



Research article

Regulatory reform and trade settlement failures in USA equity markets: Does regulatory reform matter?

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Abstract: Stock trades pass through several phases before completion, from placing an order via a brokerage firm, to the delivery of securities versus payment. This paper sheds light on the later phases of the trading process for equity securities in USA capital markets. In a continuous effort to improve the settlement process, the National Securities Clearing Corporation makes several substantial changes every year to the rules and regulations that govern the settlement process. This paper investigates the impact of rule changes on the efficiency of settlement, based on the volume of shares that failed to deliver from 2004 to 2017. The rule changes are modeled with a dummy variable in a vector autoregressive (VAR) model, where the quantity of fails and market returns are both included in the VAR model as endogenous variables. The results show a considerable impact of rule and regulation changes on the quantity of shares failed to be delivered in time for settlement; especially, the regulations implemented to improve short selling had a statistically significant impact on reducing settlement failures and improving market returns. The finding of this study provides important information for regulators and investors with regard to the settlement process and investment strategies.

Keywords: settlement failures; financial regulation; equity markets; USA

JEL Codes: G14, G18, G29, C55

1. Introduction

The USA stock markets are the largest and most developed around the world, they have a long history and they are heavily regulated. While much has been written about trading processes in stock markets, much less is understood about the impact of post-trade settlement infrastructure on market activity and values. The goal of this paper is to fill the deficit of information by explaining the importance of post-trade processing microstructures and offering an analysis of the impact of settlement rule changes on market values and activity. Market microstructure mainly concerns the regulations and processes used to conduct securities trading. O'Hara (1995) described market microstructure as the processes and outcomes of trading securities under a specific set of trading rules. The mechanisms and rules of trading are assumed to be irrelevant regarding investment decisions in traditional finance. In contrast, numerous research studies in the area of market microstructure assume different facts. For instance, Madhavan (2000) provided a survey of the market microstructure literature, analyzing price formation and the trading process, as well as the effects of market organization on establishing prices.

However, most of such studies focused on the mechanisms and regulation of trading. This study sheds light upon current post-trade activities by describing the clearing and settlement (C&S) processes in USA equity markets. In addition, this paper reviews research on regulatory schemes and internal governance by examining rule changes by the National Securities Clearing Corporation (NSCC) that require review/approval by the Securities and Exchange Commission (SEC), as well as the SEC's own rules governing the failure to deliver securities to the NSCC for settlement (fails-to-deliver, or FTDs). This study also contributes to the literature on factors that may have an impact on stock market returns such as the harmonization of rules, standardized protocols and liberalization of the provision of services. Most importantly, this study examines the impact of rules changes implemented by the NSCC on the efficiency of the settlement process, as indicated by changes in the volume of shares failed to deliver from 2004 to 2017.

To examine the efficiency of the settlement process in the context of settlement failures, this study began by recognizing that the supply and demand market paradigm is premised on the fact that there is a finite supply of securities available in the market, which cannot exceed the number of shares issued by the firm. Thus, in an efficient stock market, only the issuing company can create new shares. The price of a particular security will decline when there are more shares available for purchase than investors want to buy because supply exceeds demand. On the other hand, if investors want to buy more shares of a particular security than are available for purchase, the price of that security will increase because demand exceeds supply, requiring investors to pay a premium for the increased difficulty of obtaining the shares. FTDs disrupt this process by artificially increasing the number of shares available in the marketplace.

The fundamental relationship between supply and demand serves as the basic foundation of market efficiency. The following four factors are indicia of an efficient market:

1. Resources are allocated where demand is highest;
2. No seller effects prices, so each seller has the incentive to cut costs in order to raise profits, thereby providing for the efficient use of allocated resources;
3. Every buyer pays the same price, thereby achieving efficient distribution;
4. No one is forced to accept the sellers' terms or go without.

Thus, in an efficient stock market, market participants cannot create new shares out of thin air.

