Analysis of Japanese Stock Market Turbulence in Early August 2024

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Methodology – Use of granular data and associated indicators

- The FSA has published a detailed analysis of **the supply-demand and liquidity conditions of the Japanese stock market to examine the background of sharp swings on August 5, 2024.**
- While the analysis does not cover inter-market connectedness due to lack of data availability, **use of granular order/transaction level data** on the Nikkei 225 Futures and associated several indicators have provided a new insight into the background and mechanism of the market turbulence.

Figure 1: Stock Price Movement on August 5

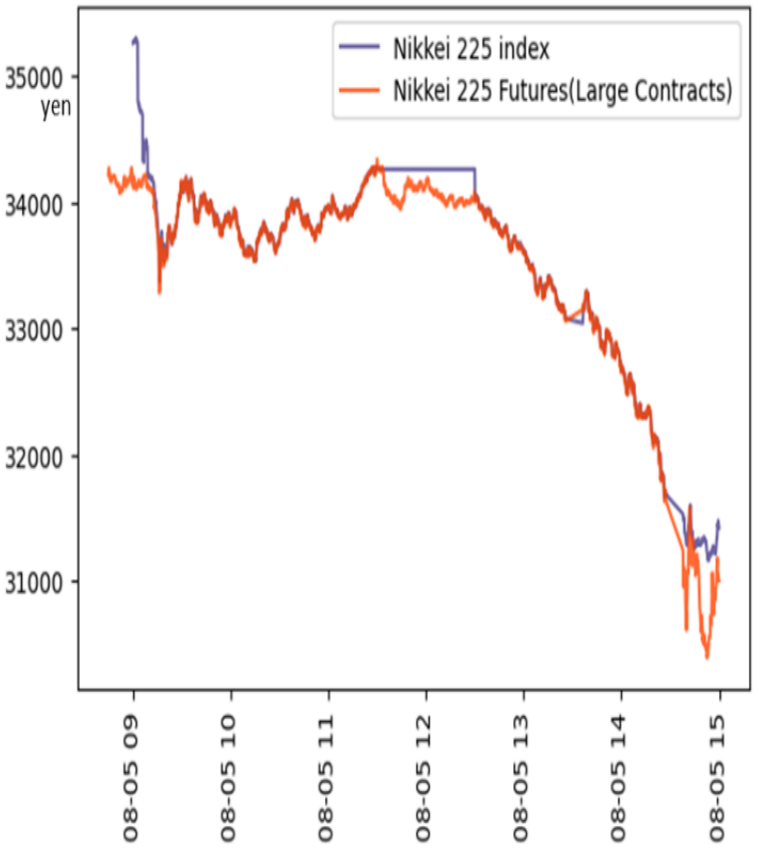


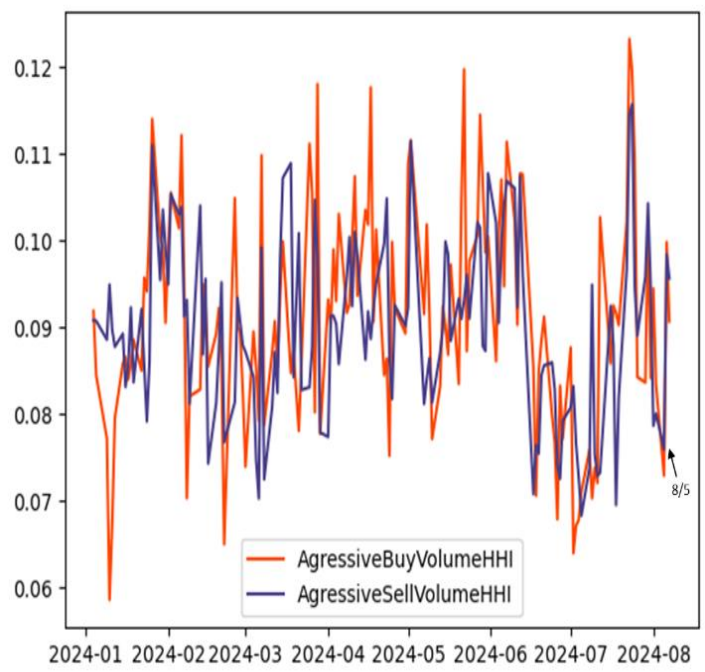
Figure 2: Summary of list of indicators

Indicator	Overview
Aggressive Buy Volume Ratio	Imbalance between supply and demand (i.e., whether buyers dominate or not)
Aggressive Buy(Sell) Volume HHI	Degree of concentration of execution amounts of take orders by buying(selling) entities (i.e., to what extent transactions by specific entities were concentrated)
