

Cash Treasuries vs Futures on October 15, 2014

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On the morning of October 15, 2014, between 9:35 and 9:45 New York time, yields on US Treasury securities underwent their largest single-day drop since 2009, and quickly recovered. For example, the yield on the 10-year note fell from 2.05% to 1.873% before recovering. Articles in *The Wall Street Journal*¹, *Financial Times*², and *Bloomberg*³ have suggested that these sharp price moves may have been in part due to the increasing prevalence of electronic trading, which is destabilizing the market for US Treasury cash products and futures.

The most detailed study of this event appeared in *Risk* magazine.⁴ Based on conversations with 24 banks, hedge funds, and others, *Risk* reported that in the first weeks of October, the sell-side as a whole was accumulating a substantial short gamma position. Hedging of these positions created market instability and amplification of any price moves.⁵ This suggests that the sharp price moves were a consequence of investment dynamics rather than electronic trading and market structure.

The most notorious and well studied incident of sharp price swings was the equity “flash crash” in 2010. A detailed academic study⁶ suggests that the dynamics of such events are as follows: High-frequency traders and market makers stabilize small price fluctuations, since they are ready to absorb trade volume in both directions. But in the presence of sustained pressure on the market in one direction or the other, these participants quickly reach their capacity and withdraw their quotes. The market thus passes a “tipping point” at which large traders cause large price swings until volume emerges on the opposite side.

Our study of public market data on October 15 suggests that high frequency trading was not responsible for the rapid price swings. It was not a “flash crash.” Indeed, risk aversion by asset managers closing losing positions may have been the largest contributor to the large price swing.

¹Tom Lauricella and Katy Burne, “Bond Swings Draw Scrutiny,” *Wall Street Journal*, Nov. 9, 2014.

²Tracy Alloway and Michael MacKenzie, “Bonds: Anatomy of a market meltdown,” *Financial Times*, Nov. 17, 2014.

³Susanne Walker and Lisa Abramowicz, “Flash boys raise volatility in wild new Treasury market,” *Bloomberg*, Nov. 18, 2014.

⁴Kris Devasabai, “No flash crash: Paulson, Pimco and the US Treasury meltdown,” *Risk*, Dec. 8, 2014.

⁵See, e.g., T. M. Li and R. Almgren, “Option hedging with smooth market impact,” preprint 2014.

⁶A. Kirilenko, A. S. Kyle, M. Samadi, and T. Tuzun “The flash crash: The impact of high frequency trading on an electronic market,” preprint 2014.

Our analysis is based on detailed trade and order book data obtained directly from the NASDAQ eSpeed and ICAP BrokerTec electronic platforms for trading US Treasury securities, as well as from the CME Globex platform for electronic trading of the corresponding futures products. To our knowledge, no study of this event published to date has had access to order book data for the cash bond markets.

Figure 1 shows the overall price dynamics on the morning of Oct. 15. The upper panel shows the time interval from 8:00 to 11:00; the lower panel zooms in on the price excursion itself. We have identified 9:33 as the approximate beginning of the rapid price move, and 9:40 as the time when the prices hit their peak and began reverting. All times are New York local, Eastern Daylight Time.

From Figure 1 it is clear that all maturities move very closely together, and also that each futures contract tracks very closely with its underlying cash instrument (the colors in Figure 1 are chosen to be similar between futures and cash). If the price excursion were the result of a breakdown in liquidity in one or more products, or if it were the result of a strongly unbalanced trade in one or more products, then we would expect that some divergences would open up between the different maturities, or possibly even between the futures and the cash.

The significant phases of the price evolution may be identified as follows:

- At 8:30, the Commerce Department released September retail sales figures, below expectations with a decline of 0.3% relative to August (though 4.3% higher than Sept. 2013). Bond prices rose sharply, a typical market response to the information revealed by an announcement.
- For the next hour, prices rose steadily.
- At 9:33, the market began its sharp rise.
- At 9:40, prices peaked, and began a reversion, roughly to pre-spike levels.