In the current market environment, securities are being sold by brokers/dealers who do not have them (and do not borrow them), so the number of shares in circulation exceeds the official supply, generating what we call “phantom shares” through settlement failures. Trade settlement failures disrupt capital markets by doing the following:

1. damaging asset values by artificially increasing the supply of shares in circulation,
2. impairing the issuer’s on-going access to capital,
3. reducing effective corporate governance by violating the voting rights of shareholders and
4. denying investors access to the use of funds between the settlement date and the date when securities are eventually delivered.

This final point—that the buyer’s broker holds the investors’ cash without delivering stocks, is especially risky because it does the following:

5. exposes investors to excess risk for which they are not compensated and
6. causes investors to miss opportunities for alternate investments.

Accordingly, we should anticipate a positive connection between market returns and the quantity of fails, since high returns are caused by an increase in risk.

The potential danger in this final point became reality with the loss of customer cash through losing investments made by MF Global (October 2011) and Peregrine/PFGBest (July 2012) (Associated Press, 2012).

Our examination of regulatory reform focuses on the impact of rule changes on market returns and post-trade failures to deliver sold shares (failures to deliver, or FTDs). Elevated settlement failures, in particular, are signals of trading activities that may impact market returns by altering the supply of shares circulating in markets (Treasury Market Practices Group, 2007). Settlement failures are defined as the failure to deliver securities in time for settlement (usually 3 days after the trade).

The structure of this study is as follows. Section 2 reviews the related literature of trading and settlement procedures in the securities market. Section 3 describes the methodology used in this study, highlighting the data, descriptive statistics, the empirical model and results. Section 4 presents a discussion of the results. Section 5 concludes the study.

2. Literature review

The trading of securities, which can be viewed as a trading value chain, has to pass through four phases, as described by Knieps (2006). First, there is the pre-trade phase or information stage, where investors collect information in order to make investment decisions. Second is the order-routing stage, where securities orders are placed to the financial markets either organized or over the counter. Third, there is the trading stage, where securities are traded among investors; at this stage, a price is set for a specific volume. Finally, there is the post-trade stage; this covers the functional elements of clearing, settlement, notary function and enhanced custody services. Most of the studies in the area of finance refer to these phases, especially the first three, as market microstructure. For example, Madhavan (2000) described this term as the process by which investors’ latent demands are ultimately translated into prices and volumes. Asmar and Ahmad (2011) provide a theoretical approach to determine the components of securities market microstructures. Their approach focuses mainly on trading mechanisms and regulations governing various aspects of the trading process. Putniņš (2010) described the process of C&S for stock trades in the USA, paying attention to what happens when the seller of a stock fails to deliver that stock at settlement and the mechanisms available to resolve delivery failures.

A securities trade is considered to be failed if, on the date originally scheduled (settlement date), either the buyer does not deliver funds in the suitable form or the seller does not deliver the securities in due time. The latter case (FTD of securities) is the most important because it affects market activities as the specific type of securities to be delivered, which, in some cases, may not be easily available in the market for purchase or borrowing (European Central Bank, 2011). FTDs can occur for several reasons, such as administrative delays, human error and the controversial practice of naked short selling (Putniņš, 2010).

Berlinger et al. (2019) contend that a clearing house is an organization that reduces the counterparty risk for traders by becoming the counterparty to both the buyer and seller, guaranteeing the terms of a trade even if one party defaults on the agreement. They have simulated the operation of a hypothetical clearing house active on the USA stock futures market to examine the effects of different margin strategies on the loss distribution of a clearing house during various crises of different stock price trends.

The scholarly examinations of post-trade processing have been covered in industry-specific research, such as the editorial introduction of Milne (2007) that reviews the literature on the industrial organization of securities market C&S, covering previous studies of institutional, theoretical and empirical contributions. For example, Knieps (2006) indicated that C&S are competitive value-added telecommunications services and therefore do not justify before-the-event market power regulation. Li and Marinč (2016) have empirically analyzed the competitive landscape within the C&S industry in several countries. They found limited competition between C&S institutions. They also found that competition increases with institutional size, with technological development and after horizontal mergers. They, in addition, found that, in the USA, competition in C&S is higher than in Europe, and that the competition during the global financial crisis was higher compared to normal times. Burns et al. (2017) described efforts to improve the efficiency of and reduce risks associated with the USA national clearance and settlement system, particularly, the steps taken by the SEC to shorten the standard settlement cycle from three business days to two business days after the trade date for most broker-dealer transactions.