Range of scale up(down) HHI	Concentration of price fluctuations by buying(selling) entities (i.e., to what extent price increases/decreases were concentrated in transactions by specific entities)
Buy(Sell) Price Impact Ratio	Likelihood of price movements due to buy(sell) orders (i.e., the extent to which prices moved per contract amount)
Number of quotations indicated within five ticks around the best quote price for each transaction	Liquidity around the best quote (i.e., whether there were a lot of orders around the best quote prices)

Analysis Part I: Daily behaviors of indicators until early August 2024

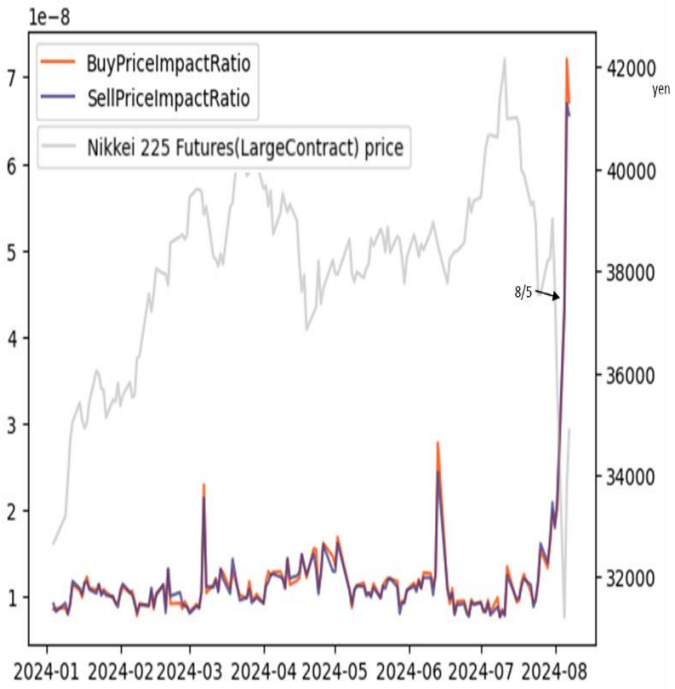
- The orders were not concentrated by specific trading entities on August 5, compared to normal times*.
- However, the indicators suggests that, **in early August, the market was prone to large price fluctuations** against a small imbalance between supply and demand, exacerbated by **sharply-declining depth of orders**.