Figure 2 shows total liquidity available in the visible order book.⁷ As is typical around an information announcement, liquidity is sharply withdrawn immediately before the release at 8:30, but rebounds quickly. Thus the Retail Sales information was likely not a contributor to the price jump.

From 9:30 onwards, liquidity is gradually withdrawn from the book, for both futures and cash markets. For example, for the 10-year note futures contract, available liquidity at 9:33 has fallen to 1/3 of its high following the Retail Sales announcement. This liquidity withdrawal happens while the prices rise only gradually.

To interpret the vertical scales in Figure 2, recall that each futures contract represents an underlying notional value of \$100,000 (we exclude the 2-year futures contract whose notional is \$200k). Thus, 10,000 lots of futures, roughly the midpoint of the upper panel of Figure 2, is equivalent to \$1 billion of cash value, the midpoint of the lower panel. Overall futures volume and overall cash volume are roughly comparable. But futures available volume decreases much more dramatically than available cash volume, both before 9:33 and during the rapid jump period.

⁷For CME, we have 10 levels on either side of the inside bid and ask; for eSpeed 5 levels, and for BrokerTec we have the entire book. Values shown here combine eSpeed and BrokerTec data.

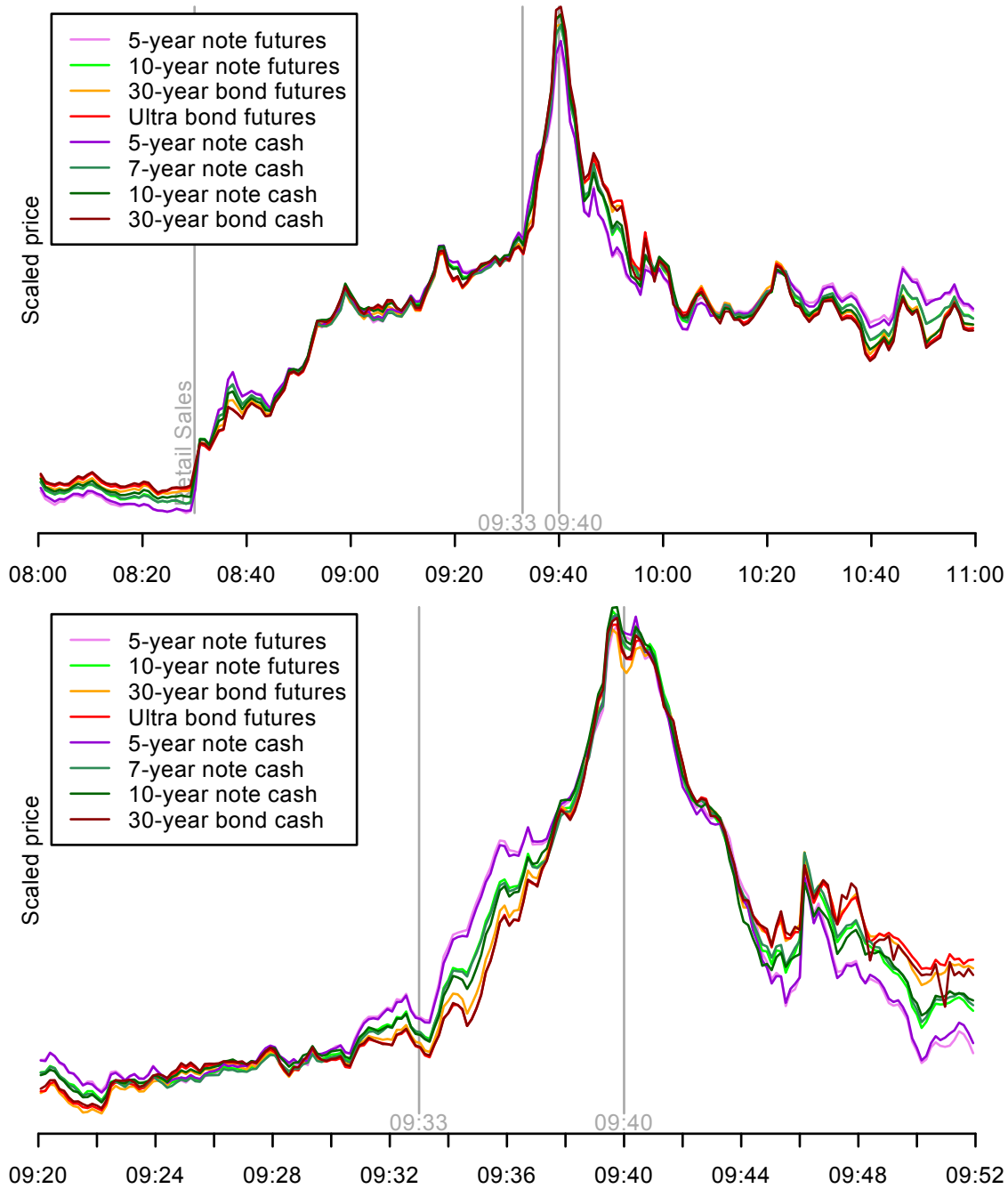


Figure 1: Prices of Treasury futures and cash products on October 15, 2014, in New York time. Each product has been scaled so that they align as closely as possible (the actual price changes are on the order of a few percent). All maturities move very closely together, and the futures track their underlying products extremely closely.