A more recent study conducted by Anand and Green (2018) examined the enforcement by securities regulators and how settlement powers interact with such enforcement in Canada. They also looked at how a securities regulator reacted prior to and in the face of the financial crisis. They found that the level of enforcement had a low level of sanctions imposed prior to the financial crisis, with large increases in the immediate aftermath of the crisis, and then a possible return to pre-crisis sanction levels.

Other studies have focused on the settlement failures in debt markets. The study of Trimbath (2008) examined trade settlement failures in the USA bond markets and showed that regulatory and market efforts to reduce the problem have been largely unsuccessful. Biais and Green (2019) described the procedure of bond trading in the 20th century for both the NYSE and the OTC market. Economists at the Federal Reserve Bank, Fleming and Garbade (2002, 2005), examined FTDs in the market for US Treasury securities. They suggested that implementing fines for settlement failures could curb the practice. Fines for FTDs in equity markets were implemented during the period covered by the current study (Garbade et al., 2010). Further studies concentrated on money market instruments, such as the study of Bartolini, Hilton, and McAndrews (2010) that investigated money market loan trades from execution to delivery and return in the USA. Their study showed that delays in settling USA money market loans are not related to random operational friction. But, the delays

are purposely planned by trading parties according to their own settlements and other high-frequency liquidity management decisions.

Donald (2007) described the indirect holding system introduced in the early 1970s to USA securities markets to resolve the market failures induced by post-trade paper-processing requirements. The new system in effect separated the benefits of ownership from the owners of record. By inducing inefficiencies to the process of corporate communication and voting, the new system encouraged niche service providers who retained a downstream interest in maintaining the system despite advances in law and technology that now negate their usefulness. To the contrary, a study by Pirrong (2007) contends that financial transactions execution, clearing and settlement are all subject to substantial economies of scope and scale, which make each of these related functions a natural monopoly, and that integration of these functions in an exchange improves efficiency.

A study conducted by Guseva (2015) examined the potential for market inefficiencies associated with the interaction between the regulator (SEC) and clearinghouses (Depository Trust and Clearing Corporation (DTCC), the parent holding company of NSCC). The study considered the low frequency of enforcement actions, principle-based regulations, participatory corporate governance mechanisms, a contestable monopoly organization of the industry and the continuous judicial support. Guseva concluded that, while there are benefits to regulator/clearinghouse interactions, like the SEC/DTCC, regulators should be cautious of disturbing ordinary market evolution.

The last decades have seen a transformation of the securities markets trading process in terms of the mechanism and regulation, and post-trade processing of transactions through the adoption of digital information and communication technologies (Donald, 2013; Panourgias, 2015). Recently, several exchanges around the world have adopted distributed ledger technology, and particularly, the blockchain technology for securities trading, clearing and settlement. However, it is still insufficiently clear whether any specific distributed ledger technology solution will be widely adopted in global securities markets (Priem, 2020).

3. Methodology

This section provides a description of the research methodology used in this study. Mainly, it explains the data sources and measurements of variables, as well as the empirical model used to investigate the impacts of changes in the rules and regulations that govern the settlement process on the total shares failed-to-deliver in USA financial markets, and the results.

3.1. Data

We used secondary data for the period from April 2004 to May 2017, which include the rule changes implemented by the NSCC to govern the settlement process. The criteria for selecting the rule changes for the analysis are based on their potential impacts on the settlement process. These changes and their implementation dates were obtained from the SEC website. The C&S process that begins after the trading of securities is governed by some regulations, specifically those related to the timing of settlement (delivery of shares and monies). C&S mechanisms used in the USA are, in many ways, seminal to structures used around the world. They are established to serve all market types. C&S microstructure mechanisms include trade comparison, settlement confirmation, delivery of shares and delivery of funds, etc. (generally, procedures and fees). C&S regulations include timing (e.g., T+3),

form of shares and funds for delivery (i.e., electronic or physical), transparency (making membership criteria known), etc. (generally, settlement timing, membership requirements and risk mitigation processes). It is imperative that we consider the components of the C&S microstructure for research into the impact of regulatory changes on market performance.