Figure 1: The degree of concentration



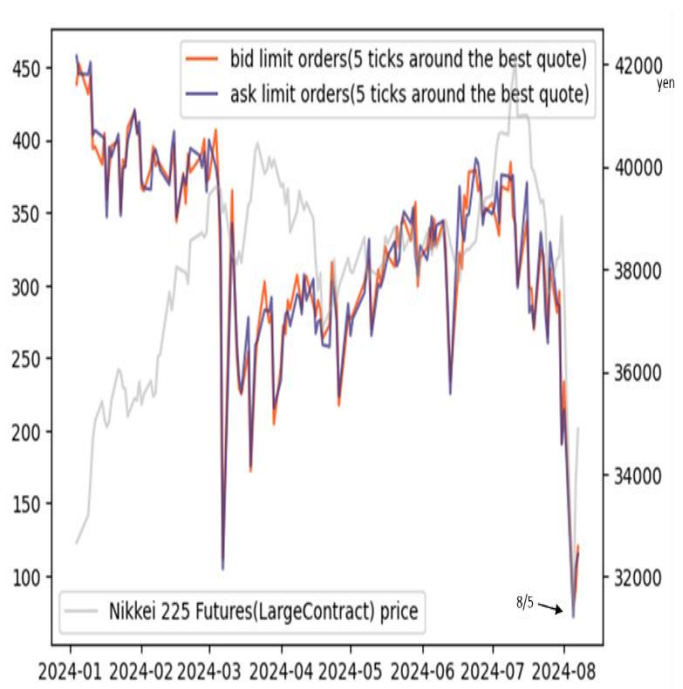
	YTD Average*	August 5
Buyer	**0.091**	**0.072**
Seller	**0.089**	**0.075**

Figure 2: Likelihood of price movements



	YTD Average*	August 5
Buyer	**1.21**×10^{-8}	**4.29**×10^{-8}
Seller	**1.20**×10^{-8}	**4.34**×10^{-8}

Figure 3: Order volume around best quote



	YTD Average*	August 5
Bid	**322.20**	**79.55**
Ask	**322.28**	**71.80**

* Analysis period is from January 2024 to August 7, 2024.

Analysis Part II: Intraday behaviors of indicators on August 5, 2024

- Several intraday indicators on August 5 confirmed that **market liquidity had rapidly subsided toward the afternoon session, which may have induced the market turbulence.**
  - The take order was biased toward sellers from around the lunch break in the cash equity market (11:30 to 12:30) to around 14:00, where a sharp fall of stock prices occurred. From 12:30 onwards, the order book got thinner, and prices moved more easily.

