Transforming the NYSE: Crisis and Expansion during the Great War and its Aftermath

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World War I marked a key turning point in the development of the New York Stock Exchange, transforming it from a major domestic market to the dominant global market. In this paper, I investigate the performance of the NYSE in the period surrounding World War I, as it dealt with the exigencies of the war itself and then managed its rapid expansion at the end of the war and the years immediately following.

The period of the First World War provides a nearly unique laboratory in which to study the impact of crisis on market performance in the absence of government regulation. The onset of World War I altered the organization and operations of the exchange. The war itself brought the closure of the NYSE and other markets from July 31 to December 12, 1914 in order to prevent a total sell-off by European traders in urgent need of liquidity.[1] The closure effectively froze commercial bank loans based on securities (call money) and prevented an acute panic, but it did not prevent the sell-off by Europeans over the succeeding few years, 1915-1920. Trading grew rapidly as soon as markets reopened. War financing in the US and Europe created a whole new population of securities investors, millions of whom had never participated in securities markets before, often using margin purchases through their banks. Issuers appealed to

[1] Silber (2005) studies the response of traders to the closure of the NYSE in the latter half of 1914 and argues that they rapidly developed an economically viable and useful alternative (New Street Market) to the liquidity that was normally provided by the NYSE.

small investors by reducing the typical amount per bond from $1,000 to $500 or even $100 and lowering the minimum trade from $10,000 to $1,000. Trading volume hit new record highs in the late teens, causing the exchange to bump up against capacity constraints and to expand its physical area in 1920.

All of these events and institutional changes very likely affected the operations of the exchange and its ability to provide price discovery and liquidity in an efficient, low-cost manner. Using a range of measures, I examine the effects on market liquidity of the waves of crisis in European and worldwide financial markets, the intervention of the US federal government into areas that affected operations at the stock market, and the rapid expansion in listings and trading during and following the war. The analysis in this paper is based on a new database of weekly data, comprising all stocks and related equity-based securities trading on the New York Stock Exchange on Fridays between 1911 and 1922.[2] Pulling all of these results together creates a broad picture of market quality over time and allows us to better understand the impact of major growth and institutional change in a largely self-regulated environment, quite unlike markets in the post-Depression era. I also put these figures into perspective by comparing with modern-day market quality measures for the NYSE.

I. Background on World War I and the NYSE

Europe had taken a respite from its repeated battles during the last quarter of the 19th century and the first decade of the 20th. Economies industrialized, international trade

[2] For weeks when the exchange was closed on Friday, the data come from the Thursday before.

thrived, and global financial markets expanded. But tensions returned and built from at least 1911, when territorial battles escalated in the Balkans, involving Austria-Hungary, Turkey and Italy, as well as Greece and the Balkan countries. Political insecurity at home as well as deep-rooted resentments and alliances among the more powerful European states—Germany, Austria-Hungary, Russia, France, and Great Britain—led in domino fashion to the events of June and July 1914, following the assassination of Archduke Franz Ferdinand of Austria-Hungary in Sarajevo on June 28th.

On July 28th Austria-Hungary declared war on Serbia, prompting an immediate sell-off in many markets worldwide to release funds for war expenses. Foreign investors, particularly from Europe, had accumulated a large stake in American corporations. As they sold off securities, they converted shares and bonds into dollars, which they then converted into gold via US banks. Three days later, on the morning of July 31st (Friday), the NYSE and many other US markets announced their closure, in order to stem the outflow of gold and the plummeting share prices. The London Stock Exchange had announced its closure earlier that morning, adding to the concern that the war in Europe left American markets vulnerable. Almost all European markets also closed the next day.

Official markets remained shut for several months, but substitutes emerged to replace the liquidity needs of traders, and the NYSE clearing house eventually began providing limited transactions at or above July 30th prices. The New York Stock Exchange, and many others in the United States, reopened on December 12th, 1914

(Saturday).[3] The London Stock Exchange reopened in January of the next year. Other markets, notably those in Paris and Berlin, remained closed for many more months and even years.

By mid-August 1914, war engulfed most of Europe, setting off a race to finance the enormous costs. By the spring of 1915, international issues of war bonds reached $10 billion.[4] US corporations already began a shift toward domestic financing. Naval blockades interrupted international trade, particularly in the Atlantic, and the sinking of the *Lusitania* by a German submarine in May 1915 incited the rage of the American public and set off talk of entry into the war by the United States.[5]

Despite the loss of foreign investors, the NYSE continued to expand, with new listings appearing at regular intervals. Indeed, industrial giants IBM and the newly reorganized GM, first listed in 1916.[6]

Nearly three years into the war, the United States finally entered the fray on April 6th, 1917, following the speech of President Wilson before a joint session of Congress a few days earlier.[7] Once engaged in the war, the federal government launched a range of regulations and initiatives to direct resources into the war effort as well as measures