We obtained the data related to the quantity of shares failed to be delivered from the SEC website. We transformed the very large raw data files into an outstanding balance level of shares failed to be delivered per company per settlement date. Prior to the implementation of Regulation SHO (Reg SHO)¹, there was no source for complete data on the number or value of settlement failures in USA equity markets. Reg SHO mandated the release of data for securities with settlement failures beginning March 22, 2004. FTDs are used as an indication of market efficiency. In the European Union, for example, regulators report “market settlement efficiency” for the stock and/or bond markets as a percent of trades that settled on time. (See, for example, European Central Bank, 2019.) By definition, all fails are the same: the seller did not present securities as agreed on the settlement date. Contrary to some popular reports, it is not just the stocks of small companies or worthless Blue Sky companies, or even only over-the-counter penny stocks that experience FTDs. It can happen to any company with publicly traded shares. Two years after Reg SHO was implemented, FTDs were still affecting 20% of NYSE- and NASDAQ-listed firms and about half of the firms trading over-the-counter (Trimboth, 2020). In July 2022, Exchange-traded funds (ETFs) represented the largest group of symbols with daily FTDs: almost 1,000 ETFs had settlement fails. The stocks of the following well-known companies had FTDs reported in their shares on every one of the 20 settlement days during July 2022: WM Technology, Voya Financial, Virgin Galactic, Sirius XM, Revlon, Redbox, IBM, GameStop, Bausch + Lomb, American Airlines and AMC Entertainment. Not even the shares of global giants like Eastman Kodak (19 days), Lands End (19), Microsoft (15), Morgan Stanley (13) or Goldman Sachs (11) escaped FTDs.

As a proxy of equity market activity (market returns) in the USA, the Russell 3000 index has been used. The daily closing prices adjusted for dividends and splits of the Russell 3000 index data were obtained from the Yahoo finance website.

The daily quantity of fails (Qf_t) was calculated by subtracting the current balance from the preceding day for the total fails reported to the SEC. The return on the market (Rm_t) was calculated using the logarithmic returns of the Russell 3000 index.

3.2. Descriptive statistics

The SEC database of FTDs covers 58,392 unique securities (by CUSIP² identification). The DTCC implemented 160 rule changes between 2004 and 2017, among which 109 are relevant to C&S in equity securities.

The rule changes were divided into those that impact the post-trade operations (comparison/settlement procedures, fees/fines and procedures/services) and those that impact post-trade regulations (settlement timing, membership requirements and risk mitigation)

¹Regulation SHO is a set of rules from the Securities and Exchange Commission (SEC) implemented to regulate short sale practices. Reg SHO consists of several amendments to 17 CFR Parts 240, 241 and 242 rules on short selling. For the final rulemaking, see SEC File No. S7-23-03.

²A CUSIP number is a unique identification number assigned to stocks and registered bonds in the USA and Canada.

Table 1. Count of NSCC rule changes.

Effective Year	Number of Rule Changes	Number Relevant to Equity C&S
2004	11	9
2005	19	14
2006	12	8
2007	13	10
2008	15	12
2009	14	10
2010	14	11
2011	13	6
2012	9	5
2013	11	8
2014	12	7
2015	9	4
2016	4	2
*2017	4	3
TOTAL	160	109

Note: *2017 through May 4 only. The changes and their implementation dates were obtained from the USA Securities and Exchange Commission (SEC) website (2018). The details and the source of each change are available upon request.