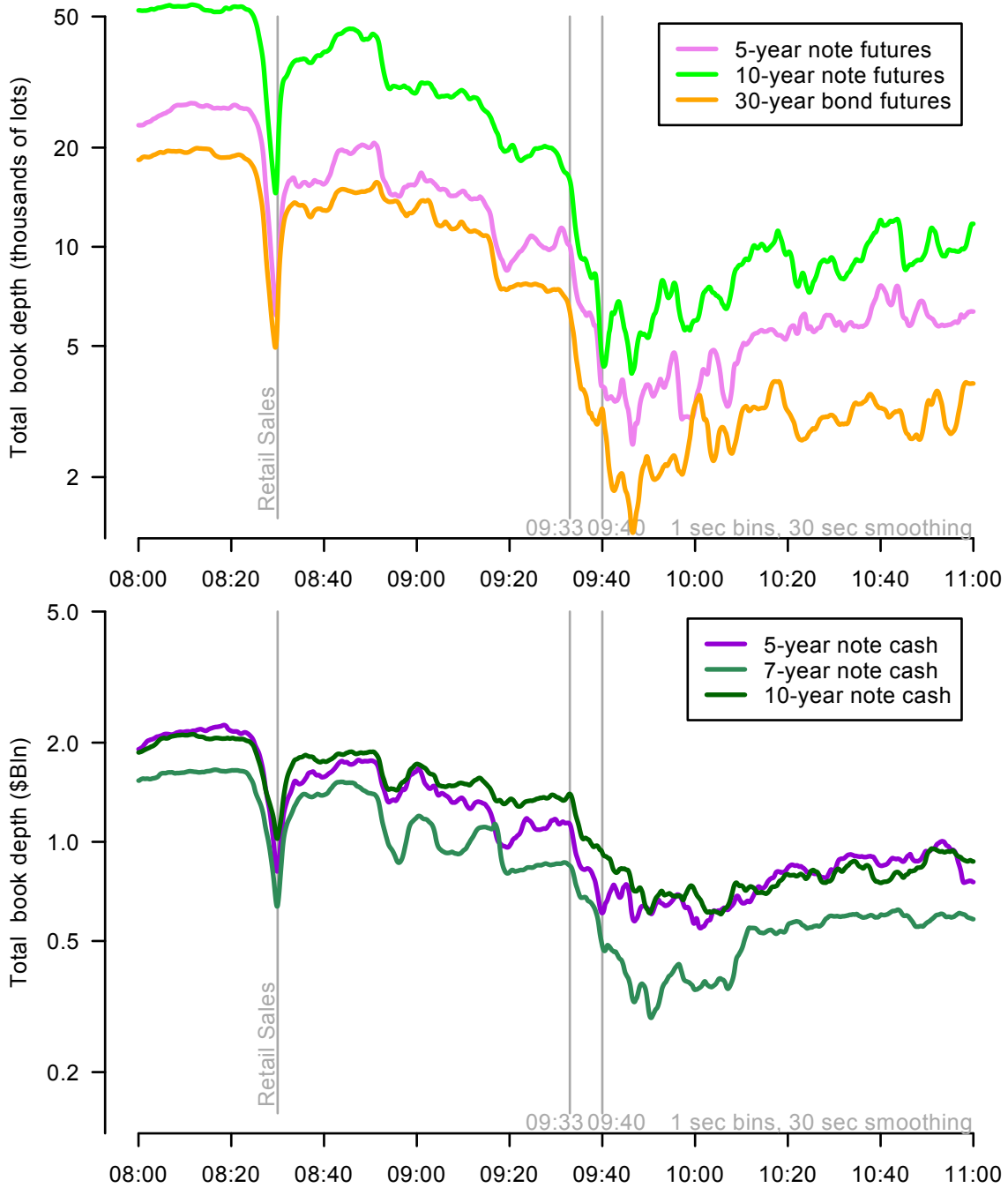


Figure 2: Total order book depth for futures and cash products, CME Globex for futures and combining eSpeed and BrokerTec for cash products. Note logarithmic vertical scale. Vertical axes are scaled to represent equal economic value: for example, 10,000 futures lots is equivalent to \$1 Bln notional of cash bonds.