[3] Notably, the NYSE had resumed bond trading a few weeks earlier, under the acknowledgement that the market served a key function in financing the war.
[4] See Vanderlip (1915), p. 104. In real (e.g., 2010) terms, of course, the figure would be many times greater, even into the billions of dollars, depending on the basis of the conversion. See the subsequent discussion of US Liberty Loans floated in 1917-1919 and www.measuringworth.com.
[5] See Rockoff (2010).
[6] GM changed its incorporation from New Jersey to Delaware and listed the new shares on the NYSE in December of 1916. Financier, vol. 108.
[7] Woodrow Wilson, War Messages, 65th Cong., 1st Sess. Senate Doc. No. 5, Serial No. 7264, Washington, D.C., 1917; pp. 3-8, passim. Retrieved from WikiSource on July 15, 2011 (http://en.wikisource.org/wiki/Woodrow_Wilson_Urges_Congress_to_Declare_War_on_Germany) Delivered at a joint session of the two Houses of Congress on April 2, 1917.

to pay for the expenditures. Indeed, the US entry into the war had rapidly escalated federal spending from $1.3 billion in 1916 to $15.6 billion in 1918, while the GNP deflator rose by more than 40 percent over those two years.[8] While government spending gradually tapered in the next two years, inflation continued at a similar pace.

The government regulations and taxes impacted the financial markets directly and indirectly. First, the treasury began floating issues of Liberty Bonds starting with a $2 billion offering in May of 1917, and continuing with new issues at 4-6 month intervals.[9] Within two years, the government had floated five separate issues totaling over $21 billion to nearly 12 million subscribers.[10] Contemporary commentators immediately recognized the historic nature of the issue, one proclaiming about the initial offering "the Liberty Loan 3 1/2s constitutes an unprecedented record as a financial transaction by the United States Government."[11] The Liberty loans absorbed much of the brokerage capacity and shifted investors away from corporate securities, especially bonds. *The Financier*, for example, reported on July 16, 1917,

> "Although the stock market has been fairly active of late dealings have been largely professional and this means few commissions for brokers. Furthermore the bond business has been dead for the last few months and the

[8] Rockoff (2010), citing U.S. Bureau of the Census (1975), series Y352 and Y457 for expenditures and Balke and Gordon (1989, table 10, pp. 84-85) for GNP deflator.
[9] Kang and Rockoff (2006) analyze the government marketing effort to place these issues, and their Table 1 provides details of all five issues (the fifth, following the Armistice, being termed "Victory Bonds").
[10] The value in real (2010) terms equates to approximately $364.57 billion based on the GDP deflator but exceeds $5 trillion based on the relative share of GDP. Figures computed at www.measuringworth.com, which also provides details of the calculators and reasoning for using particular measures in given circumstances.
[11] Childs (1917).

revival which was expected to follow the success of the Liberty Loan has not yet materialized. Some brokers have consequently been hard hit; a number have voluntarily decided to go out of business whereas a few have been thrust into receivership."[12]

In August of 1917 the government began imposing price controls in food and fuel sectors and later expanded to other key commodities and industries. In December of that year, the Wilson administration nationalized the railroads and maintained this control for more than two years. Congress passed the War Revenue Act in October of 1917, thereby raising taxes on both personal and corporate incomes and creating new taxes on excise, "excess profits," and luxury goods. Observers at the time argued that the tax increases and price fixing, and the public's anticipation thereof, discouraged investment in related securities, as investors feared suppressed corporate profits as well as considerably dampened after-tax returns.[13]

In the spring of 1918, under the auspices of the Federal Reserve, the government created The Capital Issues Committee, which for its relatively short lifespan (until December of that year) controlled new issues of securities, particularly industrial bonds.[14] The Chair of the Boston Fed, indicated that the "any unnecessary production

[12] *The Financier*, July 16, 1917, pp. 155-6.

[13] See Taussig (1919), who gives a history of World War I "price fixing" by the government. He notes that the government created three separate price fixing bodies, starting with food and fuel in August of 1917 and only later, in March of 1918, created the Price-Fixing Committee of the War Industries Board.

[14] See the speech by Frederic Curtiss, Chair of the Boston Fed, before the City Treasurers and Collectors Association of Massachusetts in Boston on March 23, 1918. The National Archives finding aid indicates that the formal body came into being in on May 17th, but replaced a prior, voluntary version of the same committee. According to the same aid, the Committee suspended activities on December 31, 1918; a Presidential proclamation on August 30, 1919 officially terminated the Committee.

or consumption of goods, and any unnecessary use of credit, saps and weakens the fighting strength of the Nation." At the same time, the Federal Reserve Board attempted to redirect funds into productive capacity by curtailing speculative activity that tended to funnel banks' surplus funds into call loans in the New York money market.

