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From pit to electronic trading: Impact on price volatility of U.S. Treasury futures

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ABSTRACT

This paper investigates the dynamics of price volatility and trading volume of 10-year U.S. Treasury note futures within the context of transition from pit to electronic trading. The analysis is conducted over four discernible phases of futures trading evolution: the pit-only phase, the leap to electronic trading, and the electronic trading dominant phase, which is divided further into two periods, the before and after the financial crisis of 2007/2009. Generalized autoregressive conditional heteroskedasticity with in-mean conditional variance and generalized error distribution parameterization (GARCH-M-GED) tests are conducted to examine the conditional volatility of total returns index as a function of trading volume. The empirical results show a consistently negative relationship between the trading volume and price volatility for all four analyzed phases. They also show decreasing leptokurtosis (except for the direct effects of the recent crisis), continuously high persistency in volatility, as well as a weakening impact of unexpected ARCH-type shocks during the most recent analyzed period. Overall, the shift to electronic trading entails a substantial increase in trading volume, but not in price volatility of Treasury futures.

1. Introduction

Financial markets for trading futures on U.S. Treasury notes and bonds have undergone major institutional evolution since they were first introduced in the 1970s. One of the critical innovations has been the transition from the open-outcry pit trading to electronic trading. This major institutional change affected the price discovery process in several critical ways. First, it allowed for extending the trading time from the U.S. business hours to a round-the-clock 24-hour period. Second, the process of matching buyers and sellers moved away from the hand signals used by pit traders to lightning-fast electronic trade matching algorithms. Besides enhancing the speed and the efficiency of price discovery, the shift to electronic trading is credited with reduced transaction costs. All of this occurred during a long, secular bull market for U.S. Treasuries. More recently, the global financial crisis of 2007/2009 brought about further institutional changes to futures markets, namely new regulatory legislation in the form of the Dodd–Frank Act. In addition, the crisis induced a considerably increased buying activity of long-term U.S. Treasury securities by the Federal Reserve.

Recognizing these changes, this study aims to examine the impact of the transition from pit to electronic trading on the nature and patterns of price volatility and trading volume of 10-year Treasury note (T-note) futures. The main investigative question is whether price volatility was affected by the massive increase in trading volume that has occurred with the introduction of the electronic trading. This study contributes new dimensions to the literature on futures markets by focusing on the dynamics of price volatility and trading volume in the context of major institutional change. The general hypothesis is that the transition from pit to electronic trading has improved market liquidity of T-note futures due to higher trading volume, while price volatility has remained relatively unaffected.

For the purpose of assessing the impact of the transition, the trading pattern of 10-year T-note futures is analyzed over four discernible phases. Phase I includes the pit-only trading. It captures the period from the beginning of 1982 when 10-year T-note futures were introduced by the Chicago Board of Trade (CBOT) to August 28, 2000 when full round-the-clock electronic was launched.[1] Phase II corresponds with the fast-track leap to electronic trading, i.e. August 28, 2000 to September 12, 2003 when a well-defined full electronic trading dominance was reached (defined as a persistent plus-85% share of 10-year T-note futures electronic in total trading). Phases III and IV are characterized by the dominance of electronic trading, with the open-outcry pit trading playing only a marginal role. These last two phases are separated by the onset of the financial crisis.

The empirical tests are based on daily data for 10-year Treasury note futures made available by the CME Group. The sample period begins in January 1982 and runs through the end of 2011. The data set contains information for every contract stub (maturity), every trading day, for open, high, low, and settlement prices, trading volumes in the regular

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[1] Notably, the after-hours electronic trading was in place prior to August 2000, but its share in the overall market activity was minor.

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pit sessions and on the electronic platform, and open interest. This data set allows deeper understanding of price volatility beyond the typical standard deviation of price returns to investigate what was happening simultaneously with intra-day high-to-low price differences and trading volumes. Under normal distribution assumption, there would be a stable relationship between the standard deviation of price returns and the intra-day high-to-low percentage price difference. However, in this paper conditional volatility characteristics are examined by employing generalized autoregressive conditional heteroskedasticity GARCH(p,q) model augmented with the general error distribution (GED) parameterization that accounts for leptokurtosis, i.e. tail risks in the data distribution.

A continuous total return index for the 10-year T-note futures has been constructed by the CME Group and made available for this study. It serves as a basis to ascertain futures price volatility. This data series essentially represents an excess return series above the interest one might earn from the futures margin account or deployment of the available capital given the embedded leverage in the structure of futures contracts. Notably, calendar rolls occur four times a year in Treasury futures, and market participants typically exit the current contract prior to the commencement of the delivery period. Depending on the level of short-term interest rates embedded in futures prices, there can be meaningful price gaps between the expiring contract and the next maturity date. Simply splicing price data as the nearby contract expires introduces volatility into the series and incorrectly handles price returns four times each year, with some of these cases being non-trivial for return analysis. Thus, the CME-constructed total return index gives a better picture of how market participants actually experience price movements in Treasury futures, compared with ignoring the price bumps involved in a calendar roll, as well as the more nuanced trading that occurs during the delivery period in the last month of the nearby contract.

