Kansas City Southern RR	4.741	2.058
Pressed Steel Car	5.446	1.477
Pittsburgh Coal	5.447	3.134
International Paper preferred	5.606	1.946
Virginia Carolina Chemical	9.039	1.453
Corn Products	9.339	4.111
Rumely Co.	15.540	9.765

Table 1 Percentage bid-ask spreads on New Street and the NYSE. Column 1 shows a stock's average daily bid-ask spread, in percent, over 28 days between August 25, 1914 and October 26, 1914. The 20 stocks in the table were traded on New Street, the marketplace that arose when the NYSE closed on July 31, 1914. The first ten stocks have the lowest average percent bid-ask spread on New Street over the sample period and the last ten stocks have the highest average percent spread. Column 2 shows the average daily percent spread for the same companies when they traded on the NYSE during a 28-day period ending with July 29, 1914.

	(1)		(2)	
Variable	Coefficient	*T*-value (robust)	Coefficient	*T*-value (robust)
Intercept	8.015	7.232	9.673	9.137
D_{it}	-0.958	-6.165	-0.530	-3.490
$PMinAsk_{it}$	-0.051	-3.091	-0.032	-2.133
Log P_{it}	-1.443	-7.041	-0.734	-3.175
SD_i	0.289	2.409	0.434	3.644
Log V_i			-0.464	-12.131
Adjusted R^2	0.427		0.487	
Number of observations	1,816		1,816	

Table 2 Pooled time series cross-section regressions explaining New Street bid-ask spreads. Column 1 shows the results of an ordinary least squares estimate of an equation explaining the structure of percentage bid-ask spreads on securities that traded on New Street, the marketplace that arose when the NYSE closed on July 31, 1914.The estimated equation is based on 1,816 observations from 28 days for 71 stocks between August 25, 1914 and October 26, 1914. The *t*-statistics are calculated using Newey-West corrected (with five lags) standard errors. The dependent variable in the regression is S_{it} = the ask price minus bid price divided by the average of the bid and ask prices, multiplied by one hundred, for each stock *i* on day *t* during the New Street sample. The independent variables are as follows: $PminAsk_{it}$ = the July 30 closing price on the NYSE minus the ask price on New Street, divided by the ask price, multiplied by one hundred, for each stock *i* on day *t* during the New Street sample; D_{it} = one when $PminAsk_{it}$ is positive and zero otherwise; P_{it} = the average of the bid price and ask price for each stock *i* on day *t* during the New Street sample; and SD_i = the standard deviation of returns on the NYSE during the 28-day period ending July 29, 1914 for each stock *i*. Column 2 shows the results of an ordinary least squares estimate of an equation that adds the following variable to the equation of Column 1: V_i = the average daily dollar volume on the NYSE during the 28-day period ending on July 29, 1914 for each stock *i.*

Stock	NYSE on December 12 (1)	New Street on December 11 (2)	NYSE on July 30 (3)
Alaska Gold	25.88	25.50	19.50
American Beet Sugar	29.00	27.75	19.00
American Can	25.75	25.75	19.50
American Can pr	91.25	90.50	80.00
American Car & Foundry	42.25	42.00	44.13
American Cotton Oil	35.75	36.00	32.00
American Ice	22.00	22.50	19.88
American Sugar	104.25	102.00	101.00
American Tel & Tel	116.38	117.00	114.00
Atchison pr	98.50	96.75	97.75
Atchison Topeka Santa Fe	91.75	91.50	89.63
Bethlehem Steel	42.00	40.50	30.00
Brooklyn Rapid Transit	85.25	86.00	79.50
Central Leather	35.75	35.50	28.00
Consolidated Gas Co	116.00	115.75	116.50
Corn Products	8.75	8.50	7.25
Distillers Sec Corp	15.00	16.56	11.00
Erie	20.50	19.75	20.50
Erie 1st pr	35.50	33.50	32.00
General Electric	138.00	136.75	139.00
General Motors	85.00	87.00	58.88
General Motors pr	90.00	87.50	79.75
Int. Harvester of NJ	91.00	92.00	82.00
Interborough Met pr	51.00	51.50	52.00
International Paper pr	33.50	33.00	30.50
Kansas City So	20.25	20.75	20.25
Louisville & Nashville	125.00	122.88	127.00
Missouri Pacific	10.50	9.88	8.00
Nevada Copper	10.75	10.13	10.25
New Haven	51.50	52.00	51.00
Northern Pacific	98.00	98.25	98.75
Ontario & Western	20.00	20.75	18.25
Pennsylvania R R	106.25	105.63	105.13
Pittsburg Coal	16.75	15.50	16.50
Rumely	6.25	6.63	8.00
Tennessee Copper	30.75	29.50	24.75
Texas Company	131.00	133.00	113.00
United States Rubber	51.00	49.38	44.75
Western Union	58.50	57.75	53.38
Westinghouse	64.50	64.50	65.50

Table 3 New York Stock Exchange (on December 12,1914) versus previous New Street and NYSE prices. Column 1 shows opening prices on 40 stocks on the NYSE when they resumed trading on December 12, 1914. Column 2 shows the midpoint of the bid-ask prices for these 40 stocks as quoted the previous day on New Street. Column 3 records the July 30 NYSE closing prices for these stocks.