Adding to the crisis atmosphere toward the end of the war, a global influenza pandemic began in June 1918 and killed on the order of 50 million people worldwide by the time it ended in December of 1920.[15]

The war ended with the armistice of November 11, 1918 (Monday). The war had made a profound impact on financial markets worldwide. Notably, it compelled foreign investors to withdraw from the US market in order to finance war needs at home. It also spurred foreigners to float securities, particularly sovereign debt, in the US market. Thus, from 1914 to 1919, foreign investment in the US dropped from $7.2 billion to $3.3 billion, while investments flowing from the US to foreign markets grew from $5 billion to $9.7 billion.[16]

II. Activity at the New York Stock Exchange, 1911-1922

Properly analyzing stock market activity requires high frequency data. For each Friday from January 1911 through December 1925, we have manually double entered, compared, and randomly checked the full list of stock names with details on type of

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http://fraser.stlouisfed.org/publications/wfca_cic/issue/5040/download/84182/cic_curtiss19180323.pdf (retrieved July 15, 2011). Curtiss outlines the English system, which provided the model for the US Committee.

[15] http://www.cdc.gov/ncidod/eid/vol12no01/05-0979.htm (retrieved July 15, 2011)

[16] See Rockoff (2010), citing statistics from the U.S. Census Bureau.

security (preferred, rights, trust certificates), ex-dividend days, ex-rights days, and any other details printed in the New York Times stock tables; volume traded, meaning number of shares ("sales"); first and last transaction prices, as well as high and low transaction prices; and the quoted bid and ask prices prevailing at the close of the market. So far, cleaning is still underway on the data for 1923-25, so for now the analysis ends in 1922.

The new database paints a detailed picture of the business of the NYSE at a high frequency, and this new level of granularity brings to light the variability of trading and allows a more accurate assessment of trends and breakpoints surrounding the many significant events of this period.

The activity of the NYSE grew rapidly over the teens and early 1920s, as evidenced by several measures (Figure 1). Total number of shares trading on each Friday grew from the range of 100 to 150 in 1911 to well over 400 individual stocks in 1920. Meanwhile, volume (number of shares traded) rose from an average of 380 thousand shares in the 1911-14 period to nearly 870 thousand shares on average in the 1919-22 period (Figure 2a). Dollar volume, in nominal terms, rose less dramatically, from an average of $37 million per day in the early period to about $55.5 million per day in the post-war period (Figure 2b). Notably, considering inflation, dollar volume actually fell.[17]

Market activity varied quite dramatically over the period, such that for example, on June 30th, 1922 332 distinct stocks traded, but a week later, on July 7th, 416 different stocks traded. Trading volume—in both number and dollar values—also varied

[17] I will create a deflated price series in a later version of this paper, but for now, the graph in Rockoff's EH.net survey of the WWI economy shows the general picture of price declines at the NYSE.

tremendously from week to week, often running 50-60 percent higher or lower than the weekly average.

In the pre-war period, the number of stocks began climbing up to October of 1912 but trailed off to often quite low levels—as low as 88 stocks (only 61 common stocks)—in 1913. While the number of stocks began to recover in 1914, it was halted by the closure in the latter half of the year. Trading volumes turned down even earlier, by the end of 1911, and generally trended down right up to the closure of the exchange.

Upon reopening in December of 1914, the numbers of stock securities and the volume of shares (numbers and dollars) began an upward climb that lasted, with some definite stalls, until late 1916 (for volume) or early 1917 (for number of securities). The entry of the US into the war in April 1917, which had been anticipated for some time, brought a string of economic events that temporarily hindered stock activity at the NYSE and put a damper on the numbers of stocks traded on the NYSE: the issue of vast volumes of Liberty Bonds, the implementation of many new government policies aimed at redirecting resources to the war effort (price controls, stock exchange controls, tax hikes, and so on) along with the physical dislocation of personnel in the call-up of men to fight.

III. **Analysis of Market Quality**

Market quality can mean a variety of things: efficiency, liquidity, ease of price discovery, and possibly low volatility. All of these market characteristics benefit market participants and presumably facilitate the use of market-based finance for corporate

capital investments while encouraging investors to place their idle funds at risk. This mobilization of capital encourages new issues on the market: good markets are good for economic growth.

In this analysis I focus on liquidity and transactions costs associated with trading at the NYSE. Empirically, the difference between quoted ask and bid prices, normalized by the transaction price of the asset, provides an estimate of the actual transaction cost. The measure also proxies for market liquidity, as the less liquidity available in the market, the higher the transaction cost to effect a trade, and naturally the wider the spread.

