

What Happened on May 6th?

May 10, 2010

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A CME/Chicago Board of Trade/NYMEX Company

Extraordinary market action was witnessed in the stock markets on May 6, 2010. Within a few minutes, the Dow Jones Industrial Average (DJIA) had fallen by 1,010.14 points for the day, or approximately 9%, only to rebound as quickly. Several stocks including Proctor & Gamble, Accenture and 3M traded down sharply before rebounding.

This paper describes the situation with a focus on CME Group stock index futures markets. In particular, we focus on the safeguards that CME Group exchanges, including CME and CBOT, maintain in place with respect to the electronic trading of its various stock index futures contracts.

Background – Prior to May 6th, domestic equity markets had been rising steadily with the major indexes rallying during 12 of the previous 14 months. Still, there were some major issues overhanging the market.

In reaction to continuing indications of economic recovery from the recent recession, concerns mounted that possible Fed monetary tightening might inhibit the recovery, possibly leading to a “double-dip” economic downturn. Many technical traders had begun to look for a possible equity market correction. This was further exacerbated by heightening tension as a result of the Greek debt crisis that had boiled over in violence on May 5th in the streets of Athens.

These factors had weighed on international equity indexes the evening before. Accordingly, domestic equity markets were generally weak as we entered the trading day on May 6th.

The Incident - Let us focus on the period from 13:30 to 14:00 (CT) during which time the incident in question occurred. CME stock index futures were declining after 13:30 (CT) followed by spot equity markets including Proctor & Gamble (PG), 3M (MMM) and Accenture (ACN). June 2010 E-mini S&P 500 futures traded at its low of 1,056.00 by 13:45:28 (CT) and then started to climb.

But PG, MMM and ACN continued to slide even after futures hit their low and began to reverse upwards. They were put into a reserve mode by the New York Stock Exchange (NYSE) per its Rule 1000(a), Liquidity Replenishment Points, at 13:45:52, 13:50:36, 13:46:10, (CT) respectively.

Still, these stocks continued to decline as orders were re-routed to possibly less liquid security

trading venues which may not have been entirely coordinated with NYSE Rule 1000(a). As depicted in Exhibit 1 of our Appendix, PG printed a low of \$39.37 at 13:47:15 (CT); MMM printed a low of \$67.98 at 13:45:47 (CT) while ACN printed a low of \$0.01 at 13:47:54 (CT). Note that those penny prints in ACN were being examined and busted by the trading venues in which they were executed. Nasdaq had announced that it would bust all trades that were more than 60% off the market.

Thus, CME E-mini S&P 500 futures were rallying upwards while PG, MMM and ACN continued to decline as indicated in the charts below. One might attribute this apparent temporary de-linkage between spot and futures markets to divergent institutional market structures amongst the venues at which the spot stocks are traded.

Price Discovery and Liquidity – The primary purposes of futures markets are to provide an efficient mechanism for price discovery and risk management. The academic literature underscores the efficacy of futures markets as a tool of price discovery. According to one study, “[e]mpirical results confirm that futures market plays a price discovery role, implying that futures prices contain useful information about spot prices.”¹

As such, stock index futures frequently represent the venue in which price information is revealed first, generally followed closely by spot markets. In fact, most researchers find that “futures lead the cash index returns, by responding more rapidly to economic events than stock prices.”²

This phenomenon was clearly in evidence as E-mini S&P 500 futures represented the primary engine of price discovery slightly leading SPDRs (the S&P 500 Exchange Traded Fund or “ETF”) during the downturn as depicted in Exhibit 2 of our Appendix. Both E-mini S&P 500 futures and SPDRs turned around near 13:45:28 (CT). The decline was orderly and rather consistent. As shown in Exhibit 2, the subsequent rally in futures was likewise consistent and orderly. However, the rally in SPDRs was

¹ Floros, C. and Vougas, D. V. (2007) Lead-Lag Relationship between Futures and Spot Markets in Greece: 1999-2001, *International Research Journal of Finance and Economics*, 7, 168-174.

² Kavussanos, Manolis G., Visvikis, Ilias and Alexakis, Panayotis, The Lead-Lag Relationship between Cash and Stock Index Futures in a New Market. *European Financial Management*, Vol. 14, Issue 5, pp. 1007-1025, November 2008.

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comparatively uneven and highlighted by rather wide swings.

Liquidity is the key ingredient that lends efficacy to the price discovery function of futures markets. Let's look at some indicators that may help us compare relative liquidity in E-mini S&P 500 futures and SPDRs.

