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# Innovation in Treasury Futures: Examining Volatility Patterns Before and After the Shift From Open-Outcry to Electronic Trading

Lucjan T. Orlowski

*Sacred Heart University*, [orlowskil@sacredheart.edu](mailto:orlowskil@sacredheart.edu)

Bluford Putnam

*Sacred Heart University*

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***“Innovation in Treasury Futures:  
Examining Volatility Patterns before and after the  
shift from Open-Outcry to Electronic Trading”***

**Lucjan T. Orlowski and Bluford Putnam**

**Presentation at Luxembourg Conference  
Luxembourg, May 18, 2012**

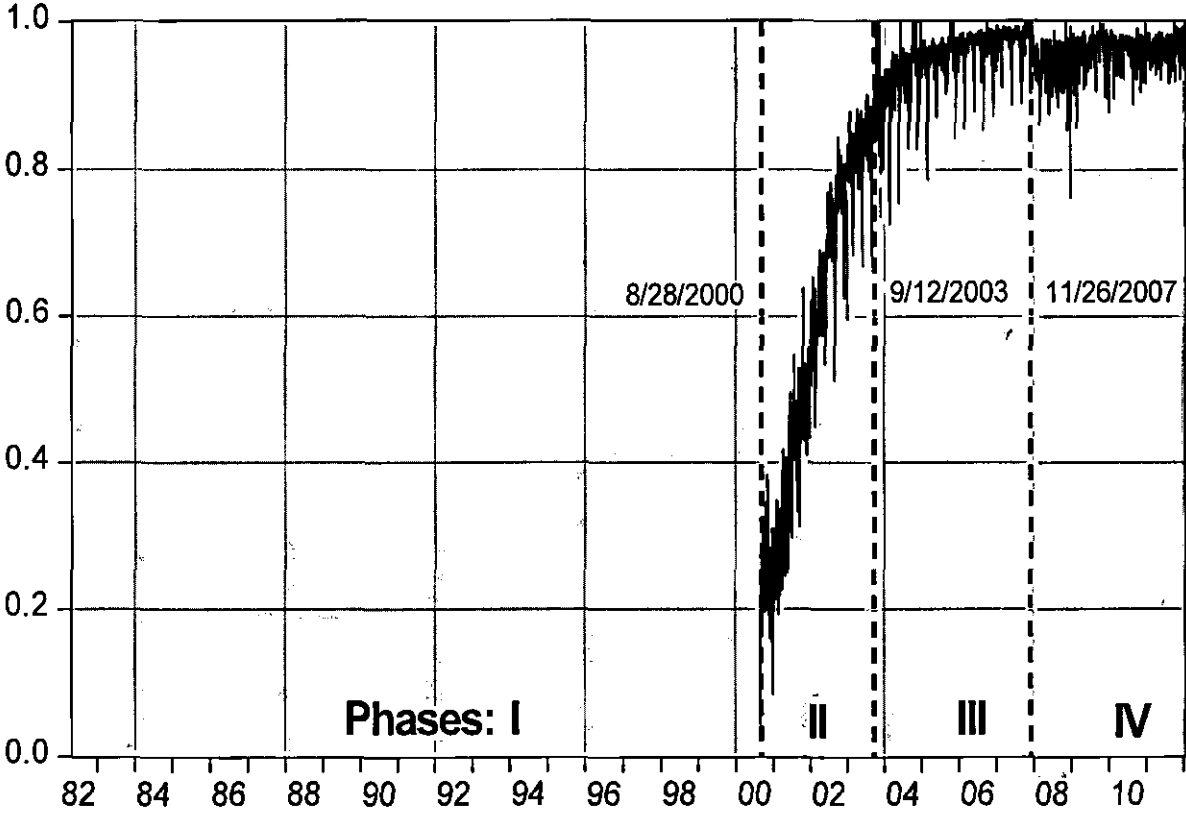
## Key Objectives

- Identify major stages of transformation of U.S. 10Y Treasury futures trading from *open-outcry* to *Globex electronic*
- Examine major features of institutional changes at each stage of this transformation