Transactions do not necessarily take place at quoted bid and ask prices, so that quoted spreads are not necessarily precise reflections of transactions costs. Moreover, the quoted spread wraps up a range of different transactions costs: order processing expenses, inventory risk, asymmetric information, and potentially monopoly rents. The relative effective spread (RES)—measured as the difference between the transaction price and the midpoint of the prevailing bid-ask spread (or mid-quote), normalized by the mid-quote—gives a potentially more accurate estimate of actual liquidity and transaction costs.[18]

[18] Relative effective spread is technically defined as the signed difference from the mid-quote, where the sign is supposed to represent "buy" or "sell" orders. Naturally, one cannot actually observe whether a buyer or seller has initiated the trade, so others have developed rules for essentially guessing. In the current paper, I use the absolute value of the difference in order to represent the distance between the last transaction price of the day and the bid-ask quote prevailing at the close. This raises the issue that we cannot know the quote prevailing at the exact time of the last trade. Surely, we will have some closing quotes that changed after the "last" transaction of the day, however, in the context of the NYSE during the WWI era, the speed of adjustment of quotes was certainly slower than today and likely not hugely problematic for estimating the relative effective spread.

Median quoted spreads at the NYSE clearly rose over the period in question, from an average of 0.9 percent in the pre-war period to an average of 1.35 percent in the post-war (1919-1922) era (Table 1). Median RES remained lower than quoted spreads, of course, but they increased more—from an average of 0.6 percent to 1.1 percent for the same time periods.

Both types of spreads also fluctuated greatly—rising or falling on a week-to-week basis by 25 percent of the average spread—much more than more widely-used annual data would suggest.

- Breakpoint analysis confirms the changes in the time series

The increasing activity in the market, very likely the new issues that entered the market during and after the war, seems to have brought greater volatility (Figure 4). Since we have only open, close, high and low transaction prices for each stock on each day, we must estimate volatility with a proxy. I measure this quasi-volatility as the high minus the low transaction price, taken as a percent of the closing price for the day. In future work, I will estimate betas for each stock over multi-week windows, but naturally, such a measure will reduce the frequency of the usable data set to the length of the time window. For now, this high-low based quasi-volatility offers a useful picture of the changes taking place in the NYSE at the time. In particular, median daily quasi-volatility averaged 0.62 percent in the 1911-1914 (July) period, but it rose to more than 1.5 percent on average during the four years following the war (1919-1922) (Table 1). In

the earlier period, a high-volatility day—that is when the median quasi-volatility stood one standard deviation above the mean—would have still come in under one percent. In the later period, high quasi-volatility would have exceeded two percent of the closing share price.

So far, the analysis shows a clear pattern of increasing activity and volatility alongside increasing transactions costs, or illiquidity. Financial market microstructure theory suggests some factors that should help explain market illiquidity, in this case measured by quoted spreads and relative effective spreads (RES). The basic idea of the theory holds that market liquidity will relate positively with information availability (conversely, negatively with asymmetric information) in a market, since market makers will have to charge higher prices (wider spreads) when they are more concerned about trading against informed insiders. Insiders will naturally try to sell when they expect prices to soon decline, and vice versa. We can try to proxy with trading volume. Capacity constraints at specialists' stations, however, could have bogged down trading and overwhelmed back office and clearing facilities.[19] Thus, in a time series analysis, we might find that rising median trading volume actually relates to higher spreads.

Market makers also have to worry about prices moving against them when they hold inventory in a stock. So, price volatility tends to induce higher spreads, as market makers give themselves a buffer on their inventories.

[19] See Davis, Neal and White (2007) on capacity constraints at the NYSE several years later, during the great seat sale of 1928-9. They also provide a cursory overview of market microstructure models of bid-ask spreads.

Almost as a mechanical matter, proportional spreads are likely to relate negatively to share prices, and in the case of fixed commissions (minimum tick, or price increment of $1/8^{th}$ dollar), as in the NYSE at the time, low priced shares will get hit with higher proportional spreads.

Time series regressions broken down by sub-period generally confirm these theories, but do show some variation in the factors producing higher spreads over time. For example, both spread measures tend to fall when either transaction prices or median share volume rise, however, the RES actually rises with both share prices and median trading volume in the last four years of the period.

Total volume for the day has little impact on either spread measure, though seems to actually lower RES slightly in the final period. This result suggests that overall volume at the exchange was not driving the higher observed transactions costs as much as higher volume on individual shares.

Higher quasi-volatility drives higher quoted spreads in all three periods, just as expected. For RES, however, this positive relationship holds only for the period before and during the war. Afterwards, quasi-volatility relates negatively with spreads.

Notably, once these hypothesized indicators of (il)liquidity are accounted for, the trend in RES becomes insignificant and even negative in the final period. The trend in quoted spreads remains positive and significant for the first two periods but also turns negative in the final period.

Cross sectional regressions, based on individual common stock trades, paints a similar picture. Both types of spreads move opposite of prices and volumes in all sub-

periods, but more so as time wears on. The individual level sales suggest that even in the end of the period, when market makers often faced very high volumes, capacity constraints did not overwhelm them and cause higher spreads. Quasi-volatility is more strongly related to higher spreads in the individual models, and increasingly so over the three sub-periods. In fact, the quoted spread actually falls significantly with volatility in the pre-war period. As in the aggregated time series data, spreads trend positively in the pre-war period even after accounting for other hypothesized factors in illiquidity but they actually trend negatively in the post-war period.