3.3. Empirical model and results

The first step of building the empirical model in this study was to test the stationarity of the quantity of fails (Qf) and market returns (Rm). The unit-root test was extensively used to test the stationarity of time-series data. The augmented Dickey–Fuller (ADF) (Dickey and Fuller, (1981) and Phillips–Perron (PP) (Phillips and Perron, (1988)) tests were used to test the stationarity of the quantity of fails and market returns. Table 2 contains the unit-root tests and the descriptive statistics of the main variables used in the analysis in the current study. Both the ADF and PP tests reject the null hypothesis (the variables have a unit root) at the 1% level for both of the variables. This implies that the quantity of fails and market returns are stationary. Over the period of the study, the daily average quantity of fails was 441,771,772 shares. An investment in the Russell 3000 would produce a daily average return of 0.02%, with a 1.12% standard deviation.

Table 2. Unit-root tests and descriptive statistics.

	ADF test	PP test	Mean	Median	Maximum	Minimum	Std. Dev.
Qf	-4.22139*	-11.2374*	441771772.1	329058526.5	2356850010.0	82146307.00	330792111.95
Rm	-44.9291*	-63.5192*	0.000234753	0.000700531	0.1086279690	-0.097403183	0.0121710855

Note: This table reports the unit-root tests of quantity of fails (Qf) and market returns (Rm) from April 23, 2004 to May 17, 2017. The stationarity of the variables was tested using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. * indicates statistical significance at the 1% level.

Based on the expected positive connection between market returns and the quantity of fails, we examined the impact of changes in the settlement rules on the quantity of shares failed to deliver by using vector autoregressive (VAR) modeling. A VAR model is a multivariate time-series model, and

it is useful for modeling more than one variable simultaneously. Further, because the parameters are assumed to follow a random walk process, VAR models can take a regime change in the market's microstructure into account. First, we constructed a simple VAR model and tested for Granger causality in order to investigate the direction of causality between market returns and the quantity of fails. Both the market returns (Rm) and the quantity of fails (Qf) are endogenous time series that are dependent on their previous values, which depend on their former values expressed by the sum of lagged returns Rm_{t-j} and quantity of fails Qf_{t-j} . The VAR model is expressed as follows:

$$\begin{pmatrix} Qf_t \\ Rm_t \end{pmatrix} = c + \sum_{j=1}^p \Phi_j \begin{pmatrix} Qf_{t-j} \\ Rm_{t-j} \end{pmatrix} + \varepsilon_t \quad (1)$$

where the quantity of fails (Qf_t) and return of market (Rm_t) were included in the VAR model as endogenous variables. The values of these variables depend on different combinations of the former values of both variables expressed by the sum of the lagged Rm_{t-j} and Qf_{t-j} plus a constant term c and error terms ε_t . Settlement (and, therefore, an FTD) occurs some days after trading; trading/settlement days exclude weekends and specific USA holidays, so they are not consistently linear. To determine the appropriate lag length p for the VAR model, a multivariate information criterion was employed. In this case, the Schwartz criteria selected the fourth order as the optimal lag, while the Hannan-Quinn criteria and Akaike's criterion selected the tenth order as the optimal lag. The purpose of these information criteria is to increase the R^2 value or minimize the residual sum of squares; nevertheless, none of these criteria are absolutely better than any other. Therefore, in this study, the VAR (4) was estimated based on the lower lag length, as suggested by the Schwartz criteria. The Granger causality test was then conducted based on the VAR (4) model. The results of the Granger causality test between the quantity of fails and market returns are shown in Table 3. These results indicate that there is a bidirectional relationship between the quantity of fails and market returns based on the VAR (4) model. The null hypothesis that the quantity of fails (Granger) cause market returns is rejected at 10%, and vice versa.

Table 3. Granger causality test for quantity of fails and return of market.