Trading volume of E-mini S&P 500 futures was approximately 300% to 400% greater than SPDRs on a notional basis from 13:30 to 14:00 (CT). At the peak of the incident near 13:45-13:50 (CT), futures volume was near 800% that of SPDRs. (Note that SPDRs are 1/500th the size of one E-mini S&P 500 futures contract so we have "normalized" SPDRs volume by dividing by 500 to be comparable to E-mini futures.)

Volume by 5-Minute Bracket

	E-Mini S&P 500 Futures	SPDRs	Ratio
13:30-13:34:59	73,880	19,935	371%
13:35-13:39:59	161,723	41,181	393%
13:40-13:44:59	247,653	58,653	422%
13:45-13:49:59	276,094	47,431	582%
13:50-13:54:59	205,188	26,791	766%
13:55-13:59:59	112,800	29,505	382%
Totals	1,077,338	223,496	482%

Order book depth cannot be compared directly between futures and cash market, given that there is no central limit order book in the cash market *per se*. But trading ranges may be illustrative as a proxy. Exhibit 3 in our Appendix depicts the ratio of the futures trading range relative to the SPDRs trading range in one-minute intervals between 13:30 and 14:00 (CT). Actually, ranges were very similar at the beginning of the period. But by the height of the incident near 13:45-13:50 (CT), the ratio had fallen to as low as 20% that of the SPDR range. This suggests that the futures order book was much deeper and resilient than the SPDRs order book.

In other words, the E-mini S&P 500 futures market continued to absorb orders and facilitate customer demand in an orderly fashion even in the face of apparent crisis in spot equity markets when liquidity was most sorely needed. As such, futures represented a moderating factor throughout the incident.

Busted Trades? – While the cash markets were still sorting out all the trades, and many trades remained unsettled as of May 10th, all futures transactions during this period had been settled and cleared. There were no instances of busted or even disputed trades in the context of stock index futures offered on CME Group exchanges throughout the period in question.

Were the futures market to have been unavailable during this period, it is unclear whether the spot or cash markets would have been able to shoulder the additional burden of risk transference demanded by market participants. As such, the incident might have had far greater implications.

CME Price Protection Measures – The CME Globex[®] electronic trading platform deploys various measures designed to preclude "run-away" markets not driven by the fundamentals of the situation. These measures include ... (1) order quantity restrictions, (2) price banding, (3) stop price logic functionality, (4) market and stop order protection points, (5) message traffic "throttling," and (6) option market maker protections.

While traders may enter multiple orders, the quantity of any single order in E-mini S&P 500 futures is constrained to 2,000 for outright positions and 5,000 for spreads. Different quantity restrictions are imposed in various markets as appropriate. This is intended to prevent so-called "fat-fingering" errors.

Price banding is a system functionality that prevents a trader from entering a buy order that is more than 12 points above; or, a sell order that is more than 12 points below, the last transacted price (or any better bid or offer) in E-mini S&P 500 futures. (Levels vary on a market-by-market basis.) The CME Globex system rejects orders entered at prices outside this protective band.

The stop price logic functionality is designed to prevent the execution of stop orders under certain conditions. If a stop order, or series of such orders, would result in transactions at price levels beyond the contract's no-bust range,³ then the market is

³ Exchange Rules allow for a review and possible adjustment or cancellation ("busting") of trades when necessary to mitigate disruptive market events caused by improper or erroneous use of the electronic trading system or by system defects; or, where it is determined that a trade may have a material, adverse effect on market integrity. These Rules generally limit such reviews to

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placed in a "reserve" state where orders may be entered, modified or cancelled but not concluded. This functionality was, in fact, triggered in E-mini S&P 500 futures for 5 seconds at 13:45:28 and precisely when the low of the day was established in E-mini S&P 500 futures. Arguably, this functionality worked very well by mustering liquidity and market resiliency which subsequently led to the market rebound.

The CME Globex electronic trading system allows users to enter market-protected and stop orders that are automatically assigned a limit level. This threshold is set at 3 points in E-mini S&P 500 futures but may vary from market to market. Use of this functionality is intended to prevent orders from being filled unintentionally apart from prevailing market levels.

CME Group maintains automated controls on the volume of message traffic for individual connections to the Globex system. This functionality can throttle back message volumes such that the number of messages per second (MPS) falls below a pre-specified threshold.

Option market maker protections represent controls established to limit one's exposure to execution on a large number of standing orders. When these parameters are met or exceeded within a specific time period, this functionality may cancel all standing orders for that trader and prevent further order entry for a specified time period.

These price protection measures worked well on May 6th to the extent that CME Group stock index markets traded in a very orderly fashion despite the high demands on the market.