Future work on market quality

The literature on liquidity and transactions costs suggests a number of alternative methods to more accurately depict transactions costs, and subsequent versions of this paper will present these measures. These measures require that I accurately identify and track each individual security from one week to the next, in order to create a time series for each stock. That work is underway but requires final checking.

In one of the earliest contributions to the literature on measuring "effective" bid-ask spreads, Roll (1984) argued that, in informationally efficient and stationary markets, variation in transactions prices results from the randomness of buy and sell orders (the bid-ask bounce) plus positive transaction costs. In liquid markets with low transaction costs, successive individual orders have little impact on observed transaction prices. In thin markets, price effects of individual trades may be more pronounced. If transaction costs are higher, the deviation of transaction prices from true fundamentals will not be

immediately arbitraged, even in efficient markets. Therefore, the covariance of successive price changes provides information about effective transaction costs.

Roll's effective spread arguably offers a better estimate of actual transaction costs than does the quoted spread. Yet the Roll measure—which assumes away asymmetric information costs—has well known deficiencies, such as the requirement of negative returns covariance. Many securities exhibit positive auto-correlation in transactions returns in today's markets, and such is likely also the case in historical markets of the current study. Even when the Roll measure exists, it is downward biased whenever (unobserved) securities returns are positively auto-correlated (George, Kaul, and Nimalendran, 1991).[20] Thus, George, Kaul, and Nimalendran (1991) developed a refinement of the spread estimate that corrects for positively auto-correlated securities returns.

While GKN typically underestimates true effective spreads, the analysis will also implement the estimator suggested by Lesmond, Ogden, and Trzcinka (1999). In contrast to the earlier measures, the LOT estimator measures the complete cost of a roundtrip transaction, effective bid-ask spreads plus transaction taxes and commissions, thus providing an upper bound estimate of trading costs. It is based on the idea that arbitrage will take place only outside the band of effective transaction costs around the security's true value. The estimator is a measure of the true roundtrip transaction costs and therefore encompasses not only the bid-ask spread but also commissions and

[20] Note that in Roll's own study, only a portion of his sample satisfied this negative covariance criterion.

transaction taxes. Because it provides an unbiased estimator of roundtrip transaction costs, it is particularly useful in comparing markets with changing microstructures.

While spread measures are widely used measures of market liquidity, they cannot reflect quantity reactions to changes in prices or spreads. Characterizing market liquidity in this manner requires alternative measures, such as the Amihud illiquidity measure, along the lines of Kyle's lambda. Asset pricing models have found the Amihud measure particularly useful in explaining liquidity risk. The Amihud stock illiquidity measure can be defined as the average ratio of the daily absolute return to the absolute dollar volume on that day, i.e. $Aill_t^i = \sum_{t \in T} \frac{|r_t^i|}{vol_t^i}$, where *T* defines the averaging period (either monthly or annual). The illiquidity measure can be interpreted as the daily price impact caused by the respective order flow.

IV. Conclusions

The results here demonstrate both marked changes and high variability over the teens and early twenties in the activity of the NYSE and of the behaviour of its participants. Market activity rose during the war, though the upheaval and related constraints took its toll on stock trading in the period of US engagement. Activity rebounded quickly and robustly following the Armistice. While spreads did rise considerably over time, the analysis indicates that the characteristics of the stocks traded help explain those rising prices.

Figure 1
Number of Distinct Securities Traded on the NYSE
Fridays, 1911-1922

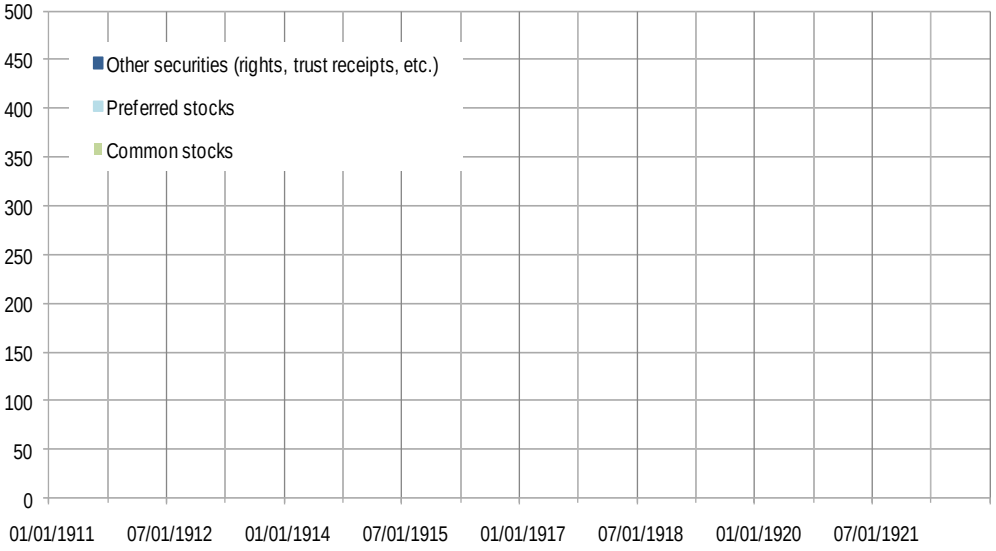


Figure 2a
Total Volume of Common Stock Shares Traded on the NYSE
Fridays, 1911-1922