Section 2 provides a perspective on the transition from pit to electronic trading along with a brief overview of the pertinent literature. Section 3 introduces the four phases of evolution of futures trading and describes the methodology for verifying break points between them. The conditional price volatility analysis of the 10-year T-note futures returns is examined and discussed in Section 4. Section 5 summarizes the main arguments and findings.

2. Perspective on transition from pit to electronic trading and literature overview

The literature examining institutional changes in futures markets has been extensive. The transition from the open-outcry pit trading to electronic trading has been examined from various institutional perspectives. The literature on this subject dates back to 1992, shortly after the Chicago Mercantile Exchange created Globex, which was initially used for after-hours trading exclusively and applied only to certain selected and specific futures products. Virtually all major futures exchanges experimented with electronic trading platforms during the 1990s, including the CBOT which operated the 10-year Treasury note futures product.

It should be emphasized that the decision to introduce electronic trading was not made without significant controversy. The history of the decision process is laid out in detail by Melamed (2009). Futures exchanges, including CME Group, are now organized as public companies with openly traded shares of stock, but in the 1990s both the CME and the CBOT were mutual organizations owned by their members. And their members, most of whom earned their livings from floor trading, at least initially were not all in favor of the move to electronic trading on a 24-hour basis in direct competition to floor trading. In addition, the investment in an electronic trading platform and the software development of trade matching engines was expensive, not easy to accomplish, and embodied considerable operational risk. Indeed, the CBOT used a number of different electronic platforms for its 10-year T-note futures product during the transition period from pit to electronic trading.

Much of the discussion in the academic literature has been focused on trading various financial futures in three distinctive trading systems: the floor-dominant, the hybrid floor/automated, and the automated dominant systems. Perhaps the most discernible functional distinctions between the floor-dominant versus automated dominant systems are that the first one is conducted only during specific daytime business hours and requires person-to-person interaction to match buyers and sellers while the second one runs almost 24 h (with a short break to reset the day) and buyers and sellers are matched with electronic trading algorithms that operate in a lightning fast manner. Both of these distinct differences have had their impacts on futures markets.

Round-the-clock trading does not just open up futures market for “after-hours” trading, it reaffirms the global nature of markets and better aligns futures with cash or physicals markets. There was nothing stopping Asians and Europeans from placing orders before the open of U.S. pit trading in Treasury futures, but futures trades could not be executed until the bell rang for trading to commence. For those outside the U.S. time zones, if one wanted to trade the market actively, one had to trade during one's night-time hours. Initially, in the 1990s, electronic platforms first handled only after hours trading, and were later extended to 24-hour trading overlapping the pit trading sessions.

The lightning-fast trade matching algorithms expanded the ability of certain market participants to trade more actively. Again, active trading has always been a feature of organized markets, but technology has altered what is possible. In the pit era, active traders wore the moniker of “day traders”, while in the electronic era we have “high-frequency traders”. It is a natural process of the evolution of how organized markets provide liquidity for all participants.

Much of the analytical literature was written *during* the transition from the open outcry to electronic trading. This literature discusses key characteristics of both trading platforms while attempting – with varying degrees of success – to identify the potential key *advantages* of the electronic trading over its floor-based predecessor. Ates and Wang (2005) discuss such characteristics as faster speed, accuracy in transactions processing, lower operating costs, open access to the limit order book, and anonymity of trader identification. These “technical” advantages allowed some authors to point toward the general conclusion that automated trading would likely contribute to greater market liquidity and to a faster, more efficient price discovery process (Martens, 1998).

The empirical literature comparing various features of electronic and the open-outcry pit system has strongly emphasized the benefit of lower transaction costs brought forth by the automated markets, due to a much faster order execution in these order-driven markets. A number of studies including Venkataraman (2001), Coppejans, Domowitz, and Madhavan (2006), as well as Tse and Bandyopadhyay (2006) indicate that cost savings from moving to automated from the open-outcry markets can be passed onto market participants in the form of lower fixed transaction costs. In addition, Gutierrez and Tse (2009) argue that the electronic trading systems entail lower inventory control costs.

The open access to limit order books and the anonymity of trader identification in electronic markets are related to the major difference in information extraction in the open-outcry versus electronic markets. In floor-based trading, the pit traders and floor brokers know and select each other, while they remain anonymous in a global electronic framework. Following this notion, Theissen (2003) makes an interesting observation that informed traders prefer to transact in an automated market, because they have incentives to hide and remain anonymous. Moreover, limit order traders in automated markets take advantage of volatility information. Foucault, Moinas, and Theissen (2007) examine whether limit order traders formulate information about future volatility on the basis of the bid–ask spread. They find that the average quoted spreads are smaller when limit order traders' identifiers are concealed, as the lower spreads may reduce their expectations about future volatility.