	VAR Granger Causality-Wald Tests	
	Chi-sq	Prob.
Null hypothesis		
Quantity of fails does not Granger cause return of market	8.891292	0.0639
Return of market does not Granger cause quantity of fails	8.398759	0.0780

The next step was to extend the VAR (4) model to include the changes in the settlement rules as follows:

$$\begin{pmatrix} Qf_t \\ Rm_t \end{pmatrix} = c + \sum_{j=1}^p \Phi_j \begin{pmatrix} Qf_{t-j} \\ Rm_{t-j} \end{pmatrix} + \sum_{i=1}^q \delta_k(L^i) d_k + \varepsilon_t \quad (2)$$

where k represents the rule changes modeled by a dummy variable d_k and $\delta_k(L^i)$ is a lag operator of d_k , which is determined using information criteria. To avoid multicollinearity, the rule and settlement regulation changes were added one by one to the VAR (4) model.

The results show³ that the rule and regulation changes implemented by the NSCC to govern the settlement process that took place on $t = 23, 117, 124, 377, 628, 734, 742, 848, 899, 1083, 1087, 1141, 1186, 1213, 1436, 1689$ and 2149 have statistically significant effects ($p = 0.10$ or better) on the quantity of shares that failed to deliver. Of these changes, eight had positive effects on the quantity of shares failed to deliver, and specifically, the changes implemented on $t = 23, 377, 742, 1087, 1141, 1436, 1689$ and 2149 . Conversely, there were nine changes that had negative effects on the quantity of shares failed to deliver, and specifically, the changes implemented on $t = 117, 124, 628, 734, 848, 899, 1083, 1186$ and 1213 .

In addition, the results show that the 10 rule changes implemented by the NSCC to govern the settlement process had an effect on market returns, specifically those implemented on $t = 841, 1083, 1141, 1178, 1186, 1225, 1545, 1858, 1894$ and 2149 . Of these changes, five had positive effects which were implemented on $t = 1141, 1186, 1545, 1894$ and 2149 , while the five changes implemented on $t = 841, 1083, 1178, 1225$ and 1858 had a negative effect on market returns.

With four exceptions, rule changes that had a statistically significant impact on the quantity of shares failed to deliver did not have a statistically significant impact on market returns. The exceptions were as follows: 1) $t = 1083$ had a negative effect on both, 2) $t = 1141$ and 3) $t = 2149$ had positive effects on both and 4) $t = 1186$ had a negative effect on the quantity of fails and a positive effect on market returns. We expected that some rule changes would have opposite impacts on fails and market returns.

4. Discussion of results

4.1. Reg SHO rule changes

The results indicate that Reg SHO had statistically significant impacts in terms of reducing FTDs and improving market returns. The initial enforcement of Reg SHO was effective on September 7, 2004 ($t = 117$). It was designed to prevent abusive naked short selling in equity securities by requiring all trades to be marked long or short. Sellers were also required to locate securities before short selling. Reg SHO imposed a 13-day delivery requirement for a group of securities with a high rate of failures to deliver (known as the “Threshold List”). Effective on October 15, 2007 ($t = 899$), Reg SHO was revised to eliminate the grandfather provision that ignored all FTDs which occurred before the September 7, 2004 effective date. It also added a “market decline limitation” which required sellers to have a net long position in a security before entering a short sale if the market declined by 2% from the last month of the previous quarter.

The results indicate a statistically significant increase in market returns associated with another revision, which was effective on May 10, 2010 ($t = 1545$). This SEC rule change adopted “a short sale-related circuit breaker” which required trading centers to “prevent the execution or display of a short sale order of a covered security at a price that is less than or equal to the current national best bid if the price of that covered security decreases by 10% or more from the covered security’s closing price” on the prior day (SEC File No. S7-08-09).

³The full outputs are available upon request.

4.2. NSCC rule changes

In general, NSCC rule changes that had a statistically significant impact on FTDs (either positive or negative) did not impact market returns with the four exceptions noted above. Table 4 summarizes the direction of the impact and provides a brief summary of the rule changes. Of the 10 rule changes that had a positive impact on FTDs (where increasing FTDs adds to inefficiencies), the majority (7) were associated with changes to procedures and services. Changes in membership requirements were frequently associated with reductions in FTDs.