## **Four Distinct Phases of Transition from Pit to Globex (see Figure 1)**

- 1. Pit Only Phase.** The period of exclusive CBOT floor (open-outcry auction) trading runs from the inception of the US 10-Year Treasury Note futures trading on May 3, 1982 to August 28, 2000 when the CBOT US 10-Year Treasury Note futures was added to the Globex trading platform.
- 2. Hybrid or Transitional Phase.** A hybrid period, with active trading in both the pit session and on the electronic trading system existed from August 28, 2000 (4% share trading on Globex) to September 11, 2003 (Globex's share reaching 90%).
- 3. Globex Dominant Phase.** The phase of a dominant, well-established electronic Globex trading system ran from September 12, 2003 to November 26, 2007. The end-point coincides with a major dive in the Globex share from 99 to 90 percent as the effects of the US subprime mortgage debacle spread through the financial system.
- 4. Globex Leadership Phase,** involving a renewed role for pit trading. The commencement of the limited revival of pit trading corresponded with the elevated systemic risk crisis period from November 26, 2007 and has continued through the end of 2011 (the end of our data range). This phase is characterized by the dominance of Globex but with some, discernible role for the floor-based trading.

**Figure 1:** Share of U.S. Treasury 10-Year Note futures trading volume on Globex as a percent of total trading volume:



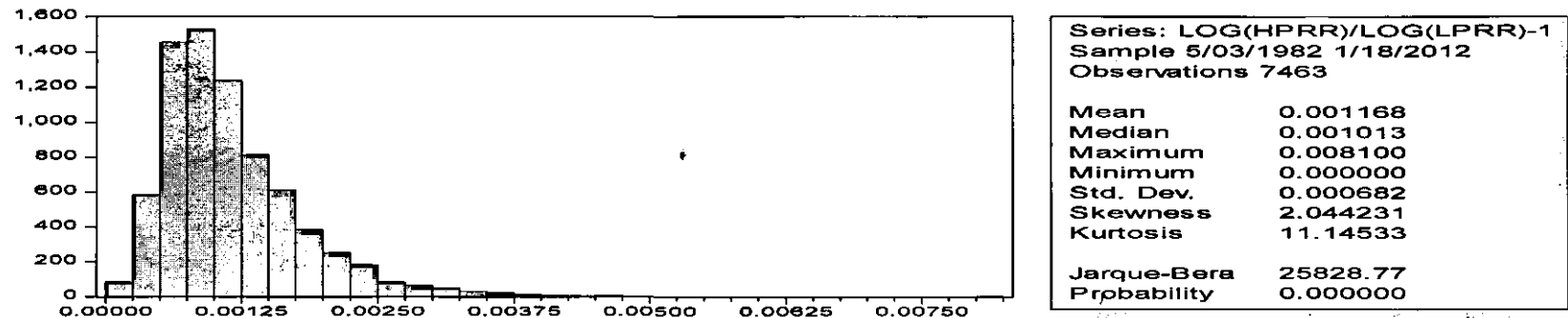
Data source: CME Group.

# Institutional Difference I : Price Discovery Pit vs. Globex

## Diagnostic Statistics of High-Low Price Ratio

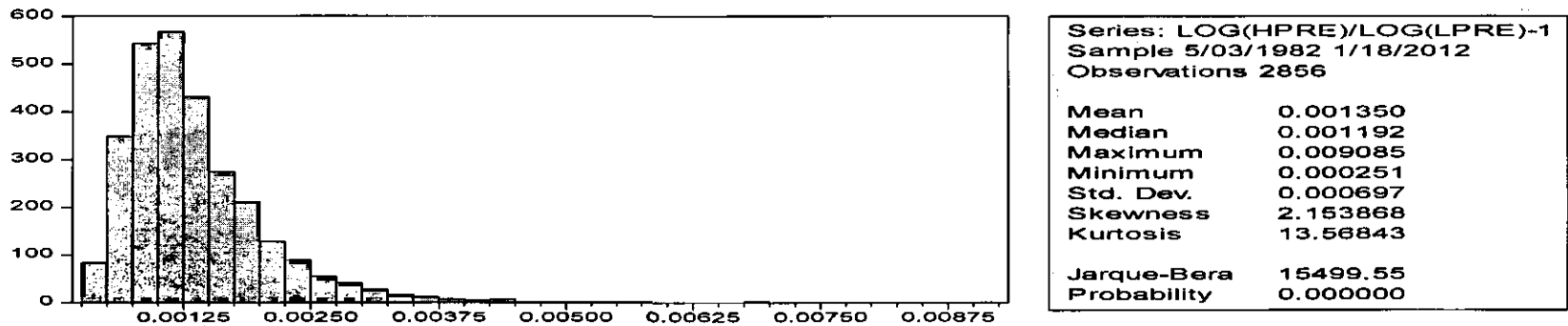
**Figure 2: The ratio of logs of high-to-low price**

