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# Deflation and Reflation: The Pre-WW I Impact on NYSE Trading Volumes and Seat Prices

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***Abstract***

*The study analyzes a unique time period of sustained deflation from 1867 to 1896, followed by sustained reflation after 1896. We use these periods to test two hypotheses concerning the impact on NYSE trading volumes and seat prices. The first is the "liquidity-trading" hypothesis, which hypothesizes that liquidity trading, a component of total trading volume, is positively correlated with interest rates. The second is the price-volume relationship, which hypothesizes a positive relationship between stock prices returns and changes in trading volume. These hypotheses suggest that NYSE trading volume should fall (rise) with falling (rising) stock prices and interest rates. We find strong support for both hypotheses, and additionally show that the impact of stock market prices on trading volumes is highly asymmetrical. As well, the study argues and finds evidence that the high level of systematic risk found in the pricing of NYSE seats is another reflection of the price-volume relationship. Therefore, the study finds strong evidence of a link between deflation, reflation and market liquidity as reflected in trading volumes and the pricing of NYSE seats.*

***Keywords***

*deflation, reflation, liquidity trading, price-volume relationship, NYSE seat pricing*

## 1. Introduction

How do periods of deflation and reflation impact financial market prices and trading volumes? As Saunders (2000) discusses, there is only a limited amount of such data from which to draw conclusions. Despite this limited experience, the relevance of the topic has increased with the low inflation and potential deflation that has occurred post-subprime crisis. This study analyzes a period of sustained price deflation that occurred from 1867 to 1896, a 29-year period. After 1896, a sharp reversal occurred to price reflation (Note 1). These periods of sharp deflation and reflation allow the study to construct powerful tests of theories concerning the determinants of NYSE trading volumes and relatedly the pricing of NYSE seats. Both of these reflect aspects of the liquidity of the NYSE securities market.

The study tests two hypotheses concerning how deflation and reflation might impact trading volumes in equity markets. First, a period of deflation, and related low nominal interest rates, reduces the opportunity cost of holding cash, and in turn reduces the need for liquidity trading. Saunders (2000, p. 1070) discusses this hypothesis and presents data showing the fall in NYSE trading activity during the deflation period of the Great Depression. In turn, low trading activity increases the transaction costs of market makers, which then further reduces trading volumes. We term this the "liquidity-trading" hypothesis, i.e., that part of trading volume related to liquidity trading is positively correlated with interest rates.

Second, deflation might impact trading volume through the so-called price-volume relationship, which hypothesizes a positive relationship between stock price returns and changes in trading volume. Karpoff (1987) posed this as the "asymmetric volume-price change hypothesis", which hypothesizes that positive stock price changes will have a larger impact on trading volumes than negative stock price changes. Karpoff hypothesizes that this asymmetry results from the impact of costly short sales on trading activity, since costly short positions would reduce trading on bearish news. Karpoff (1987) presents evidence in support of the price-volume relationship in stock and bond markets, but concludes that the relationship is absent from futures markets, where the cost of short and long positions is symmetrical. Therefore, asymmetry in the cost of taking positions in the stock and bond markets leads to the asymmetric version of the price-volume relationship.

Behavioral aspects of trading can also play a role in the price-volume relationship. Griffin et al. (2007) present evidence of (1) the *participation effect* that increased awareness of rising stock prices can increase public participation in trading, (2) the *disposition effect* that traders are reluctant to sell losers in down markets, but trade more frequently in rising markets to lock in gains, and (3) the *over-confidence effect* that trading volumes increase in rising markets as traders accumulate profits from past successful trading. All three of these effects indicate that trading volumes should increase with market prices. These behavioral effects provide additional support for the asymmetric price-volume relationship, complementing the costly-short sale explanation. Statman et al. (2006) also report results in support of the overconfidence hypothesis and the disposition effect.

Griffin et al. (2007) also find that the institutional and regulatory structure of trading can impact trading volumes. The study reports that markets with less trading support (through specialists and other market makers) show reduced trading volumes, and that stock markets with weaker investor protections show a stronger price-volume relationship. Finally, markets dominated by retail investors show greater momentum trading, and thus a stronger price-volume relationship. These results suggest that we might expect a stronger price-volume relationship during the study's pre-WW I data period, due to the more primitive institutional and regulatory structure of NYSE trading at the time and the dominance of trading by retail investors.

The pricing of NYSE seats during the same pre-WW I period should also reflect the price-volume relationship. Our analysis addresses some issues similar to Davis, Neal and White (2007) and Schwert

(1977), but is unique in hypothesizing an impact of the price-volume relationship on the pricing of NYSE seats. The price-volume hypothesis applied to NYSE aggregate trading volume and the NYSE equity index also implies a corresponding level of systematic risk in the pricing of NYSE seats. NYSE seats derive value from the trading opportunities granted by seat ownership. Thus seat prices should represent the capitalized value of these trading opportunities and reflect the value placed on liquidity provision. If the price-volume relationship does not hold, aggregate trading volumes would be symmetrical in up and down markets, implying that the ownership of profits from trading volume should show little systematic risk.

Our study covers the period: 1879-1908. The study tests the "liquidity-trading" hypothesis that trading volume is positively related to call-loan rates, and tests the "price-volume hypothesis" that trading volume is positively related to the NYSE stock-price index. These two hypotheses create links between the monetary phenomena of deflation and reflation and the impact on market liquidity in terms of trading volumes and the pricing of NYSE seats. Furthermore, the study tests through a cointegration analysis whether the liquidity-trading and price-volume relationships create an equilibrium relationship. Given the long period of deflation and then reflation, the cointegration analysis allows the study to test the cumulative effects of study variables over the sample period.

Finally, while the study focuses on trading volumes and seat prices, it does not examine the direct impact of deflation and reflation on NYSE stock prices, which is likely intermediated by a firm's capital structure and how its profitability is impacted by deflation and reflation. Davis, Neal and White (2003) discuss how railroad companies were unable to repurchase their high-yield, non-callable debt as bond yields fell and bond prices rose. As well, declining agricultural and commodity prices likely pressured the profitability of mining and railroad firms listed on the NYSE. However, a study of these relationships is beyond the scope of the present study. Similar comments apply to how deflation and reflation impacted call-loan rates during this period. Saunders (2000) discusses the general impact of deflation and inflation on nominal interest rates.

The rest of the paper is organized as follows. Section II discusses the institutional structure of NYSE trading and seat ownership during our sample period. Section III describes the data set analyzed. Section IV presents univariate time-series analyses of our study variables. Then section V presents our cointegration analysis of the trading-volume variable, and tests the two hypotheses raised above concerning trading volumes. Section VI then presents a cointegration analysis of NYSE seat prices. In section VII a CAPM analysis of seat prices is presented for comparison with Davis, Neal and White (2007) and Schwert (1977). Conclusions follow in Section VIII.

## 2. NYSE Seat Ownership, Institutional Structure and Short Sale Restraints

This section explores the institutional and regulatory setting of NYSE seat ownership and trading for the 1879-1908 study period. First, NYSE seat ownership structure is examined through data compiled from Faye (1873), published by *Evening Post Steam Presses*, which lists the name, company or partnership affiliation and professional address of seat owners. Next the study relates the NYSE's floor trading to the ownership results. Finally, the regulatory and institutional structure of short selling is discussed.

*2.1 NYSE Ownership Structure*

NYSE seat-ownership structure has implications for the pricing of NYSE seats. Seat ownership represents a unique asset class, since revenues are derived from the trading activities of brokers and market makers on the NYSE floor. If NYSE ownership was held largely by floor brokers and market makers, whose fortunes were tied closely through commissions and spreads to trading volumes, then seat prices would reflect those factors affecting trading volumes. However, if NYSE seats were held by large, broadly-diversified financial firms, non-systematic trading risks could be diversified away (Note 2). For example, the impact of deflation and reflation on trading profitability might be diversifiable, perhaps through asset classes such as bonds that might be positively impacted by deflation (Note 3).

Figure 1 graphs the frequency distribution of NYSE seat ownership by type of owner affiliation.