Table 4. Direction of the impact and a summary of the rule changes.

t =	Effective Date	Category	Rule Change Summary
Increased FTDs			
23	April 22, 2004	Membership requirements	Eliminate Higher Capital Requirements Imposed on Members for Processing Investment Fund Transactions Through NSCC's Mutual Fund Services
377	September 16, 2005	Procedures/Services	Change to the Mutual Fund Commission Settlement Service
742	March 2, 2007	Procedures/Services	Change to Collateral Management Service
1087	July 15, 2008	Fees/Fines	Restructure Rules Relating to Fines (Harmonize with Similar Rules of Affiliates)
1141	September 30, 2008	Procedures/Services	Restructure Rules Relating to Fines (Harmonize with Similar Rules of Affiliates)
1436	December 1, 2009	Risk mitigation	Move the Canadian Depository for Securities to Risk-Based Margining
1689	December 2, 2010	Procedures/Services	Discontinue the Cost Basis Reporting Service
2149	September 28, 2012	Procedures/Services	Enhance the Default Pricing Methodology Used by NSCC's Automated Customer Account Transfer Service
Decreased FTDs			
117	September 7, 2004	Settlement timing	New Reg SHO adopted under Exchange Act (of 1934)
124	September 16, 2004	Risk mitigation	Amend the Procedure for Determining Intraday Mark-to-the-Market Payments
628	September 15, 2006	Risk mitigation	Institute a Clearing Fund Premium Based Upon a Member's Clearing Fund Requirement to Excess Regulatory Capital Ratio
734	February 20, 2007	Fees/Fines	Modify NSCC's Fee Schedule
848	August 2, 2007	Fees/Fines	Change to Fees Charged for Its Positions and Valuations Service
899	October 15, 2007	Settlement timing	Amend SHO to eliminate grandfather provision, amends close-out requirement and updates market decline limitation
1083	July 9, 2008	Membership requirements	Amend Membership Disqualification Criteria Rules
1186	December 3, 2008	Membership requirements	Amend Membership Disqualification Criteria Rules
1213	January 13, 2009	Membership requirements	Reorganize Membership Rules and Procedures
Increased market returns			
1141	September 30, 2008	Procedures/Services	Restructure Rules Relating to Fines (Harmonize with Similar Rules of Affiliates)
1186	December 3, 2008	Membership requirements	Amend Membership Disqualification Criteria Rules
1545	May 10, 2010	Settlement timing	Amend SHO to impose a short sale circuit breaker (10%)

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t =	Effective Date	Category	Rule Change Summary
1894	September 26, 2011	Settlement timing	Amend Rules Relating to the Settlement Timing of Partial Transfers Which Include Mutual Fund Assets Through NSCC's Automated Customer Account Transfer Service
2149	September 28, 2012	Procedures/Services	Enhance the Default Pricing Methodology Used by NSCC's Automated Customer Account Transfer Service
Decreased market returns			
841	July 24, 2007	Procedures/Services	Change to Use of the National Settlement Service
1083	July 9, /2008	Membership requirements	Amend Membership Disqualification Criteria Rules
1178	November 20, 2008	Risk mitigation	Amendment No. 2 to Third Amended and Restated Options Exercise Settlement Agreement (Margin Requirements)
1225	January 30, 2009	Membership requirements	Amend Rules to Add an Agreement from Fund Members that Submit Mutual Fund Profile Information
1858	August 4, 2011	Procedures/Services	Amend Rules Relating to Discontinuing Dividend Settlement Service, Funds Only Settlement Service, Data Distribution Box Services and Changes to the Envelope Settlement Service
Impact on Both			
1141	September 30, 2008 + FTDs & + MRs	Procedures/Services	Restructure Rules Relating to Fines (Harmonize with Similar Rules of Affiliates)
2149	September 28, 2012 + FTDs & + MRs	Procedures/Services	Enhance the Default Pricing Methodology Used by NSCC's Automated Customer Account Transfer Service
1083	July 9, 2008 - FTDs & - MRs	Membership requirements	Amend Membership Disqualification Criteria Rules
1186	December 3, 2008 - FTDs & +MRs	Membership requirements	Amend Membership Disqualification Criteria Rules

5. Conclusions

Issuers, investors and financial market participants may be impacted by settlement failures in equity markets. Investors are not receiving shares for which they are paying. Institutions (e.g., investment banks and pension funds) see the value of shares in their portfolios diluted by the excess shares in circulation; they relinquish voting rights by lending shares to cover some settlement failures.