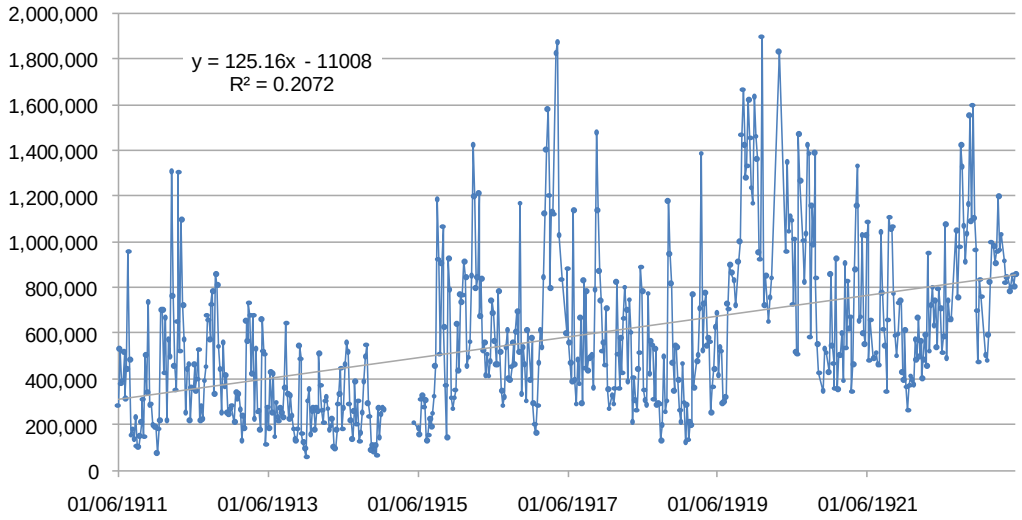


Figure 2b
Total Dollar Volume of Common Stock Shares Traded on the NYSE Fridays, 1911-1922

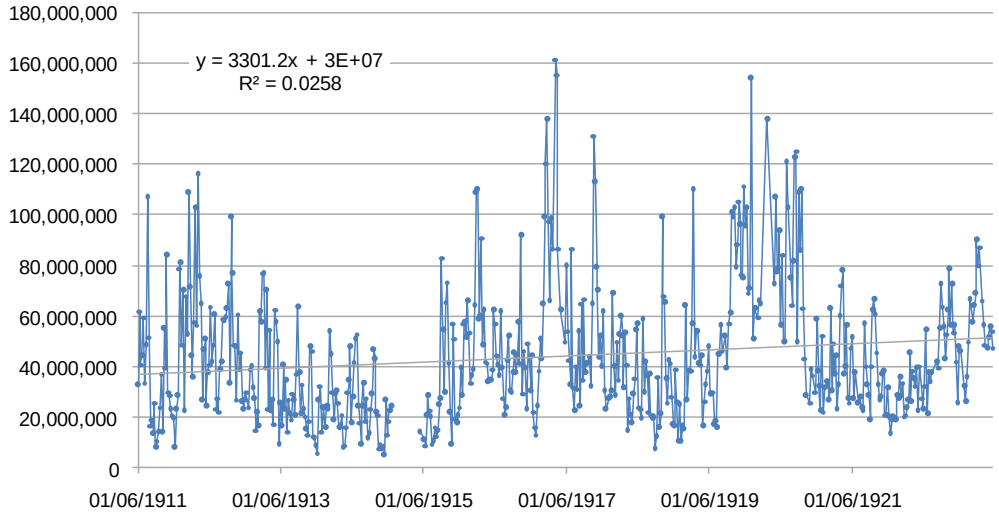


Figure 3a.
Median Relative Effective Spread of Common Stock Shares Traded on the NYSE on Fridays, 1911-1922