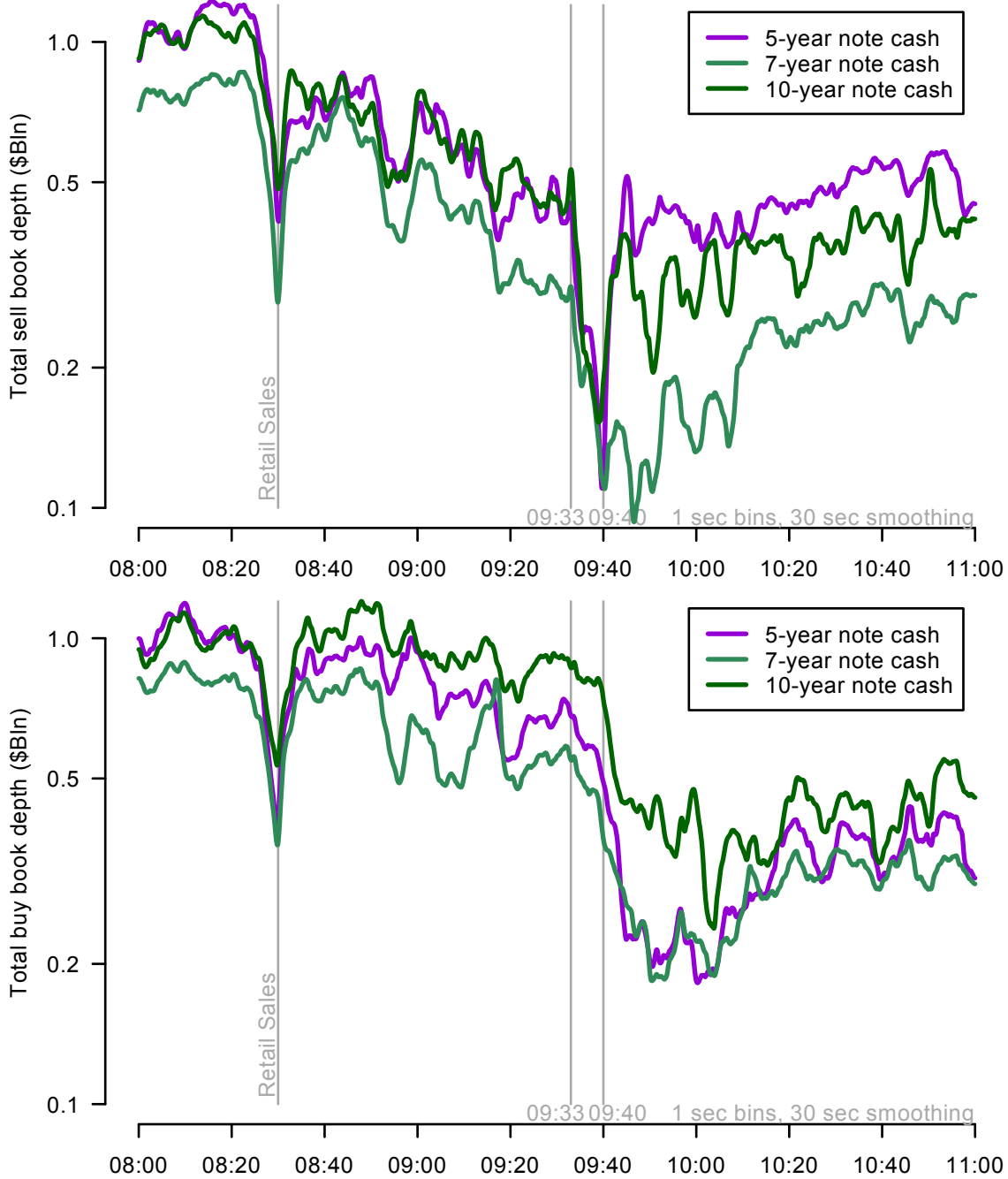


Figure 3: Total quantity available for cash notes and bonds in the combined eSpeed and BrokerTec orderbooks. Upper panel shows “sell” volume: limit sell orders above the market. Lower panel is total “buy” volume: limit buy orders below the market. Sell volume decreased much more than buy.

Figure 3 separates market depth in the cash markets by side (we combine eSpeed and BrokerTec). Sell volume does not fully recover from the dip around Retail Sales at 8:30, although buy volume does recover. Between 8:30 and 9:30, sell volume steady and substantially decreases, while buy volume is approximately constant. At 9:33, sell volume drops very sharply as the price rises. Buy volume decreases only moderately until 9:40, when the price hits its peak and begins to revert.

Figure 4 shows signed trade volume. To calculate this, we look at each trade print, relative to the prevailing bid and offer in effect at the time of the trade. If the trade price is above the bid-offer midpoint, then we count the trade a “buy,” with positive volume; if the trade price is below the bid-offer midpoint, then we count it a “sell,” with negative volume. Signed volume is the difference between these two volumes. The quantities in Figure 4 represent a smoothed “rate” of this volume, in thousands of lots per minute for futures and billions of dollars per minute for cash products. The total quantities are thus approximately comparable.

Signed trade volume fluctuates up and down during the hour following the news release. There is a substantial upward move slightly *before* the price begins to move sharply, especially in the 10-year note futures, the most active contract. Possibly this directional trade volume, coming into a market that had been thinned by quote withdrawal, is what kicked off the price swing. Directional trade activity in the cash products is much less pronounced.

Figure 5 shows total (unsigned) volume for futures and cash. There is steady trade activity through the entire period, and substantially higher volume during the jump.

We thus reach the following picture of the events of Oct. 15:

- The market was under steady pressure from options hedging.
- Liquidity providers and market makers were able to absorb some of the pressure, but only in limited quantity and only for a finite time.
- At 9:33, the market “broke.” Liquidity was rapidly exhausted and prices rose. There seems to be no obvious signal that would have anticipated this move.
- At 9:40, the market hit its peak and reverted. Again, there seems to be no obvious effect that would have indicated the top.