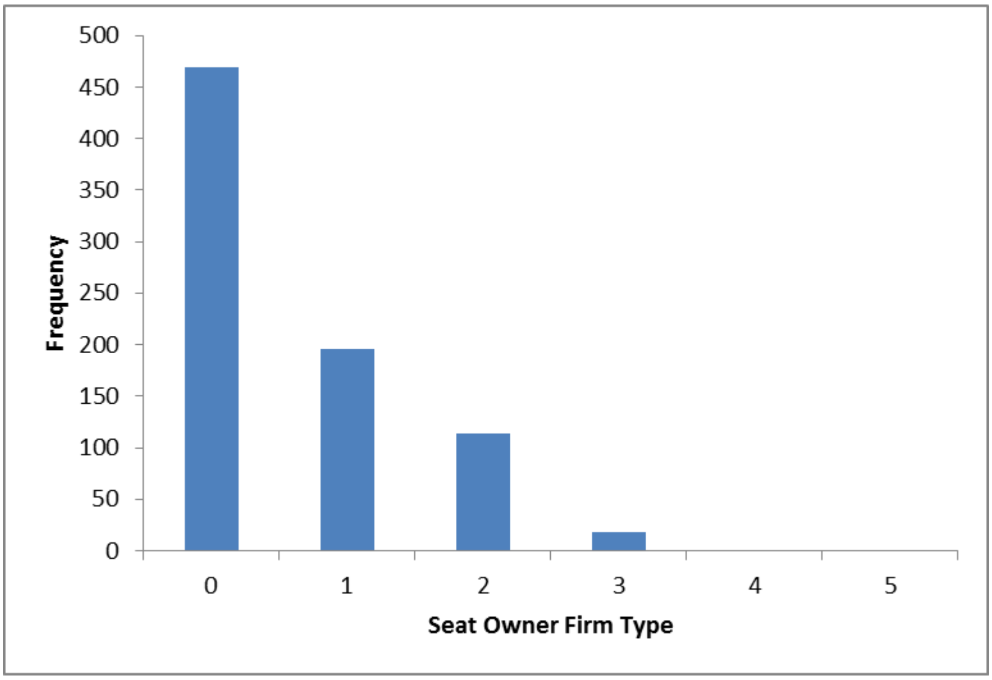


**Figure 1. Frequency Histogram of Firm Types of NYSE Seat Owners**

The data presented in Figure 1 is compiled from Faye (1873), published by *Evening Post Steam Presses*, which lists the name, company or partnership affiliation and professional address of seat owners. Shown in the figure is the number of seatholders affiliated within a common corporate or partnership affiliation.

Note that in 1869 there were 1,060 NYSE seats that resulted from the merger of three exchanges. In addition, in 1879 40 new seats were sold at $13,000 each to finance construction of a new building for the NYSE. However, the total number in our database portrayed above is 799 seats. As suggested by

Davis, Neal and White (2007), seats owned by out-of-town and foreign traders reduced the number of active traders on the NYSE floor. 99.08 percent of the firms in our database were located near the NYSE in lower Manhattan. As well, according to Davis, Neal and White (2007), on any given day the number of active brokers on the floor of the exchange "was estimated to be approximately 970 city members less 150 inactive seats".

In Figure 1, "0" gives seats held without a listed corporate or partnership affiliation, while "1" ("2", "3", "4" and "5") represents 1 (2, 3, 4, 5) seat owner(s) affiliated within one Wall Street firm. 469 of the 799 seats (58.7 percent) were listed as unaffiliated, while 196 (114, 18, 1 and 1, respectively) of seat owners were affiliated together within one Wall Street firm. Thus, the majority of seat-holders were un-affiliated, and might represent "independent" and/or "2-dollar" brokers, who executed trades for other brokerage houses and seat-holders, respectively. 196 of 799 seats (24.5 percent) were single seat-owner firms. 114 of 799 seats (14.3 percent) were firms with two seat holders affiliated within a firm (Note 4). The data indicates little evidence of institutional concentration of NYSE seat ownership (Note 5). The conclusion is that seat holder interests were tied closely to their trading activities on the NYSE floor.

The small size of NYSE firms during our sample period may have nonetheless provided valuable functions. The NYSE's overnight settlement process was complex and labor intensive (McSherry & Wilson, 2013) and might have required one seat owner's time to deal with over certification and other aspects of trade settlement that could not be done by clerks employed by a commission house. A second seat owner's time might be required to deal with retail customers, managing customer orders and over-seeing security deposits (Note 6). Finally, an additional seat owner might specialize in the floor execution of trades. Therefore, the optimal size of a firm specializing in a retail business might have been two or three seat owners. In contrast, unaffiliated and single-seat owner firms might specialize in speculative trading (termed stock jobbers) or providing trading services.

The relatively simple structure of NYSE ownership lends support to the conclusion that trading during our study period was relatively primitive, dominated by retail investors, was less regulated and with limited market-maker support. Davis, Neal and White (2003) observe that NYSE commission houses used branch networks to collect retail security orders from across the United States and internationally. As well, mutual funds (as institutional investors) were largely absent during the study period (Note 7). Finally, there was some trading regulation set by the NYSE and by state regulation, but federal regulation was absent. As Griffin et al. (2007) show, we might expect to find a stronger price-volume relationship under these conditions.

### *2.2 NYSE Trading and Institutional Structure*

Michie (1986) and Meeker (1922) describe the floor-trading specializations among NYSE members. Mitchie (1986, p. 183) states that "As early as 1865" stockjobbers had appeared who traded on their own account. Meeker (1922, p. 47) further divides stockjobbers into odd-lot dealers, floor traders and specialists, and describes $2 brokers as members who assisted commission houses in executing their orders, particularly in heavy markets (Note 8) (Note 9):

Under the NYSE's commission law, commissions were fixed at 1/8 of one percent of a security's par value. Mitchie (1986) cites that "The commission law is the fundamental principle of the Exchange, and on its strict observance hangs the financial welfare of all the members and the life of the Institution itself". Therefore, for independent brokers and $2 brokers trading volume was critical to their profitability as seat-holders, while the profitability of floor traders and other stockjobbers would depend both on volume and the spreads they were able to realize. The NYSE's commission law reinforces the importance of trading volumes to the profitability of seat owners.

*2.3 Short Sales*

According to McGavin (2010), the New York state legislature banned short selling in 1792, which was circumvented within a few weeks by the Buttonwood Agreement. Jones (2008) and Meeker (1975, p. 114, p. 237) cite that the New York state legislature again banned short sales in 1812, but repealed the ban in 1858. Meeker (1975, p. 115) notes that after the 1907 Panic, the Hughes Commission of 1909 and the Pujo Investigation of 1912-1913 refused to recommend a ban on short sales. Then in 1917 the NYSE required all brokers to confidentially identify short sellers, due to fears of market disruption during WW I (Meeker, 1975, p. 122). Federal regulation of short selling began with creation of the SEC under the Securities and Exchange Act of 1934. The SEC instituted the uptick rule in 1938, and naked short selling was banned in 2005.

Therefore, for our sample period there was no outright ban on short sales at the NYSE. In terms of institutional structure, Meeker (1922) discusses the existence of a "loan crowd" on the exchange floor, where brokers seeking to lend or borrow shares met. To affect a short sale, the broker with the short interest would borrow the shares within the loan crowd, and would in turn make a loan to the lending broker equivalent to that day's market value of the shares shorted. The loan came due when the short was covered. The cost to the client of shorting was the sales commissions for selling, and then covering, the shorted stock, plus any dividends paid by the stock while shorted. This process of short selling appears to have been well organized within the exchange.

## 3. Results

*3.1 Data*

Our sample period starts January 1879, when the NYSE trading-volume series begins, and ends December 1908 to capture the impact of the 1907 Panic. This data period is divided into two sub-periods: (1) 1979-1896, a period of general price deflation, and (2) 1897-1908, when prices showed reflation due to new gold discoveries.

Our monthly data includes five series, namely:

1) Index of The General Price Level for the United States obtained from FRED (Federal Reserve Economic Data) (series M04051USM324NNBR),

2) Median call-loan rates compiled from weekly data taken from *The Commercial and Financial*

*Chronicle*,

3) NYSE Stock Index taken from Goetzmann, Ibbotson and Peng (2001),

4) NYSE trading volume compiled from *NYSE Total Sales*: 1879-1934 (NYSE Archives),

5) NYSE seat prices compiled from the NYSE Committee on Admissions' *Transfers of Membership: Volumes 1 (1869-1905) and 2 (1905-1934)*. NYSE seats began trading in October 1868, when memberships first became saleable (Note 10) (Note 11) (Note 12).

Figures 2-6 present graphs of our principal study variables, with each series natural log (Ln) transformed. The time period covered in each figure is 1879-1908.

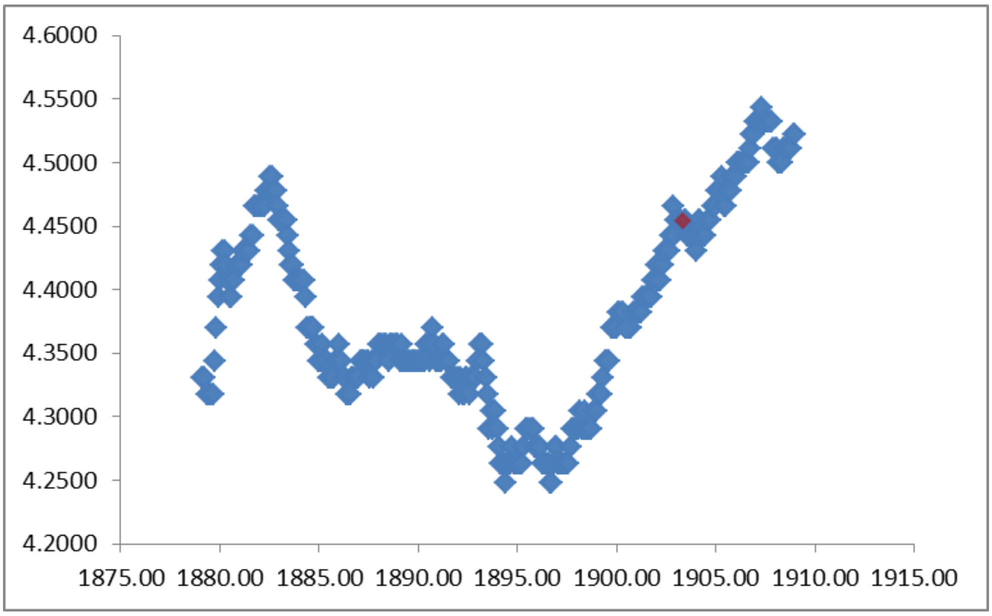


**Figure 2. Ln of U.S. General Price Index: 1879-1908**

*Note*: The historical price data is taken from http://www.research.stlouisfed.org/fred2 and from http://www.nber.org/databases/macrohistory/contents/chapter04.html

Friedman and Schwartz (1963) conclude that a period of sustained deflation lasted approximately over the period: 1867-1897. We term this period as the "Great Deflation period". A period of reflation then follows.