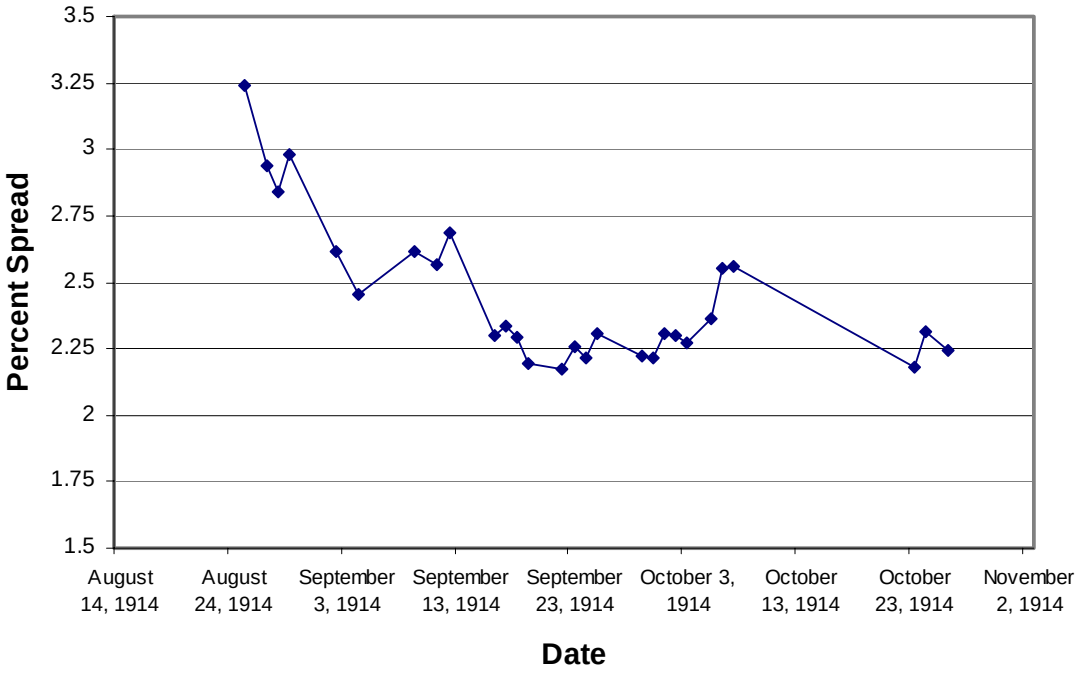

Fig.1 Percent bid-ask spread on New Street over time. Each point in the gure measures the average percent bid-ask spread for the securities trading on New Street on each of the 28 days of the sample between August 25, 1914 and October 26, 1914. The New Street market arose when the NYSE closed on July 31, 1914,

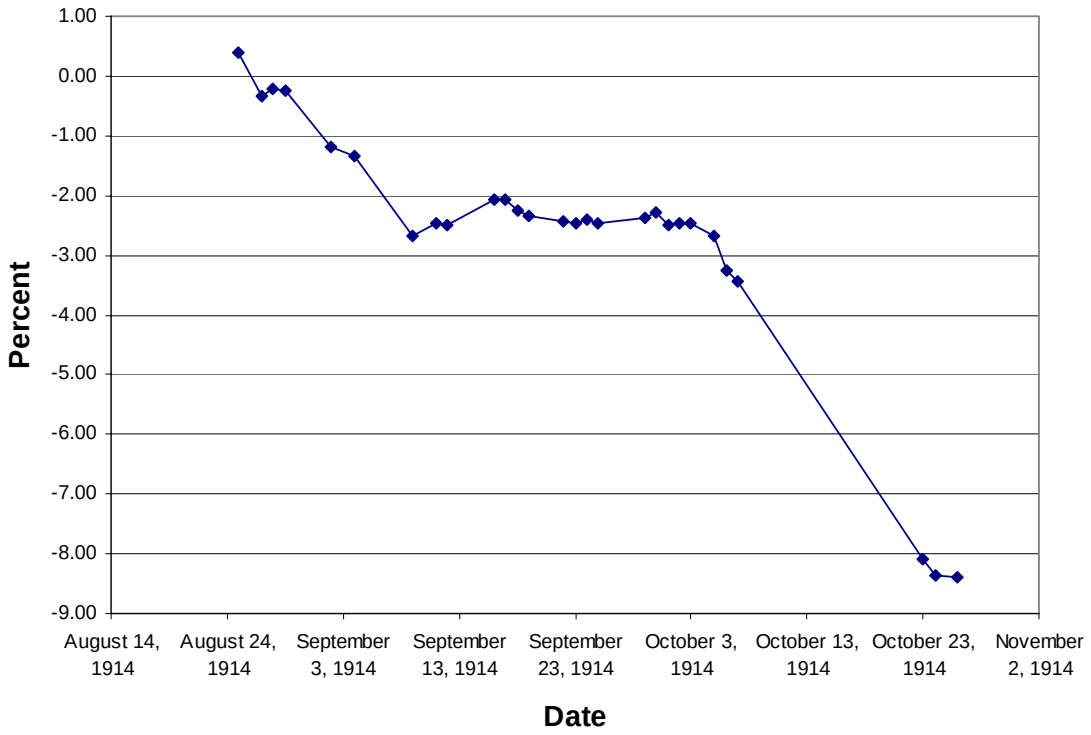

Fig. 2 New Street price level versus NYSE on July 30 close. Each point in the figure represents an index of prices on New Street (the market that arose after the NYSE closed) relative to the closing price on the NYSE for July 30, 1914 (the last day of trading on the NYSE). The price index is calculated for the 28 days in the sample between August 25, 1914 and October 26, 1914, based on equally weighted returns for all stocks on New Street.