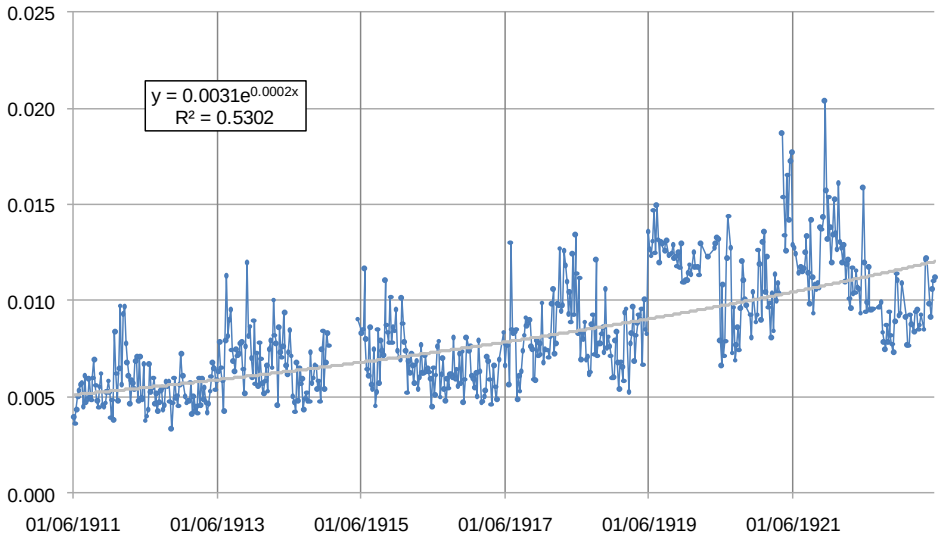


Figure 3b.
Median Percentage Bid-Ask Spread of Common Stock Shares Traded on the NYSE on Fridays, 1911-1922

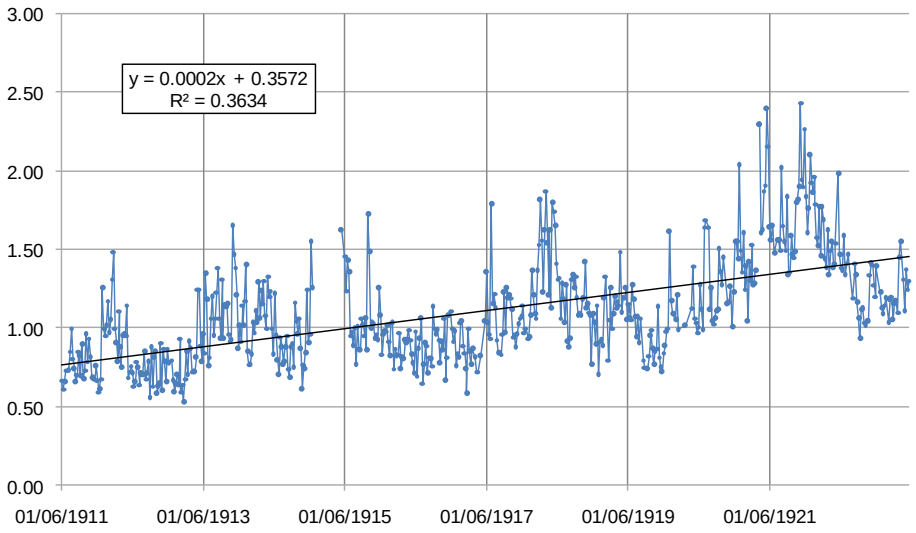
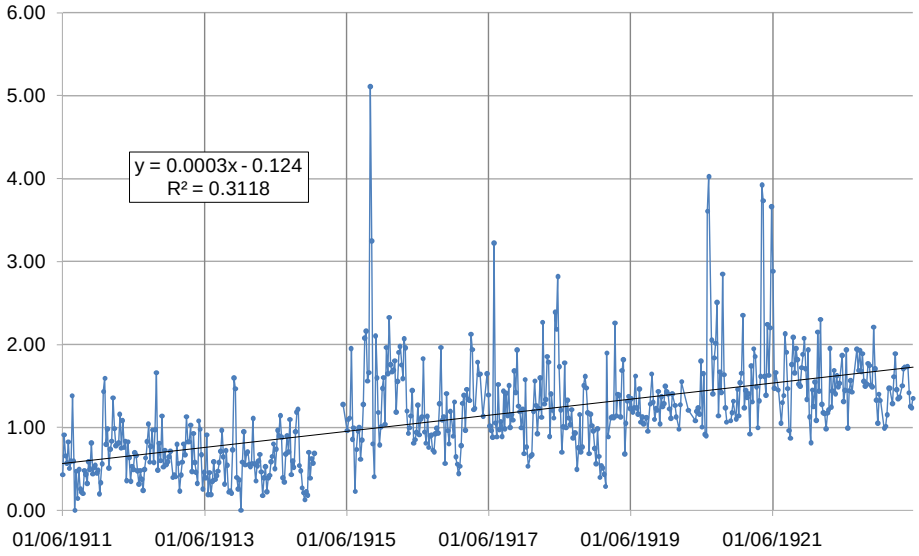


Figure 4.
Median Quasi-Volatility of Common Stock Shares Traded on the NYSE on Fridays, 1911-1922



Note: quasi-volatility is measured as the daily high minus low transaction prices of a given stock divided by that stock's closing transaction price.