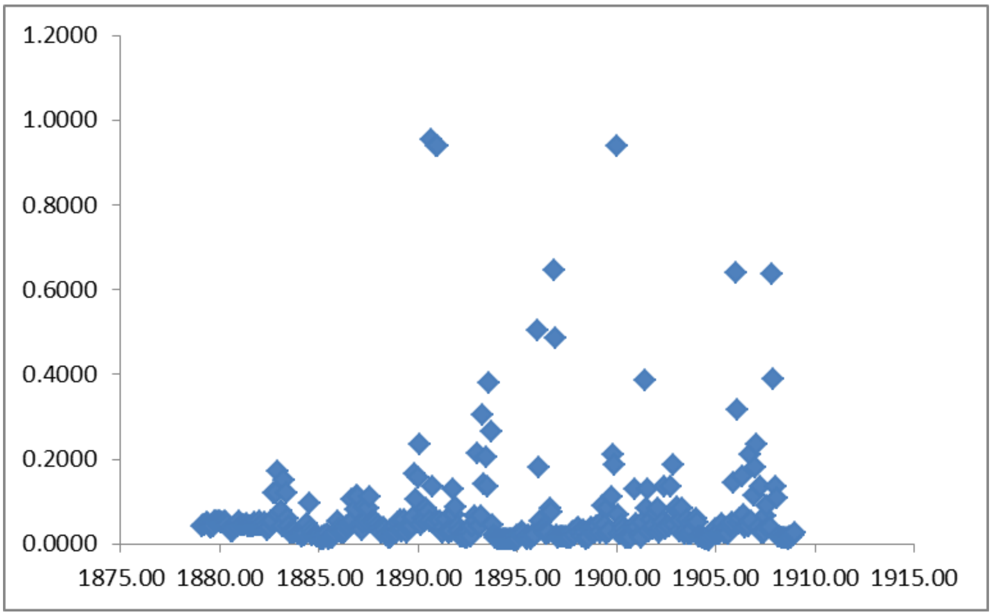


**Figure 3. Median Call Loan Rates: 1879-1908**

Figure 3 plots median call loan rates over the sample period. Call loan rates were compiled from weekly data taken from *The Commercial and Financial Chronicle*. Graphed here is the median of the weekly rates observed for that month.

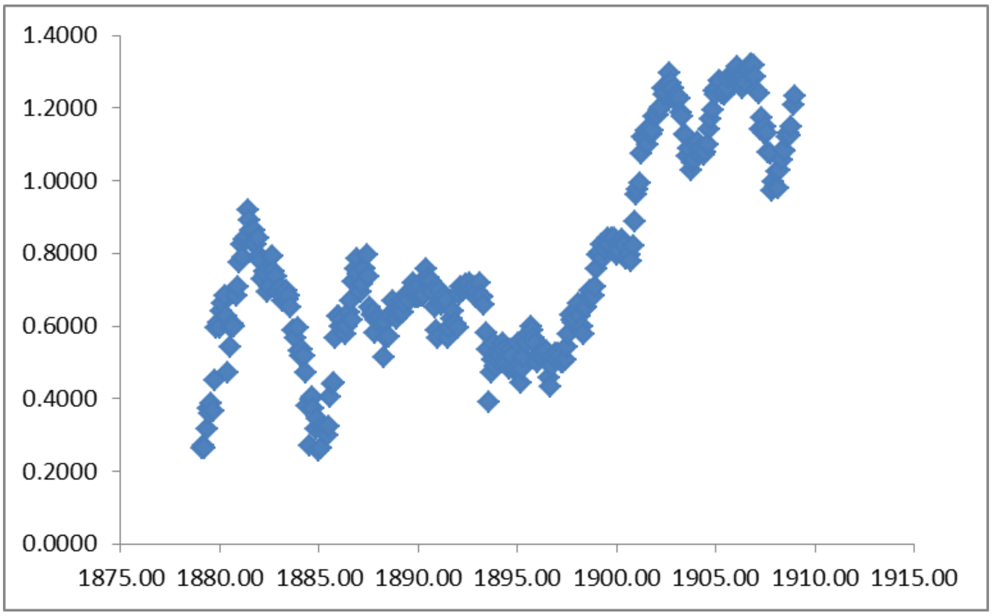


**Figure 4. Ln of NYSE Stock Market Index: 1878-1909**

Figure 4 depicts an index of the valuation of all NYSE equity shares for the period: 1878-1909. The index data is from Goetzmann, Ibbotson and Peng (2001).

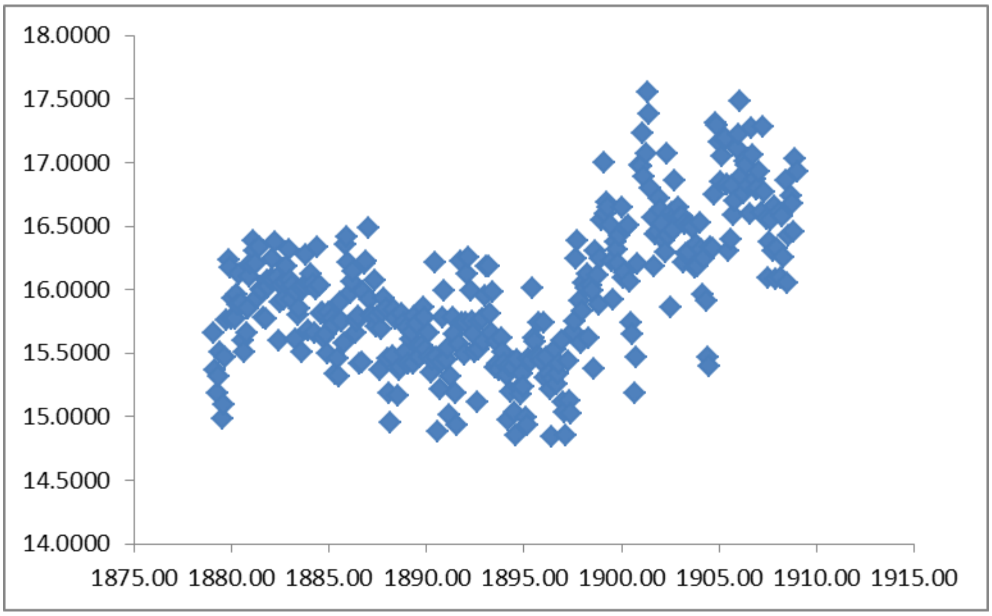


**Figure 5. Ln of Monthly NYSE Stock Trading Volume: 1879-1908**

Figure 5 depicts monthly aggregate trading volume for the years 1879 through 1908. A period of declining trading activity from roughly 1882 through 1896 appears to reflect the impact of deflation on both NYSE stock prices (Figure 4) and trading volumes. This may reflect the so-called "price volume relationship" from the market microstructure literature. The data on trading volumes is compiled from the volume: Total Sales; Stocks, Gov't, State, & R. R. Bonds; New York Stock Exchange (Source: NYSE Archives).