**Fig. 2a: Pit sessions. Sample period: May 3, 1982 – January 18, 2012**



Strong leptokurtosis, right skewed:

**Figure 2b: GLOBEX sessions. Sample period August 29, 2000 – January 18, 2012**



Higher mean, even more leptokurtic, and more right skewed than the distribution for the same ratio for pit trading.

# Institutional Difference II

## Responses of trading volume to the difference between high and low prices on pit vs. Globex

**Figure 3:** Impulse responses of total 10Y Treasuries trading volume to a one-standard-deviation shock in the change in high-low price spread on pit vs Globex sessions

Fig. 3a: Pit sessions

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

Response of DLOG(TRV10Y) to D(HPRR-LPRR)

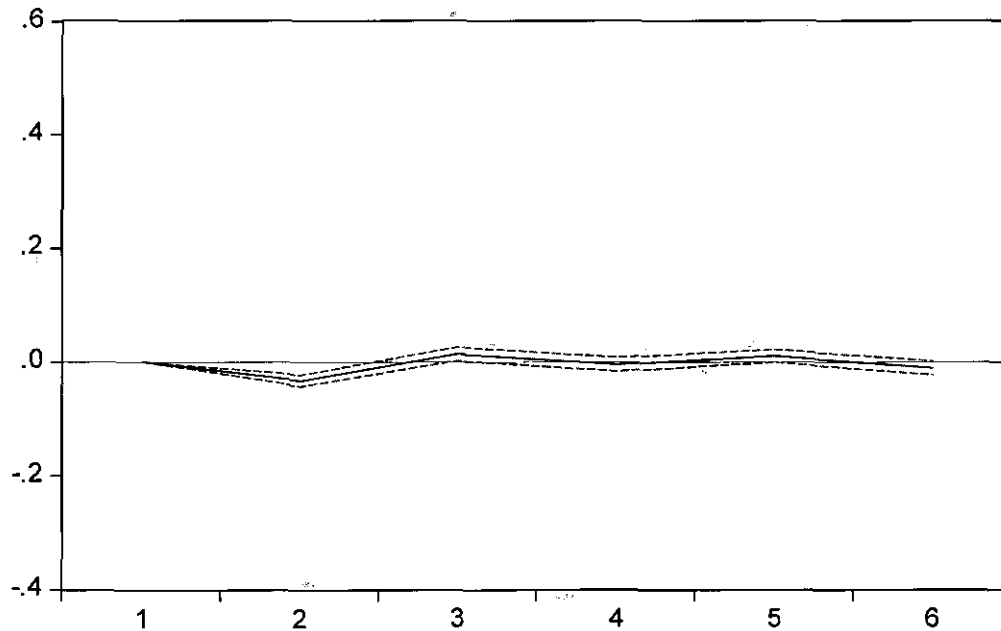
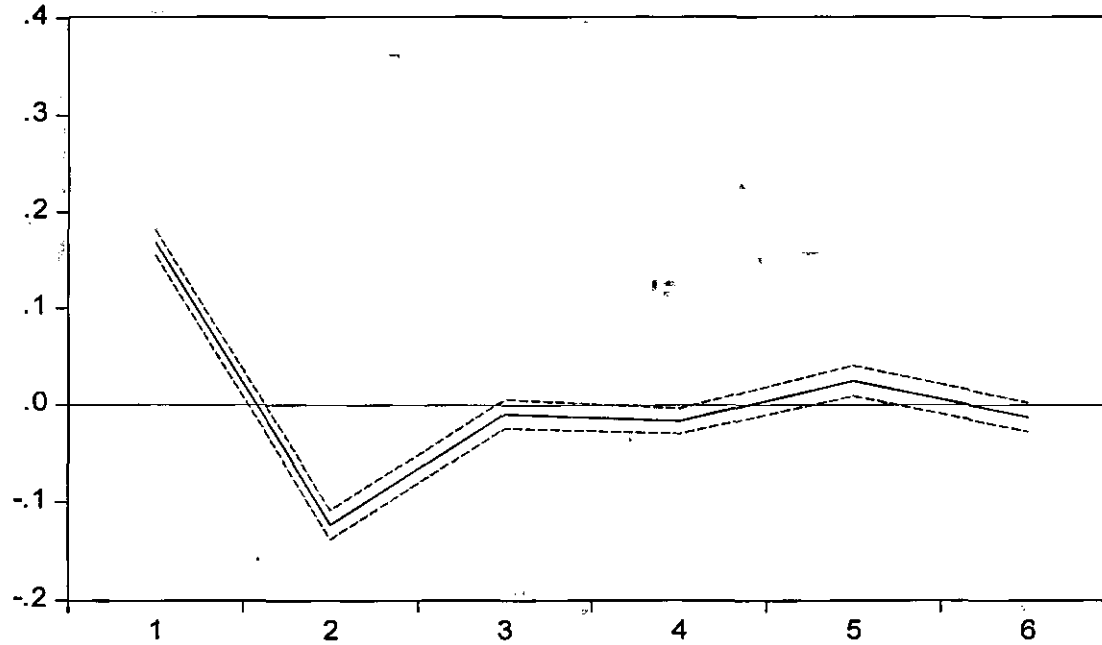