Revisiting Price Limits – All domestic CME Group stock index futures are subject to price limits (sometimes called "circuit breakers"). These price limits are recalibrated on a quarterly basis and triggered by market declines of 10%, 20% and 30% of the stock index futures contract in question.

Further, CME Group domestic stock index futures are coordinated with New York Stock Exchange (NYSE) Rule 80B which is triggered by 10%, 20% or 30% declines in the Dow Jones Industrial Average (DJIA).

orders executed outside of the "no-bust range" or a specified range above and below prevailing market levels. The no-bust range for E-mini S&P 500 futures is 6 index points. No-bust ranges are uniquely specified for each individual market.

Thus, if the NYSE should declare a trading halt, CME Group follows suit.

Note that these price limits were not triggered on May 6th to the extent that price declines in stock index futures or in the DJIA were not sufficient to set them off.

CME Group price limit policy is designed to be compatible with price limit policies in the primary spot markets. Remember that futures are derivative instruments. Futures market trading practices must be coordinated with, and take their lead from, the primary spot market in order to maintain their relevance and utility. In the case of stock markets, the primary market is generally the New York Stock Exchange (NYSE) whose Rule 80B is generally regarded as the equity market standard.

Role of High-Frequency Traders – Some have questioned whether high-frequency traders (HFTs) deploying so-called algorithmic trading methods played a role in the May 6th incident. Certain HFTs were active in both spot and futures markets during this period as an ordinary course of business. However, there is no visible support of the notion that algorithmic trading models deployed in the context of stock index futures traded on CME Group exchanges caused the market fluctuations in question.

Rather, we believe that automated trading contributes to market efficiencies, generally bolsters liquidity and thereby contributes to the price discovery function served by futures markets. This view is supported in the academic literature where one study found that "the move to screen trading strengthens the simultaneity of price discovery in the cash and futures markets and lessens the existence of a lead-lag relationship."⁴ Another study concluded that their "results are consistent with the hypothesis that screen trading accelerates the price discovery process."⁵

⁴ Frino, Alex and McKenzie, Michael D., The Impact of Screen Trading on the Link Between Stock Index and Stock Index Futures Prices: Evidence from UK Markets. EFMA 2002 London Meetings.

⁵ Grünbichler, Andreas, Schwartz, Eduardo S. and Longstaff, Francis A., Electronic Screen Trading and the Transmission of Information: An Empirical Examination. JOURNAL OF FINANCIAL INTERMEDIATION Vol 3 No 2, 1994. Available at SSRN: <http://ssrn.com/abstract=5806>

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Further, we find no evidence in CME stock index futures of any undue concentration of activity amongst algorithmic or any other types of traders. In fact, activity levels amongst various CME constituencies on May 6th were quite consistent with normally observed patterns.

Trading by the most active of these traders was generally balanced between buy and sell orders during the period from 13:30 to 14:00 (CT). It is difficult to attribute the declining market action to any concentration of high frequency traders. Rather, we suggest that HFTs may have had the effect of providing a buoyant function in the market.

Conclusion – Stock index futures markets on CME Group exchanges performed their function as price discovery and risk management tools efficaciously throughout the period in question. Our markets experienced no untoward dislocations, no errors were in evidence and no trades were busted. We believe there is evidence that futures were a moderating factor during the incident, providing liquidity when it was needed the most.

While inconclusive at this point, we believe that the stock market incident of May 6th might be traced to divergent trade practices and price protection mechanisms amongst the various stock trading venues on which domestic equities are traded and which comprise the National Market System (NMS).

Of course, we will continue to study the situation and adapt CME Group systems to maintain harmonization with the primary spot markets and to protect the utility and relevance of our futures markets.

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Appendix of Supporting Data

Exhibit 1: Jun-10 E-mini S&P 500 Futures vs. Select Stocks
(Low Print in 1-Second Brackets)