Where FTDs are tolerated, the short seller has no incentive to cover: the trade may be allowed to remain unsettled indefinitely. Initially, settlement failures were thought to have been caused by the necessity of moving paper securities which had to be re-registered to the name of the buyer to affect settlement (in exchange for paper representations of payment, too). In the late 1960s, activity literally ground to a halt, as trading was suspended one day per week to allow the paperwork to catch up for settlement (SEC, 1968). These events provided the impetus for the creation of a central C&S organization (which would eventually become the DTCC for the USA). Subsequently, to facilitate electronic settlement, entitlements were created, which were eventually institutionalized in all state securities laws through the Uniform Commercial Code (on this, see Mooney et al., 1994 and Wittie, 1999). In less than 25 years, the DTCC immobilized most certificates (DTCC, 1999). According to a research study by the Securities Industry Association, certificates are involved in “just over one-tenth of 1% of all trade transactions processed daily” (cited in DTCC, 2004). Yet, the proportion of trades that fail today is not substantially different than it was in 1968 (SEC, 1973).

The NSCC routinely processes more than one trillion dollars’ worth of transactions, but makes settlement for only 3% of that value, which is a reduction in obligations due to netting (i.e., netting credits against debits for each participant in each security). In netting trade obligations, the NSCC uses securities due to a participant to offset securities due from the same participant in the same security. This process is believed to benefit the financial markets by simplifying the final settlement. Data are not made public about the number or quantity of stocks that change ownership after netting. In any event, unless the number of shares bought and sold exactly balanced, there would be a stock movement for every participant in every security traded. There are, therefore, limited benefits from netting for stock deliveries, which is the subject of this research.

The DTCC generally “re-nets” settlement failures, that is, failures are reset to zero each morning and only the end-of-day fails are recorded. When this is done, the DTCC’s records reflect that failed obligations are no longer outstanding because they had all been re-submitted for settlement, along with any new trades for the day. Regardless of the trade-date value, re-netted, previously failed trades are carried at current market value (“marked to market”).

Every market transaction requires completion for the analytical framework to work correctly. Efficient capital markets require that all participants have the same information. When one participant is allowed to fail to deliver securities on selected trades, then that participant has private information not available to the rest of the market. Critical information creates unfair competition in the relevant market—in this case, the stock market.

The elements of economic efficiency may be violated when securities transactions fail to settle, i.e., when securities are not delivered to the purchaser and the title does not transfer to the new owner for the following reasons. First, the supply of securities is permitted to exceed demand (exceed shares issued and outstanding) and, thus, when purchased securities are not delivered, an entitlement to the same share may be sold multiple times. Second, sellers have no incentive to reduce transaction costs because they are not required to complete the transaction. Finally, there is a temporal distortion of

profit incentives where the buyer who purchased undelivered securities paid a price other than the market price.

Our primary objectives were to examine the impact of modifications made to the settlement process rules and regulations by the NSCC on the efficiency of settlement by utilizing the volume of shares that failed to deliver. In the first stage, the data generating process was identified in terms of time-series models. In this study, a multivariate time-series model called a VAR model was identified with four lags by using various model selection criteria. The Granger causality test was then conducted based on the VAR (4) model. The Granger causality test findings between the quantity of failures and market returns show that, according to the VAR (4) model, there is a bidirectional link between the quantity of fails and market returns. The VAR (4) model has been expanded in order to account for the settlement rule modifications. The results show that the rule and regulation changes implemented by the NSCC had statistically significant effects on the quantity of shares failed to deliver. In addition, the results show that the rule changes implemented by the NSCC to govern the settlement process also had an effect on market returns. This research may provide important input to the design and operation of securities markets. In addition, C&S microstructures may address issues to improve the trading strategies of individual investors.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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