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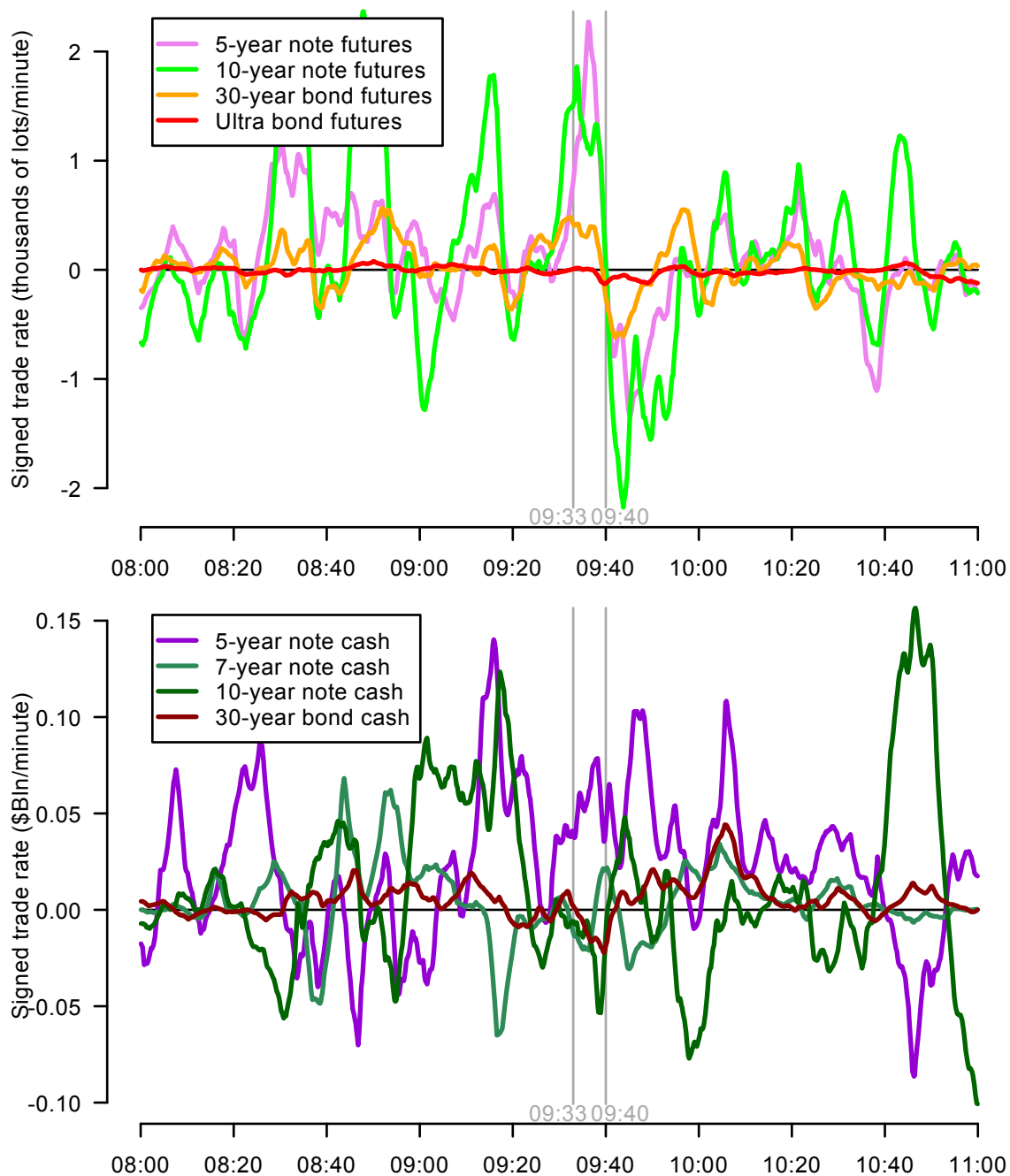


Figure 4: Signed trade volume for futures and cash products. We propose that the rise in signed volume just before 9:33, in particular for the 10-year futures contract, launched the price swing.