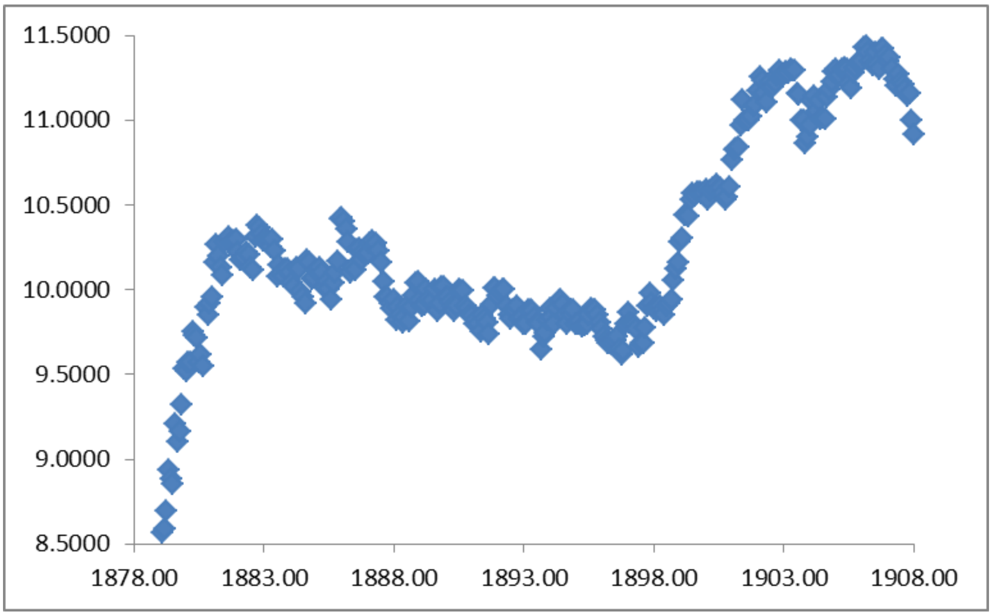


**Figure 6. Ln of NYSE Seat Prices Averaged Monthly: 1876-1908**

Figure 6 depicts the mean monthly value of NYSE memberships (seats) for the period 1876-1908. Note that after an initial rise, a declining trend in seat prices may reflect the impact of deflation. In the late 1890s, seat prices rose dramatically as market valuations recovered and trading volumes grew rapidly. For some months no seat sales were recorded, and one-month lagged values were substituted to maintain continuity of the data. The data is compiled from the NYSE Committee on Admissions: Transfers of Membership; Volume 1 (1869-1905) and Volume 2 (1905-1934).

Figure 2 shows a long period of fairly sustained price deflation through 1896, followed by a sharp reversal to price reflation through 1908. The period of reflation appears steeper and with less volatility. Friedman and Schwartz (F&S, 1963, p. 32) credit the deflation to the spread of agricultural and mining as the West closed, along with the stringency of the gold standard at the time, and credit the reflation to new gold discoveries and improved gold mining and refining technologies.

Figure 3 shows the time series of monthly call-loan rates. Call-loan rates spike during the various panics of the study period. Figures 4 and 5 suggest that NYSE stock prices and trading volumes showed somewhat similar overall trends to the deflation and reflation trends in Figure 2 (Note 13). A low monthly total trading volume of a mere 2,795,846 shares occurred May 1896 during the deflation period, while high monthly trading volumes of 14,403,784 shares occurred earlier (December, 1886) during the deflation period, and 42,138,208 shares (April, 1901) during the reflation period. The NYSE stock price index peaked in May 1881 at a level that would not be reached again until December 1900; thus spanning just over 19 years. The stock-price index reached lows in December 1884 and again July 1893. Overall, the stock-index and trading-volume series showed an overall downward trend during the deflation period, and then moved sharply higher with reflation.

Finally, in Figure 6 seat prices peaked in the early 1880s and then showed a declining trend until the monetary expansion of the late 1890s. As noted above NYSE seats began trading in October 1868. The peak seat price was $33,667 (12/1885) during the deflation period, and then reached a low seat price of $15,000 in September 1896. Finally, during the reflation period seat prices reached a high of $93,000 in February 1906, the highest ever seat price of our sample period.

*3.2 Single-Series Time Series Analysis and Sample Statistics*

Table 1 presents Box-Jenkins analyses of the Ln transformed series of the study. Results are presented separately for the deflation (1879-1896) and reflation (1897-1908) periods. We make the following observations:

1) Most series show unit roots, including the price-level (Ln Price Level), stock-index (Ln Stk Index) and seat-price (Ln Seat price) series. The two exceptions are the call-loan rate (Ln call-loan rate) and the trading-volume (Ln Trade Vol) series, both of which show significant AR 1 terms ($p = 0.000$) in both periods.

2) Several series show significant autoregressive (AR) and/or moving average (MA) terms, which imply some level of predictability to these series. Ln Price Level shows a significant MA 2 component during the deflation period ($p = 0.003$) and a significant MA 10 term for the reflation period ($p = 0.007$),

along with its significant unit root (Note 14). The Ln Trade Volume series shows significant MA components during the deflation period, along with the significant AR 1 term. The Ln Stk Index also shows a significant AR 2 term during the reflation period, along with its unit root.

**Table 1. Single-Series Time-Series Analyses**

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | **Reflation = 0** | | | |
| | **Identified** | **Stationary** | | **ARIMA model Parameters** | | |
| **Series** | **Model** | **$R^2$%** | **$R^2$%** | | **Estimate (S.E.)** | **p-value** |
| Ln Price Level: | ARIMA (0, 1, 2) | 97.7 | 3.9 | MA 2: | -0.201 (0.068) | 0.003 |
| Ln Call Loan Rate: | ARIMA (1, 0, 0) | 79.1 | 79.1 | Constant: | -5.556 (0.136) | 0.000 |
| | | | | AR 1: | 0.777 (0.047) | 0.000 |
| Ln Stk Index: | ARIMA (0, 1, 0) | 90.3 | 17.8 | | | |
| Ln Trade Vol: | ARIMA (1, 0, 3) | 46.4 | 46.4 | Constant: | 15.638 (0.119) | 0.000 |
| | | | | AR 1: | 0.969 (0.030) | 0.000 |
| | | | | MA 1: | 0.347 (0.076) | 0.000 |
| | | | | MA 2: | 0.273 (0.075) | 0.000 |
| | | | | MA 3: | 0.157 (0.073) | 0.032 |
| Ln Seat Price: | ARIMA (0, 1, 0) | 93.6 | 26.1 | | | |
| | | | **Reflation = 1** | | | |
| | **Identified** | **Stationary** | | **ARIMA model Parameters** | | |
| **Series** | **Model** | **$R^2$%** | **$R^2$%** | | **Estimate (S.E.)** | **p-value** |
| Ln Price Level: | ARIMA (0, 1, 10) | 99.4 | 38.1 | Constant: | 0.002 (0.0004) | 0.000 |
| | | | | MA 10: | 0.247 (0.090) | 0.007 |
| Ln Call Loan Rate: | ARIMA (1, 0, 0) | 43.7 | 43.7 | Constant: | -5.723 (0.152) | 0.000 |
| | | | | AR 1: | 0.626 (0.066) | 0.000 |
| Ln Stk Index: | ARIMA (2, 1, 0) | 98.4 | 9.0 | AR 2: | 0.337 (0.080) | 0.000 |
| Ln Trade Vol: | ARIMA (1, 0, 0) | 54.2 | 54.2 | Constant: | 16.411 (0.123) | 0.000 |
| | | | | AR 1: | 0.772 (0.053) | 0.000 |
| Ln Seat Price: | ARIMA (0, 1, 0) | 98.3 | 0.0 | Constant: | 0.010 (0.006) | 0.065 |

*Note*: Univariate time-series results are given for the first difference of the natural log (Ln) of:

(1) Index of The General Price Level for United States (Price Level),

(2) Call loan rate (Call Loan Rate),

(3) NYSE Stock Index (Stk Index),

(4) NYSE Trading Volume (Trade Vol),

(5) NYSE seat prices (Seat Price),

Details concerning these variables are given in the text.

These results suggest that to produce stationary series in a uniform way, all series will be first differenced in much of the remaining analyses of the study.

Table 2 presents summary statistics for the 1st differenced (Ln transformed) series, again split between the deflation (1879-1896) and reflation (1897-1908) periods. The table lists the average monthly percentage changes as (1) -.0251% and 0.1702% for the general price series, (2) -.3224% and 0.2211% for the call-loan rate series, (3) 0.1137% and 0.5040% for the NYSE stock-index series, (4) -.2534% and 1.2575% for the NYSE trading-volume series, and (5) 0.6043% and 0.9849% for NYSE seat prices, for the deflation and reflation periods respectively. The seat-price result for the deflation period may seem anomalously high, but recall that seat sales only came into existence October 1868, and perhaps at a below-market price.