Table 1. Subperiod averages

Period		Sales (number of shares)	Total dollar volume	Median RES (common)	Median spread (common, %)	Median quasi-volatility (%)
1911-14	Mean	382,026	37,629,136	0.60	0.90	0.62
	Median	308,724	30,100,000	0.57	0.87	0.57
	Std dev.	228,252	22,865,900	0.15	0.23	0.31
1919-22	Mean	868,244	54,531,319	1.13	1.35	1.53
	Median	812,727	50,250,000	1.14	1.34	1.43
	Std dev.	359,371	27,897,184	0.23	0.35	0.52

Note: RES means relative effective spread. See text for definitions.

Table 2a. Factors Associated with Median RES at the NYSE on Fridays, 1911-1922

	Period 1 1911-1914 (July)		Period 2 1915-1918		Period 3 1919-1922	
Median last price	-0.0043***	-0.0057***	-0.00925***	-0.008***	1.256***	1.601***
	-0.00325	-0.00808	(2.10e-08)	0.00	-0.0013	(3.30e-06)
Median sales (number of shares)	-0.0003***	-0.0003***	-0.000104**	-0.000157***	0.00589	0.046***
	(3.88e-05)	-0.00612	-0.0146	(3.47e-06)	-0.186	(9.59e-10)
Total dollar volume	2.61E-07	-1.68E-07	-2.06E-07	3.12E-07	-0.0001	-0.00029**
	-0.738	-0.885	-0.72	-0.48	-0.188	-0.0293
Median quasi-volatility	0.148***	0.173**	0.166***	0.182***	-0.407	-22.07***
	-0.00839	-0.0443	(2.27e-10)	0	-0.864	(9.91e-08)
Trend	0.00047*	0.0004	0.000177	-2.04E-05	-0.500**	-0.242***
	-0.0842	-0.207	-0.457	-0.903	-0.0154	(1.17e-05)
Constant	0.844***	0.919***	1.128***	1.080***	26.19	-12.88
	0	(1.25e-09)	0	0	-0.416	-0.497
Observations	182	183	192	193	185	186
R-squared	0.226		0.463		0.131	
Model type	p-w	median	p-w	median	p-w	median

Note: P-values beneath coefficients. "p-w" indicates Prais-Winston regression (implemented in Stata), while "median" indicates median regression. The latter procedure does not produce r-squared statistics.

Table 2b. Factors Associated with Median Quoted Spreads at the NYSE on Fridays, 1911-1922

	Period 1 1911-1914 (July)		Period 2 1915-1918		Period 3 1919-1922	
Median last price	-0.00988***	-0.0120***	-0.011***	-0.0097***	-0.029***	-0.024***
	(2.17e-07)	(1.12e-06)	(1.21e-08)	0	0	0
Median sales (number of shares)	-0.00045***	-0.00055***	-0.00026***	-0.00025***	-0.00015**	-0.00024***
	(2.94e-07)	(8.93e-06)	(3.90e-08)	0	-0.0124	(6.69e-05)
Total dollar volume	1.66e-06*	2.17E-06	-1.29E-07	-5.32E-07	1.73e-06*	8.89E-07
	-0.094	-0.107	-0.839	-0.191	-0.0964	-0.386
Median quasi-volatility	0.242***	0.237**	0.275***	0.281***	0.160***	0.198***
	-0.000699	-0.0157	0	0	(2.88e-06)	(1.35e-08)
Trend	0.000909**	0.00085**	0.00038	0.0004**	-0.0029***	-0.0024***
	-0.0107	-0.0285	-0.189	-0.0116	(1.87e-06)	(2.07e-07)
Constant	1.385***	1.515***	1.496***	1.418***	2.671***	2.462***
	0	0	0	0	0	0
Observations	182	183	191	192	185	186
R-squared	0.396		0.579		0.551	
Model type	p-w	qreg	p-w	qreg	p-w	qreg

Table 3. Factors Associated with Individual Relative Effective Spreads and with Percentage Quoted Spreads at the NYSE on Fridays, 1911-1922

	RES			Quoted spread (%)		
	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
Last price	-0.005	-0.004	-0.008	-0.008	-0.005	-0.010
	0.000	0.000	0.000	0.000	0.000	0.000
Sales	-0.0001	-0.0002	-0.0003	-0.0001	-0.0003	-0.0006
	0.000	0.000	0.000	0.000	0.000	0.000
Quasi-volatility	0.002	0.040	0.056	-0.010	0.053	0.066
	0.289	0.000	0.000	0.012	0.000	0.000
Year	0.009	-0.002	-0.011	0.052	-0.002	-0.025
	0.074	0.869	0.075	0.000	0.819	0.000
Constant	1.007	0.992	1.570	1.457	1.373	2.240
	0.000	0.000	0.000	0.000	0.000	0.000
Observations	17,233	15,470	44,579	17,048	15,314	44,196

Note: Periods are 1911-1914 (July); 1915-1918; 1919-1922. Equations are estimated using quantile regression.

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