Fig. 3b: Globex sessions.

Response to Cholesky One S.D. Innovations  $\pm 2$  S.E.

Response of DLOG(TRV10Y) to D(HPRE-LPRE)



Source: Authors' estimation based on CME Group data.



## Figure 3 Results

- *Pit*: No change in total 10Y Treasuries trading volume in response to the high-low price spread on pit sessions
- *Globex*: a sharp immediate increase in trading volume in response to a wider high-low price spread, followed by a correction
- This reaction underscores the stronger role of day traders in electronic markets
- It reflects sudden shocks induced by a flight to quality at times of financial distress that are normally followed by the second day correction
- *Arguably, traders seem to react much faster to the new information in electronic trading, while in pit sessions the news spreads over time*

# Analysis of Returns and Volatility Dynamics

## GARCH-M-GED Model

- The conditional mean equation:

$$\Delta\left(\frac{\log P^H}{\log P^L}\right)_{t+\tau} = \gamma_0 + \gamma_1 \Delta(VOL)_t + \gamma_2 \sigma_{t-1}^2 + \mu_t \quad (3)$$

- The conditional variance equation:

$$\sigma_t^2 = h_0 + h_1 \mu_{t-1}^2 + \dots + h_p \mu_{t-p}^2 + v_1 \sigma_{t-1}^2 + \dots + v_q \sigma_{t-q}^2 \quad (4)$$

**Table 6: GARCH(p,q)-M-GED Tests (Eqs. 3 and 4).**

Dependent variable:

Change in the logs of high/low price ratio for the day of 10Y Treasury 10-Year Note Futures.

Regressors:

Change in the 10Y Treasury 10-Year note futures trading volume (VOL); log of GARCH term (logGARCH).