**Table 2. Summary Statistics (Monthly) for 1st Differences of Ln of Study Variables**

| | **Deflation Period** | | **Reflation Period** | |
|---|---|---|---|---|
| | Mean (%) | Std. (%) | Mean (%) | Std. (%) |
| D Ln Price Level: | -0.0251 | 0.9048 | 0.1702 | 0.7727 |
| D Call Loan: | -0.3224 | 69.5935 | 0.2211 | 79.7104 |
| D Ln Stk Index: | 0.1137 | 4.5499 | 0.5040 | 3.0607 |
| D Ln Trade Vol: | 0.2534 | 29.438 | 1.2575 | 36.2589 |
| D Ln Seat Price: | 0.6043 | 7.9431 | 0.9849 | 6.6595 |

**Selected Correlations Among 1st Differenced Ln Study Variables**

| | **Deflation Period** | | | | **Reflation Period** | | | |
|---|---|---|---|---|---|---|---|---|
| | **-1** | **0** | **+1** | **S.E.** | **-1** | **0** | **+1** | **S.E.** |
| **D Ln Trade Vol With:** | | | | | | | | |
| D Ln Price Level: | 0.004 | 0.123 | 0.028 | 0.068 | 0.009 | 0.166* | 0.104 | 0.084 |
| D Ln Call Loan: | -.057 | 0.182* | 0.034 | 0.068 | -.135 | 0.318* | 0.077 | 0.084 |
| D Ln Stk Index: | 0.042 | 0.196* | -.006 | 0.068 | 0.201* | 0.213* | 0.115 | 0.084 |
| **D Ln Seat Price With:** | | | | | | | | |
| D Ln Price Level: | 0.279* | 0.140* | 0.159* | 0.068 | 0.302* | 0.217* | 0.061 | 0.084 |
| D Ln Call Loan: | -.037 | 0.024 | -.003 | 0.068 | 0.047 | 0.164* | -.110 | 0.084 |
| D Ln Trade Vol: | 0.157* | 0.025 | -.037 | 0.068 | 0.424* | 0.099 | -.186 | 0.084 |
| D Ln Stk Index: | 0.459* | 0.084 | -.049 | 0.068 | 0.561* | 0.162 | 0.099 | 0.084 |

*Note*: Means and standard deviation (Std.) of percentage change (first difference of log transformed) are listed for each study variable. Also listed are selected correlations involving the key study variables: NYSE trading volumes (Trade Vol) and NYSE seat prices (Seat Price).

Note that reflation lifted monthly average stock-index returns from 0.1137% to 0.5040%, but lifted average trading volumes from -.2534% to 1.2575% for the reflation period, suggesting that the return to reflation had a much stronger impact on trading volumes than on the equity index. The next section will show that this result is in part due to the asymmetric version of the price-volume relationship. Also, note that after trading volumes, seat prices show the second highest growth rate in the reflation period, while call loan rates and then trading volumes show the largest percentage declines during the deflation period. Finally, the call loan and then trading-volume series show the highest volatilities in both periods, while the price-level, stock-index and seat-price series show the lowest volatilities.

Table 2 also lists selected lag (-1), current (0) and lead (+1) correlations among study variables, with a focus on trading volumes and seat prices, the principal dependent variables of our analysis. The seat-price series shows positive correlations with the lag, current and lead general price-level series in the deflation period, and positive correlations with the lag and current general price level in the reflation period, giving some evidence that seat prices anticipated deflation. In both periods, seat prices show significant positive correlations with lagged stock-index and lagged trading-volume series. Finally, the trading-volume series shows (1) a positive current correlation with the call-loan rate in both periods, (2) a positive current correlation with the general price-level series in the reflation period, and (3) a positive correlation with current stock-index series in the reflation period, and a positive correlation with lag stock-index series in the reflation period.

*3.3 Cointegration Results for NYSE Trading Volume*

This section presents cointegration results to test for an equilibrium relationship of NYSE trading volume with general price level, call loan rates, NYSE stock-index values, and NYSE stock-index volatility, which is derived from a GARCH (1,1) model. All variables, except the volatility variable, have been natural log (Ln) transformed. The results will allow the analysis to test two hypotheses. First, the “liquidity-trading” hypothesis that trading-volume changes are positively correlated with changes in call-loan rates. Second, the “asymmetric volume-price change” hypothesis that stock-price increases have a larger impact on trading volumes than stock-price declines. Cointegration allows the study to test whether a stable equilibrium exists among these study variables, and to test the cumulative effects of the study variables on trading volumes.

The cointegration test is whether the residuals from the equilibrium regression are stationary, i.e., that the residual series does not random walk away from the equilibrium relationship. The residuals are then incorporated into the Error Correction Model (ECM), where the monthly percentage change of NYSE trading volume is regressed on the monthly percentage change of: (1) price level, (2) call-loan rate, (3) NYSE stock-price index, and (4) the NYSE stock-price index volatility.

**Table 3. Analysis of NYSE Trading Volume**

**Reflation = 0**

**Equilibrium Regression: Dependent Variable = Ln Trade Vol, $R^2$ = 37.9%**

| Series | Beta | S.E. | t-value | p-value |
|---|---|---|---|---|
| Constant | 15.709 | 0.211 | 74.612 | 0.000 |
| Ln Price Level_O | 2.909 | 0.393 | 7.392 | 0.000 |
| Ln Call Price | 0.076 | 0.023 | 3.277 | 0.001 |
| Ln Stk Index | 0.344 | 0.169 | 2.036 | 0.043 |
| Stk Index Vol | 2.529 | 1.229 | 2.058 | 0.041 |

**Cointegration Test:**

| | Identified | Stationary | | ARIMA model Parameters | | |
|---|---|---|---|---|---|---|
| Series | Model | $R^2$% | $R^2$% | | Estimate (S.E.) | p-value |
| Res 1: | ARIMA (1, 0, 0) | 22.2 | 22.2 | AR 1: | 0.471 (0.060) | 0.000 |

**ECM Results: Y Variable = 1st Diff. of Ln Trade Vol, $R^2$ = 28.1%**

| Series | Beta | S.E. | t-value | p-value |
|---|---|---|---|---|
| Constant | -.057 | 0.046 | -1.224 | 0.222 |
| DLnPrice_O | 2.320 | 2.117 | 1.096 | 0.274 |
| DLnCall | 0.121 | 0.036 | 3.376 | 0.001 |
| DMktVol | 1.409 | 3.146 | 0.448 | 0.655 |
| Dn_DLnIndex | -1.981 | 0.738 | -2.685 | 0.008 |
| Dn_DLnIndex_1 | 2.188 | 1.260 | 1.737 | 0.084 |
| Up_DLnIndex | 4.347 | 0.719 | 6.041 | 0.000 |
| Up_DLnIndex_1 | -.880 | 1.195 | -.736 | 0.462 |
| LagDRes_1 | -.220 | 0.066 | -3.322 | 0.001 |
| LagDRes_2 | -.250 | 0.063 | -3.972 | 0.000 |

**Reflation = 1**

**Equilibrium Regression: Dependent Variable = Ln Trade Vol, $R^2$ = 52.7%**

| Series | Beta | S.E. | t-value | p-value |
|---|---|---|---|---|
| Constant | 15.197 | 0.482 | 31.552 | 0.000 |
| Ln Price Level_O | -1.380 | 0.814 | -1.694 | 0.092 |
| Ln Call Loan | 0.118 | 0.814 | 2.984 | 0.003 |
| Ln Stk Index | 1.647 | 0.262 | 6.290 | 0.000 |
| Stk Index Vol | 2.674 | 1.826 | 1.465 | 0.145 |

**Cointegration Test:**

| | Identified | Stationary | | ARIMA model Parameters | | |
|---|---|---|---|---|---|---|
| Series | Model | $R^2$% | $R^2$% | | Estimate (S.E.) | p-value |

| | | | | | | |
|---|---|---|---|---|---|---|
| Res 1: | ARIMA (1, 0, 0) | 29.9 | 29.9 | AR 1: | 0.555 (0.070) | 0.000 |

| **ECM Results: Y Variable = 1st Diff. of Ln Trade Vol, $R^2$ = 41.0%** | | | | |
|---|---|---|---|---|
| **Series** | **Beta** | **S.E.** | **t-value** | **p-value** |
| Constant | -.083 | 0.062 | -1.324 | 0.188 |
| DLnPrice | 2.383 | 2.492 | 0.956 | 0.341 |
| DLnCall | 0.178 | 0.062 | 2.860 | 0.005 |
| DMktVol | 6.294 | 3.722 | 1.691 | 0.093 |
| Dn_DLnIndex | -3.494 | 1.515 | -2.306 | 0.023 |
| Dn_DLnIndex_1 | 6.022 | 2.606 | 2.311 | 0.022 |
| Up_DLnIndex | 9.397 | 1.472 | 6.385 | 0.000 |
| Up_DLnIndex_1 | -1.363 | 2.262 | -.603 | 0.548 |
| LagDRes_1 | -.390 | 0.082 | -4.723 | 0.000 |
| LagDRes_2 | -.228 | 0.076 | -2.982 | 0.003 |

The "equilibrium regression" tests whether there is an equilibrium relationship between the (natural log of) NYSE trading volume (as dependent variable) and the (natural log of) price level, call-loan rate, NYSE stock index and NYSE stock-index volatility. The cointegration test is then a test whether the residuals from the equilibrium regression are stationary, i.e., the residual does not display a unit root. Finally, the Error Correction Model (ECM) estimates the adjustment process as the trading-volume series is shocked away from the equilibrium relationship.

The upper panel of Table 3 gives results for the deflation period. With the Ln Trading Volume equilibrium relationship, Ln Stk Index is significant in both periods (p = 0.043 and p = 0.000, respectively), in support of the price-volume hypothesis. As well, the Ln Call Loan variable is highly significant in both periods (p = 0.001 and p = 0.003, respectively), which supports the "liquidity-trading" hypothesis. The Stk Index Vol variable is marginally significant in the deflation period. The Ln Price Level_O variable is the general price index orthogonalized to both the call-loan rate and stock-index variables to focus the analysis on the study's two primary hypotheses. It is highly significant in the deflation period but insignificant in the reflation period.