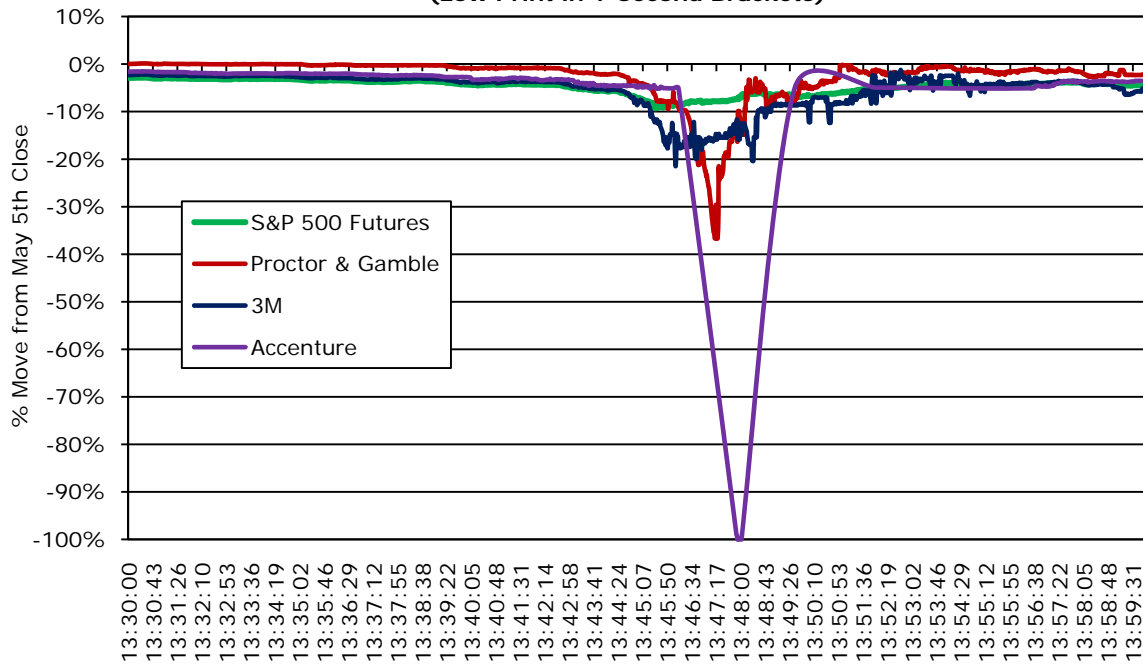
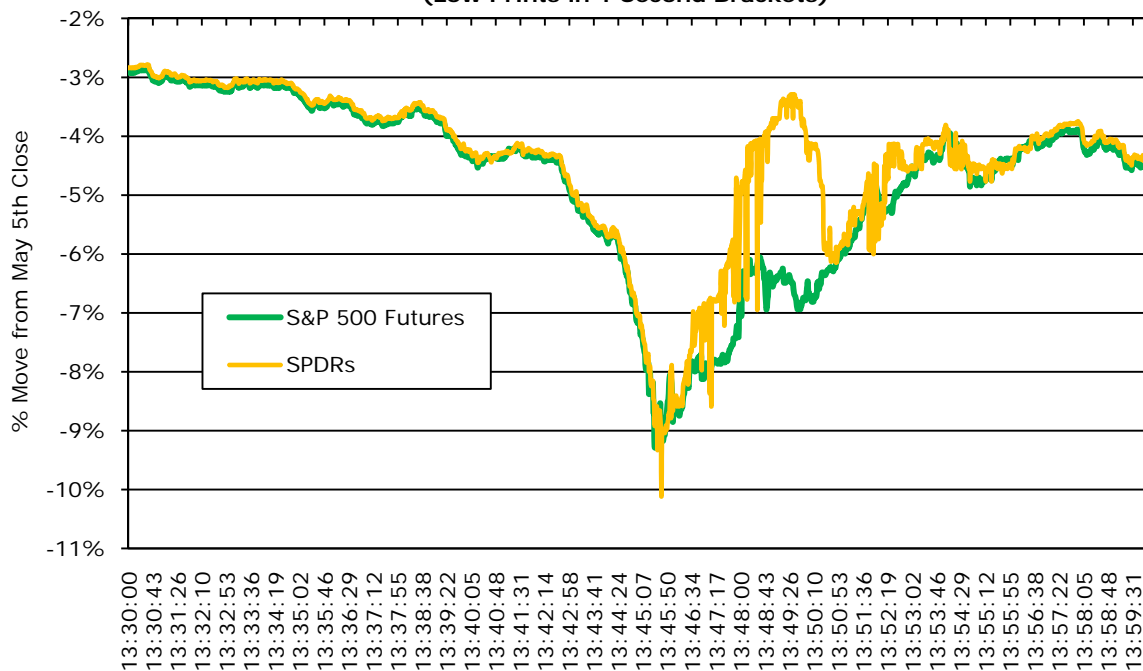


Exhibit 2: Jun-10 E-mini S&P 500 Futures vs. SPDRs
(Low Prints in 1 Second Brackets)



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Exhibit 3: Liquidity in E-mini S&P 500 futures vs. SPDRs
(Relative Second-by-Second Trading Ranges)