<b>Variables:</b>	<b>Phase I</b>	<b>Phase II</b>	<b>Phase III</b>	<b>Phase IV</b>
<i>Conditional mean equation:</i>				
Constant term	0.001*** (8.54)	0.001*** (4.07)	0.001*** (4.40)	0.001*** (3.43)
VOL	0.039*** (43.73)	0.007*** (21.15)	0.002*** (36.17)	0.002*** (23.97)
GARCH var.	-105.21*** (-10.84)	-160.32*** (-4.66)	-96.948*** (-5.86)	-57.19*** (-4.80)
<i>Conditional variance equation:</i>				
Const.	0.001**	0.001	0.001	0.001
ARCH(1)	0.423***	0.486***	0.687***	0.499***
ARCH(2)	-0.379***	-0.443***	-0.240	-0.481***
ARCH(3)	-0.020	-0.027	0.035	NA
ARCH(4)	-0.007	0.085**	-0.017	NA
ARCH(5)	0.032**	-0.064**	0.005	NA
ARCH(6)	-0.031**	0.023	-0.004	NA
ARCH(7)	NA	NA	0.012	NA
GARCH(1)	0.976***	0.897***	0.328	0.981***
GED parameter	1.242***	1.387***	1.163***	1.177***
<i>Diagnostic statistics:</i>				
Adjusted R <sup>2</sup>	0.26	0.34	0.53	0.29
AIC	-8.841	-8.937	-9.547	-8.789
SIC	-8.825	-8.860	-9.485	-8.751
Log Likelihood	20413.2	3406.4	5039.2	4591.5
Durbin-Watson	2.58	2.43	2.60	2.65

Notes: Z-statistics are in parentheses; AIC= Akaike information criterion; SIC= Schwartz Information criterion; \*\*\* indicates significance at 1%, \*\* at 5%, \* at 10%.

Source: Authors estimation based on CME data.

## Table 6 Results

- Phase I: increase in volume in pit sessions associated with a higher high-low price ratio; negative GARCH in mean = higher risk engenders lower returns (underscoring risk hedging function of Treasuries); highly persistent conditional variance; unruly impact of high-order ARCH news on volatility; pronounced tail risk (high leptokurtosis implied by GED parameter lower than 2)
- Phase II: increase in volume in pit sessions associated with a higher high-low price ratio; negative GARCH in mean; less persistent GARCH variance; complex ARCH terms; significant tail risks
- **Phase III: less pronounced direct relationship between higher volume and high-low price ratio; much lower GARCH persistency, but stronger role of ARCH-type shocks implying high susceptibility to random shocks; strongest leptokurtosis, i.e. most extreme tail risks; most robust result among all four phases**
- Phase IV: increase in volume in pit sessions associated with a higher high-low price ratio; negative GARCH in mean; return of high GARCH persistency in volatility; weaker tail risks than in phase III; weaker role of ARCH-type surprises to volatility

## Conditional Volatility Characteristics of the Four Transitional Phases

- Transition from pit to Globex has been quite dramatic, but there is now some room for person to person trades
- Trading volume strongly reacts to shocks in high/low price ratio in electronic trading, but not in open-outcry
- The price discovery (high/low price ratio) is strongly affected by the trading volume, regardless of the institutional transition
- Phase III exhibits quite different conditional volatility characteristics than the remaining three phases; volatility during the Globex-dominant period was driven predominantly by ARCH(1)-type shocks and had low persistency
- During Phase III, changes in high/low price ratio were subject to the most extreme tail risks

## A Summary: Highlights of Our Findings

- A rapid transition (a leap) from open-outcry to electronic trading
- Substantial increases in trading activity and open interest within the transition process
- Trade matching at the lightening speed → lower transaction costs → high frequency trading
- In Globex dominant trading, external (ARCH-type) shocks or surprises hit the Treasury futures market → a greater propensity for price jumps (discontinuities) and → higher trading volume; the day after resumption of normal volumes gets shorter
- Higher correlations between price volatility and intra-day high-low price spreads in Phases III and IV → market surprises (shocks) cause problems for option traders relying on straight-forward implied volatility models (i.e. Black-Scholes)
- Phase III shows discernible volatility characteristics, i.e. predominance of ARCH-type shocks, significant tail risks; nevertheless, the higher volatility might be attributable to the risk-taking associated with the sub-prime debacle