The cointegration test results are listed next in Table 3. The results indicate that the equilibrium-regression residuals are auto-regressive with parameter estimates of 0.471 and 0.555, respectively for the two periods. These results indicate mean reversion to the equilibrium relationship.

Error Correction Model (ECM) results are presented next in each panel. These regressions explore the dynamic relationship between NYSE trading volumes and the study's independent variables. The ECM regressions involve the first differences of the (Ln transformed) study series. As well, for a specific test of the asymmetric version of the price-volume relationship, the differenced log stock-price index (DLnIndex) variable is divided between down and up stock-index movements, denoted as

Dn_DLnIndex and Up_DLnIndex, respectively.

The ECM results can be summarized as follows:

1) The impact of changes in call loan rates (DLnCall) is highly significant, with beta estimates of 0.121 ($p = 0.001$) and 0.178 ($p = 0.005$), respectively for each period. Thus, increasing (decreasing) call loan rates are associated with increasing (decreasing) trading volumes. These results strongly support the "liquidity-trading" hypothesis.

2) The ECM results also provide strong evidence of an asymmetric impact of percentage NYSE stock-index changes (DLnIndex) on percentage changes in NYSE trading volumes. Down (up) movements show betas of -1.981 (4.347) and -3.494 (9.397) for the deflation and reflation periods, respectively. Thus, the up beta is more than twice the down beta in absolute value. These results give strong support to the asymmetric version of the price-volume relationship. Also note that the up betas for DLnIndex are much more highly significant than the down betas. Finally, there is also some significant evidence of a lag relationship (Note 15).

3) The first lag (LagDRes_1) and second lag (LagDRes_2) of the first differenced residuals from the equilibrium regression are highly significant and with negative beta estimates. These results imply a strong mean-reversion of trading-volume changes to the equilibrium relationship.

4) Finally, the two variables: (1) change in Ln price level (DLnPrice_O), and (2) change in Ln market volatility (DMktVol) are not significant in either period.

Therefore, the results of this section show a strong equilibrium relationship between trading volumes, and (1) call loan rates, and (2) NYSE stock-index values. The ECM results are consistent in showing a strong relationship between changes in call loan rates and changes in the stock index with changes in trading volumes. The results provide strong support for the "liquidity-trading" hypothesis and the "asymmetric volume-price change" hypothesis.

### *3.4 Cointegration Results for NYSE Seat Prices*

The cointegration tests of the previous section are repeated here with NYSE seat prices. One primary interest in this case is a further test of the price-volume relationship. Seat ownership confers the right to participate in trading on the floor of the NYSE, and trading volumes are a significant component of the profitability of this activity (Note 16). In addition, a significant price-volume relationship would be expected to give rise to systematic risk in the pricing of NYSE seats. The price-volume relationship would imply that aggregate trading volumes rise and fall with the stock-market index on average. In contrast, if the price-volume relationship is not significant, we would expect seat prices to show low or no systematic risk, since trading profitability would on average be equal in up and down equity markets. In addition, the study tests whether the asymmetric version of the price-volume relationship continues to hold with seat prices.

**Table 4. Analysis of NYSE Seat Prices**

| | | | | | |
|---|---|---|---|---|---|
| **Reflation = 0** | | | | | |
| **Equilibrium Regression: Dependent Variable = Ln Seat Price, $R^2$ = 93.6%** | | | | | |
| **Series** | **Beta** | **S.E.** | **t-value** | **p-value** | |
| Constant | 0.451 | 0.307 | 1.471 | 0.143 | |
| Ln Seat_1 | 0.873 | 0.020 | 43.737 | 0.000 | |
| Ln Price Level_O | 0.050 | 0.114 | 0.443 | 0.658 | |
| Ln Call Loan | -.008 | 0.006 | -1.308 | 0.192 | |
| Ln Trade Vol | 0.043 | 0.018 | 2.385 | 0.018 | |
| Ln Stk Index | 0.082 | 0.047 | 1.752 | 0.081 | |
| MktVol | 0.494 | 0.319 | 1.547 | 0.123 | |
| **Cointegration Test:** | | | | | |
| | **Identified** | **Stationary** | | **ARIMA model Parameters** | |
| **Series** | **Model** | **$R^2$%** | **$R^2$ %** | **Estimate (S.E.)** | **p-value** |
| Res 2: | ARIMA (0, 0, 0) | 0.0 | 0.0 | | |
| **ECM Results: Y Variable = 1st Difference of Ln Seat Price, $R^2$ = 27.4%** | | | | | |
| **Series** | **Beta** | **S.E.** | **t-value** | **p-value** | |
| Constant | -.004 | 0.009 | -.443 | 0.658 | |
| DLnPriceO | 0.319 | 0.586 | 0.544 | 0.587 | |
| DLnPriceO_1 | 1.445 | 0.568 | 2.546 | 0.012 | |
| DLnCall | 0.011 | 0.010 | 1.154 | 0.250 | |
| DLnCall_1 | 0.022 | 0.010 | 2.070 | 0.040 | |
| Dn_DLnIndex | 0.144 | 0.202 | 0.715 | 0.476 | |
| Dn_DLnIndex_1 | 0.370 | 0.207 | 1.784 | 0.076 | |
| Up_DLnIndex | -.034 | 0.210 | -.160 | 0.873 | |
| Up_DLnIndex_1 | 1.001 | 0.207 | 4.833 | 0.000 | |
| DLnTradeVol | 0.003 | 0.018 | 0.157 | 0.875 | |
| DLnTradeV_1 | 0.009 | 0.018 | 0.527 | 0.599 | |
| LagDRes_1 | -.014 | 0.053 | -.262 | 0.793 | |
| LagDRes_2 | -.020 | 0.053 | -.378 | 0.706 | |
| **Reflation = 1** | | | | | |
| **Equilibrium Regression: Dependent Variable = Ln Seat Price, $R^2$ = 98.8%** | | | | | |
| **Series** | **Beta** | **S.E.** | **t-value** | **p-value** | |
| Constant | 1.678 | 0.565 | 2.971 | 0.004 | |
| Ln Seat_1 | 0.754 | 0.047 | 16.084 | 0.000 | |
| Ln Price Level | 0.232 | 0.159 | 1.455 | 0.148 | |

| | | | | | |
|---|---|---|---|---|---|
| Ln Call Loan | 0.006 | | 0.007 | 0.784 | 0.434 |
| Ln Trade Vol | 0.039 | | 0.014 | 2.815 | 0.006 |
| Ln Stk Index | 0.379 | | 0.088 | 4.320 | 0.000 |
| MktVol | 0.114 | | 0.286 | 0.398 | 0.692 |
| **Cointegration Test:** | | | | | |
| | **Identified** | | **Stationary** | **ARIMA model Parameters** | |
| **Series** | **Model** | **$R^2$%** | **$R^2$ %** | **Estimate (S.E.)** | **p-value** |
| Res 1: | ARIMA (0, 0, 0) | 0.0 | 0.0 | | |
| **ECM Results: Y Variable = 1st Difference of Ln Seat Price, $R^2$ = 49.2%** | | | | | |
| **Series** | **Beta** | | **S.E.** | **t-value** | **p-value** |
| Constant | 0.002 | | 0.009 | 0.289 | 0.773 |
| DLnPriceO | 0.625 | | 0.448 | 1.396 | 0.165 |
| DLnPriceO_1 | 1.180 | | 0.427 | 2.765 | 0.007 |
| DLnCall | 0.017 | | 0.011 | 1.539 | 0.126 |
| DLnCall_1 | 0.022 | | 0.010 | 2.053 | 0.042 |
| Dn_DLnIndex | 0.195 | | 0.261 | 0.747 | 0.457 |
| Dn_DLnIndex_1 | 1.117 | | 0.274 | 4.080 | 0.000 |
| Up_DLnIndex | 0.267 | | 0.287 | 0.929 | 0.355 |
| Up_DLnIndex_1 | 0.926 | | 0.281 | 3.301 | 0.001 |
| DLnTradeVol | -.005 | | 0.015 | -.372 | 0.710 |
| DLnTradeV_1 | 0.050 | | 0.015 | 3.476 | 0.001 |
| LagDRes_1 | -.049 | | 0.065 | -.765 | 0.446 |
| LagDRes_2 | -.145 | | 0.065 | -2.227 | 0.028 |

The "equilibrium regression" tests whether there is an equilibrium relationship between the (natural log of) NYSE seat prices (as dependent variable) and the (natural log of) price level, call-loan rate, NYSE trading volume, NYSE stock index and NYSE stock-index volatility. The cointegration test is then a test whether the residuals from the equilibrium regression are stationary, i.e., the residual does not display a unit root. Finally, the Error Correction Model (ECM) estimates the adjustment process as the seat price series is shocked away from the equilibrium relationship.