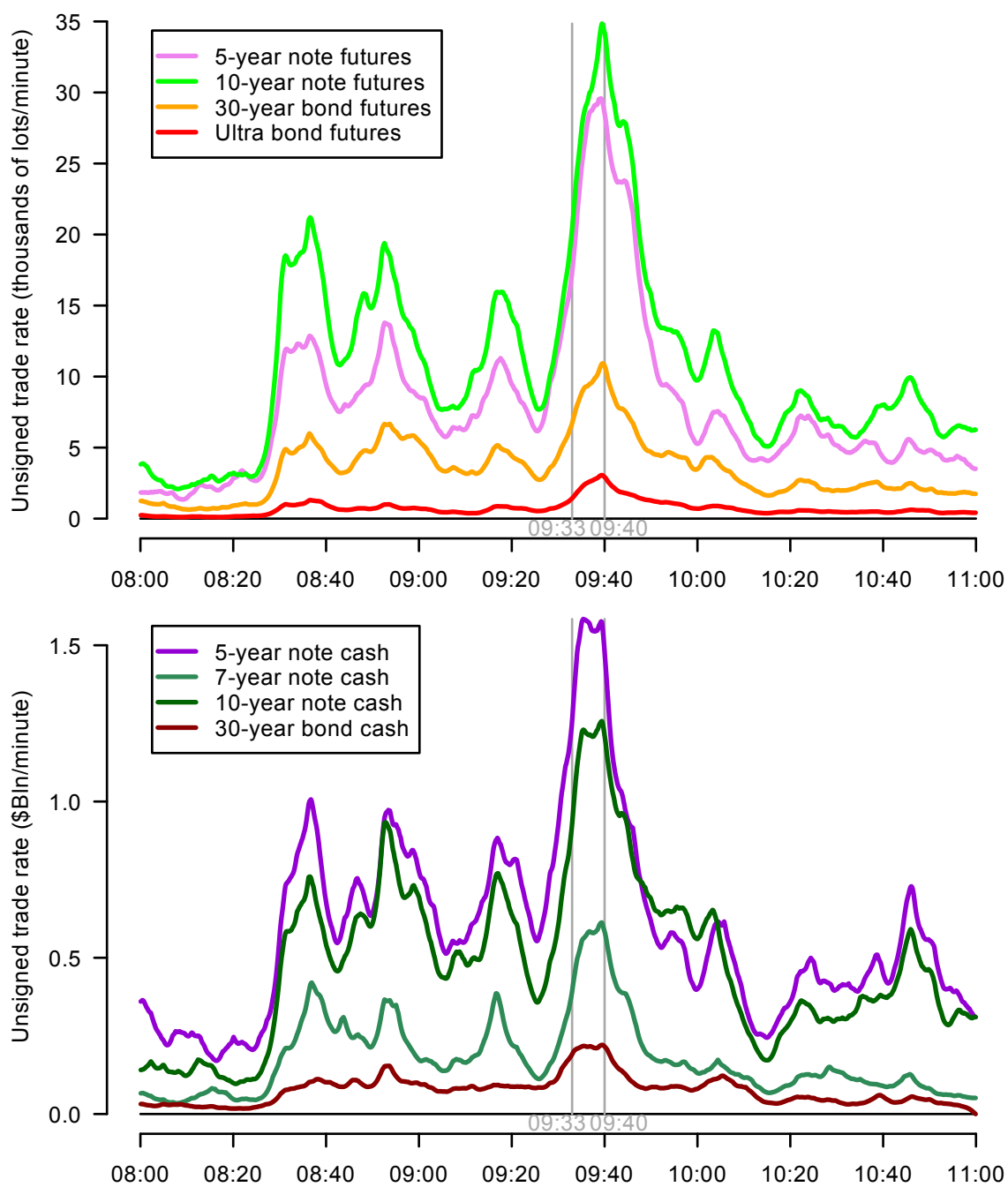


Figure 5: Trade volume (per minute) for futures and cash products. Trade activity hit a peak as prices hit their peaks, and the price recovery happened on diminishing volume.