Table 4 presents regression results, constructed similarly to Table 3. The dependent variable is the natural log of the monthly seat price (Ln Seat Price) and its first difference for the ECM regression. The equilibrium regression and cointegration test results are presented first. Note that in this case lagged Ln Seat Price is included to obtain an equilibrium relationship. Without including the lagged dependent variable, the cointegration tests indicated unit roots in the residuals in both the deflation and reflation periods. These residuals are plotted in Figure 7.

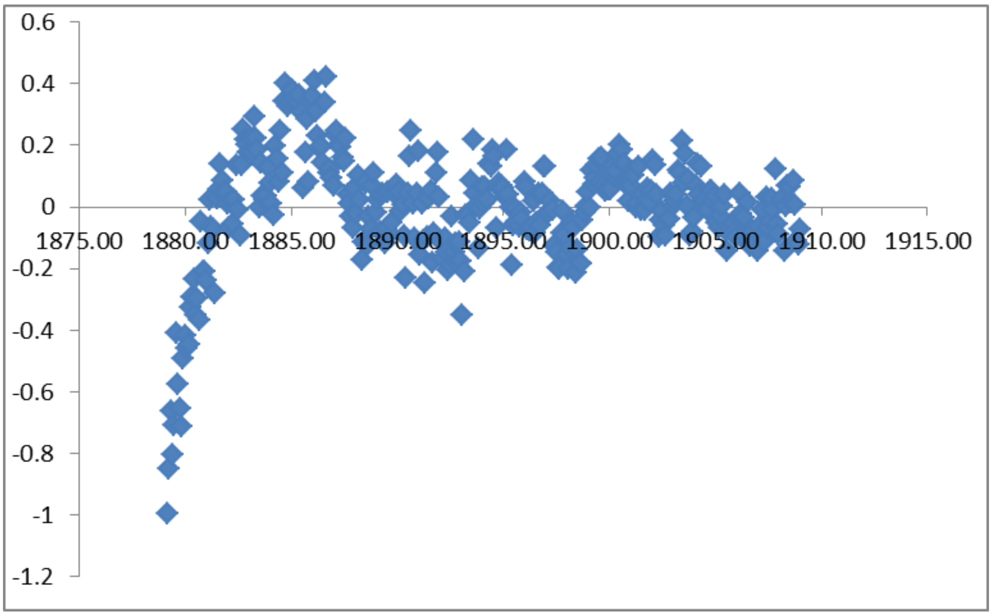


**Figure 7. Residuals from the Equilibrium Regression of Seat Price: 1876-1908**

Figure 7 plots residuals from the equilibrium seat price regressions of Table 4 without the addition of a lagged dependent variable.

The rising residual trend on the left side of the figure stands out markedly. It may reflect that trading in NYSE seats started just in 1868, and perhaps seats were underpriced at their introduction. As well, the figure shows other trends in the residuals, which may reflect behavior influences on seat pricing such as anchoring. Alternatively, as discussed by Schwert (1977), seat prices are generally thinly traded and thus slow to adjust to market conditions.

The Table 4 results indicate that lagged Ln Seat Price was by far the most significant factor in the equilibrium regression, suggesting that the previous month's value served as an anchor in determining the current seat price. As well, the cointegration test results indicate that the residual series from the equilibrium regression are white noise, in contrast to the autoregressive residuals found with the trading volume variable of the previous section. The equilibrium regressions also indicate that the NYSE trading-volume and stock-index variables had positive betas and were generally significant in both periods. The price-level, call loan and equity-market volatility variables were not significant in either period.

The ECM results are given next in Table 4. One lag of the ($1^{st}$ differenced Ln) study variables are included to test for lagged effects. However, the lagged dependent variable was not significant, and thus not included.

To test for asymmetry in the relationship between seat-price changes and stock-index changes, the analysis continues to include separate variables for up and down stock-index movements. In the present case these variables continue to be generally significant, indicating a significant relationship between stock-index changes and seat-price changes, but the evidence of an asymmetric effect as with trading volumes is much weaker. The price-level (DLnPrice) and call-loan (DLnCall) series have a significant positive impact on percentage changes in seat prices at a one-month lag in both periods. The trading-volume (DLnTradeVol) variable was significant only in the reflation period, and then at a one-month lag. Finally, note that the first lag (LagDRes_1) and second lag (LagDRes_2) of the first differenced residuals from the equilibrium regression are generally not significant, consistent with the cointegration tests just discussed.

The ECM results give some support to a weak equilibrium relationship of NYSE seat prices with the NYSE stock-index and other study variables. The cointegration tests do not indicate mean reversion to this relationship, and likewise the ECM regressions do not show a correction to the equilibrium relationship.

The ECM results show a much weaker asymmetric impact of stock-index changes on percentage changes in seat prices. One potential explanation for a weaker effect is that seat owners held other profit opportunities in periods of low NYSE trading, such as increased trading in commodity markets, the curb market, or in foreign markets not subject to the same deflation. Otherwise, we would expect seat prices to show the same regression trends as between trading volume and stock index because of trading volume’s impact on seat profitability.

*3.5 NYSE Seat Analysis; Traditional CAPM Approach*

In this section a CAPM regression of NYSE seat-price excess returns is fit for comparison with Davis, Neal and White (2007) and Schwert (1977). The dependent variable is the seat-price excess returns. Independent variables are (1) excess returns on an NYSE stock-index, (2) NYSE trading-volume changes, (3) the call-loan rate changes, and (4) the price-level changes. Two lags of each independent variable are included, since as discussed by Schwert (1977), seat prices are thinly traded and thus slow to adjust to market conditions. The price-level variable is included to test whether the deflation and reflation periods had a direct impact on NYSE seat-price excess returns, independent from the other independent variables.

**Table 5. CAPM Regression Analysis of Seat Prices**

| **Dependent variable: NYSE seat price excess return (DLnSeatPrice-$r_f$ )** | | | | |
|---|---|---|---|---|
| | | **Reflation = 0: R-square = 31.1%** | | |
| | **Beta** | **Std. Error** | **t-value** | **Significance** |
| Constant | 0.003 | 0.005 | 0.703 | 0.483 |
| DLnStkIdx-$r_f$ | 0.118 | 0.108 | 1.100 | 0.273 |
| one-month lag | 0.694 | 0.111 | 6.266 | 0.000 |
| two-month lag | 0.204 | 0.112 | 1.824 | 0.070 |
| DLnTradingVolume | 0.011 | 0.017 | 0.613 | 0.541 |

| | | | | |
|---|---|---|---|---|
| one-month lag | 0.029 | 0.017 | 1.669 | 0.097 |
| two-month lag | 0.033 | 0.017 | 1.892 | 0.060 |
| DLnCall | -.002 | 0.010 | -.177 | 0.860 |
| one-month lag | 0.014 | 0.010 | 1.307 | 0.193 |
| two-month lag | 0.000 | 0.010 | 0.027 | 0.978 |
| DLnPriceO | 0.266 | 0.574 | 0.464 | 0.643 |
| one-month lag | 1.067 | 0.571 | 1.869 | 0.063 |
| two-month lag | -.374 | 0.561 | -.666 | 0.506 |
| **Reflation = 1: R-square = 44.3%** | | | | |
| | **Beta** | **Std. Error** | **t-value** | **Significance** |
| Constant | 0.003 | 0.004 | 0.795 | 0.428 |
| DLnStkIdx-$r_f$ | 0.246 | 0.146 | 1.687 | 0.094 |
| one-month lag | 0.942 | 0.140 | 6.750 | 0.000 |
| two-month lag | 0.113 | 0.150 | 0.752 | 0.453 |
| DLnTradingVolume | 0.000 | 0.014 | -.021 | 0.984 |
| one-month lag | 0.052 | 0.014 | 3.670 | 0.000 |
| two-month lag | -.001 | 0.014 | -.090 | 0.929 |
| 0.929 | 0.009 | 0.012 | 0.797 | 0.427 |
| one-month lag | 0.019 | 0.011 | 1.744 | 0.083 |
| two-month lag | -.008 | 0.011 | -.777 | 0.439 |
| DLnPrice_O | 0.658 | 0.460 | 1.432 | 0.154 |
| one-month lag | 1.008 | 0.444 | 2.272 | 0.025 |
| two-month lag | -.428 | 0.435 | -.985 | 0.326 |

The table presents a more conventional CAPM-type regression of seat-price excess returns (DLnSeatPrice-$r_f$) on the current value plus two lags of (1) NYSE stock-index excess returns (DLnStkIdx-$r_f$), (2) NYSE trading-volume returns (DLnTradingVolume), (3) call-loan rate returns (DLnCall), and (4) general price-level returns (DLnPrice_O), where the general price series (LnPrice) has been orthogonalized to the call-loan (LnCall) and stock-index (LnStkIdx) series to focus on the study hypotheses.

The Table 5 results indicate that the NYSE stock-index excess returns have a significant impact on seat-price excess returns, particularly at the 1-month lag. As noted by Schwert (1977), thin trading in the dependent variable (seat price) may result in significant lagged independent variable effects. In particular, summing the betas estimated for the current and lagged NYSE stock-market excess returns may better estimate the relative market risk of NYSE seat-price excess returns. In this case, 0.118 + 0.694 + 0.204 yields an estimate of 1.016 for the deflation period and 0.246 + 0.942 + 0.113 yields an estimate of 1.301 for the reflation period, for the systematic risk of seat-price excess returns relative to the stock market index excess returns. We interpret this relatively high market beta as further evidence of the price-volume relationship.

The NYSE trading-volume and general price-level changes show only a marginally significant impact on seat-price excess returns, while call loan changes were not significant. Trading-volume changes should have a strong impact on seat-price changes, since the profitability of exchange seat ownership should depend on the volume of transactions realized. But the price-volume relationship may mask the impact of trading volumes on seat prices, particularly since the stock-index series is much lower volatility that the trading-volume series.

## 4. Discussion

This study has sought to test two hypotheses using a study period from 1879-1908, which includes extended periods of deflation and reflation. First, the "liquidity-trading" hypothesis is that trading volume changes are positively correlated with changes in call loan rates. Second, the 'asymmetric volume-price change' hypothesis is that stock-price increases have a larger impact on trading volumes than stock-price declines. Karpoff (1987) relates this asymmetry to the impact of costly short sales on trading activity. Griffin et al. (2007) provides an alternative behavioral explanation of asymmetry between stock price movements and trading volumes in terms of the *participation effect*, the *disposition effect* and the *over-confidence effect*.

The study results give strong support for both hypotheses. As well, a cointegration analysis shows a strong equilibrium relationship between trading volumes, and (1) call loan rates, and (2) NYSE stock-index values. Error Correction Model (ECM) results are consistent with this relationship, in terms of the significant impact of changes in call loan rates and changes in a NYSE stock index on the changes in trading volumes. The results provide strong and consistent support for both the "liquidity-trading" hypothesis and the "asymmetric volume-price change" hypothesis.

The study finds that the NYSE monthly trading-volume series showed much higher volatilities than the corresponding NYSE stock-index series. While the monthly change in the log-transformed stock index had volatilities of 4.5499% and 3.0607% for the deflation and reflation periods, respectively, the monthly change in the log-transformed trading-volume series showed volatilities of 29.438 and 36.2589, respectively. The asymmetrical price-volume relationship may have contributed to the heightened volatilities of the trading-volume series. For example, the monthly average stock-index return increased from 0.1137% (deflation period) to 0.5040% (reflation period), while the average NYSE trading-volume percentage change increased from -.2534% (deflation period) to 1.2575% (reflation period). Thus, trading volumes experienced a much greater rebound from the return to reflation, which likely contributed to the volatility of the series as well.

The study also investigates the potential impact of the deflation and reflation periods on NYSE seat prices. The study's seat-price regression results are broadly consistent with Schwert (1977) and Davis, Neal and White (2007). These analyses covered the periods: 1926-1972 and 1920-1928, respectively. Like these studies the analysis finds evidence of a "Fisher effect", where inactivity of seat trading can result in lag effects of the independent variables, which in our regression are stock market, trading volume, call loan and price-level effects. The present study finds that NYSE total trading volume is only marginally significant in the CAPM regression of seat prices, like Davis, Neal and White (2007). The price-volume relationship may offer an explanation for the lack of a strong relationship, since stock-index returns may mask the impact of trading-volume changes on seat-price returns, especially given the high volatility of trading-volume changes.

Finally, the study finds significant evidence that seat prices were underpriced during the early years of our analysis. NYSE seats began trading in October 1868, when memberships first became saleable, and as a result of the merger in 1869 of 533 seats of the NYSE, 354 seats of the Open Board of Brokers, and 173 seats of the Government Bond Department. In 1879 an extra 40 seats were created and sold at $13,000 each to finance construction of a new building for the NYSE. Since then the number of NYSE seats were fixed at 1,100 well into the 1920s. Seat prices may have been underpriced for similar reasons that rights offerings to current shareholders are underpriced, e.g., to ensure participation by a broad number of brokers.

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**Notes**

Note 1. Friedman and Schwartz (F&S, 1963, p. 32) date the period of sustained price deflation from 1867 to the 1896 defeat of Bryan's Presidential bid on a free-silver platform. After 1896, a sharp reversal to price reflation occurred with new gold discoveries and improved mining and refining technologies. F&S credit the cause of deflation primarily to the spread of agricultural and mining as the West closed and as transportation improved. F&S (p. 139) conclude that "The defeat of Bryan and his free-silver platform in the Presidential election of 1896 is a convenient and dramatic date to mark the turning point". We therefore take the period: 1867-1896 as the "Great Deflation period". This conclusion is illustrated in Figure 2.

Note 2. Schwert (1977) discusses that seats could be sold only to individuals and not to groups or corporations. However, these latter parties could purchase an NYSE seat through an ABC agreement, which is a contract between the employee and purchasing firm that restricts the employee's ability to sell the seat.

Note 3. For example, Spear, Leeds, & Kellogg, L. P. (SLK), a specialist firm, held six NYSE seats when its merger with The Goldman Sachs Group, Inc. (GS) was announced September 11, 2000. GS is a diversified U.S. financial services firm. SLK was also diversified at the time beyond market making, particularly into derivatives trading and clearing services.

Note 4. The data set of seat owners does include a few well known firms, such as Clark, Dodge & Co. with two seats, Drexel, Morgan & Co. with one seat, Jay Cooke & Co. with one seat and Oppenheimer Brothers with one seat. However, even these well-known firms did not hold any concentration of NYSE seats.

Note 5. However, according to Davis, Neal and White (2003), there were no limits on the size of a brokerage house with a seat on the NYSE, and they did operate branch networks across the United States and internationally to collect retail orders.

Note 6. According to Wikipedia (under "Depository Trust & Clearing Corporation"), *before DTC and NSCC were formed, brokers physically exchanged certificates, employing hundreds of messengers to carry certificates and checks. The mechanisms brokers used to transfer securities and keep records relied heavily on pen and paper. The exchange of physical stock certificates was difficult, inefficient, and increasingly expensive*. According to the source, the Depository Trust Company (DTC) was created in 1973 to deal with rising trading volumes.

Note 7. According to Wikipedia, the first mutual funds in the U.S. occurred in the 1890s, but these were not popularized until the 1920s. These early funds were closed-end funds.

Note 8. At the time minimum broker commissions were fixed by NYSE rule at 1/8 of par value for non-NYSE members and 1/50 of par for members not acting as principal. Since most stocks had a $100 par value, independent brokers, who typically transacted overflow business for other members, became known as "$2 brokers".

Note 9. The NYSE originally formed to enforce a common set of charges, and this remained of fundamental importance to the exchange. For example, the Governing Committee (April 1894) stated that, "The commission law is the fundamental principle of the Exchange, and on its strict observance hangs the financial welfare of all the members and the life of the Institution itself". In the 1860s it was possible to reduce the minimum commission (1/4 percent of par value), by one-half to such important customers as bankers and outside brokers. When 1/8 percent became the minimum rate, however, no further reductions were allowed.

Note 10. Up until October 1868, a new member gained admission to NYSE membership by paying a membership fee of $3,000 in 1862, which was raised to $10,000 in 1866 (Mitchie, 1986).

Note 11. At the time and well into the 1920s, the number of NYSE seats was fixed at 1,100, a result from the merger in 1869 of 533 seats of the NYSE, 354 seats of the Open Board of Brokers, and 173 seats of the Government Bond Department, plus an extra 40 seats that were created in 1881 to pay for expenses.

Restricting the number of NYSE seats likely encouraged competition from new exchanges, e.g., the Consolidated with 1,225 seats and the Curb with at least 200 seats by 1913 (Meeker, 1922, p. 34).

Note 12. Seat ownership conferred both the ability to trade on the floor of the exchange and to participate in the governance of the exchange.

Note 13. There are several potential explanations for falling NYSE stock prices over the deflation period. Coal and other mining stocks were directly impacted by declining commodity prices. Declining agricultural and commodity prices would also pressure railroad earnings. At the time most NYSE-listed stocks were from the railroad and mining firms. Falling bond yields also increased the value of corporate liabilities (Davis, Neal, & White, 2003).

Note 14. Cecchetti (1992) examined the Great Depression period and concluded that "beginning in late 1930, and possibly as early as late 1929, deflation could have been anticipated at horizons of 3-6 months". Perez and Siegler (2003) make similar conclusions about the sharp deflation and then reflation periods before WW I, which corresponds to this paper's study period.

Note 15. Griffin et al. (2007) assert that a significant positive relationship between market-wide turnover and lagged market-wide returns is consistent with the overconfidence hypothesis.

Note 16. Schwert (1977, p. 59) asserts that: "assuming the discount rate is constant through time, the only thing that would cause seat prices to change over time would be changes in expectations of future share volume and stock prices".