Figure 1: Imbalance between supply and demand

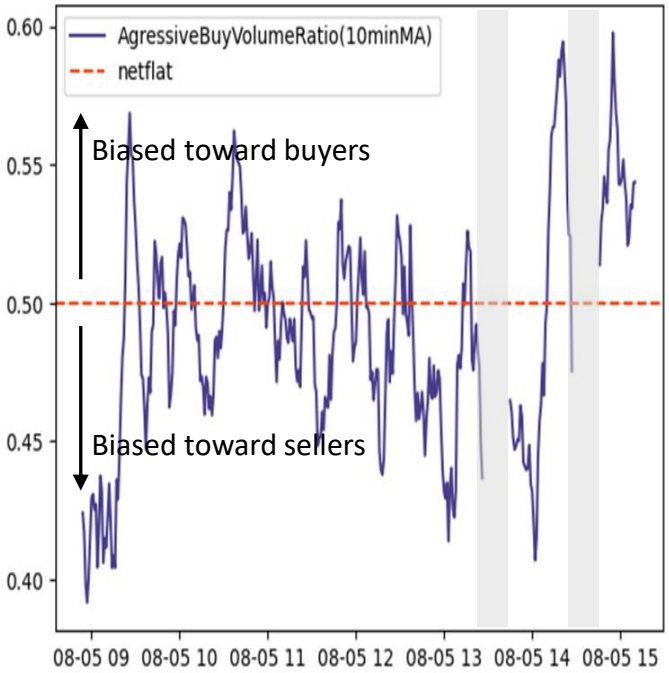


Figure 2: Concentration of price fluctuations by buying/selling entities

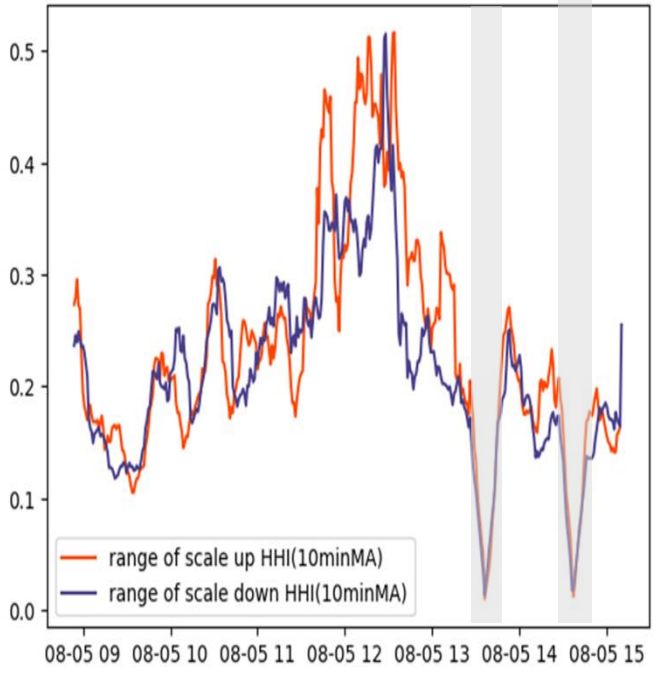
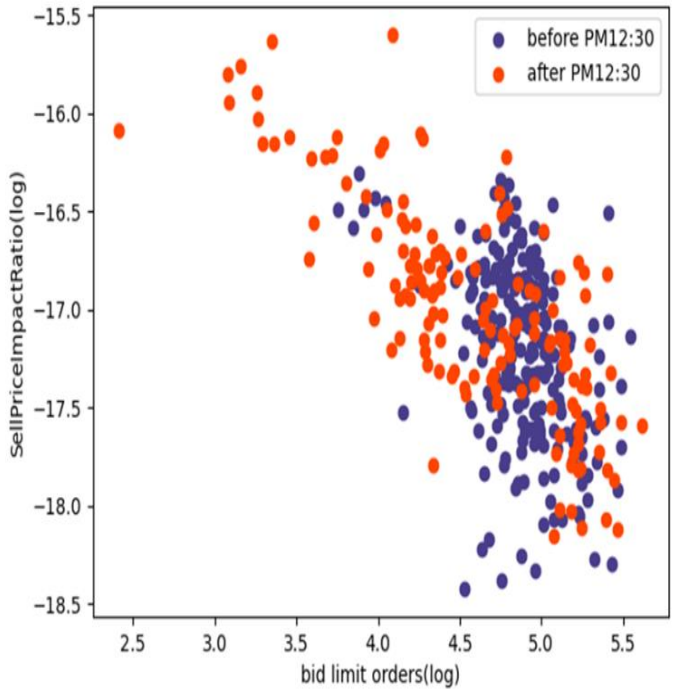


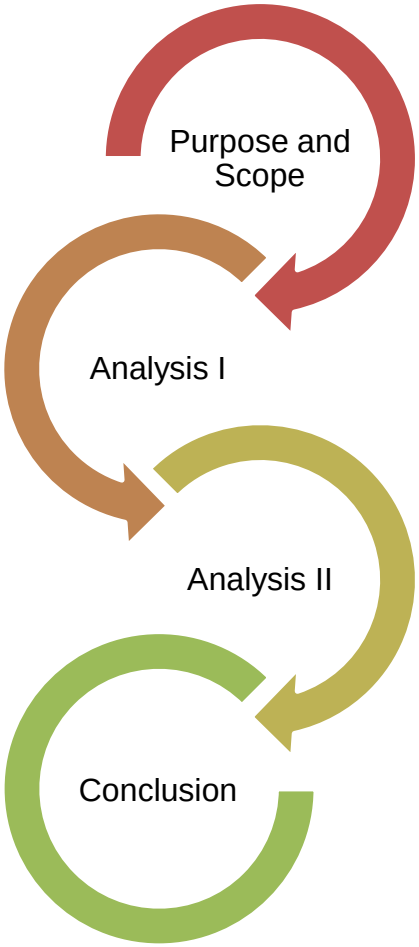
Figure 3: Scatter plot of Sell Price Impact Ratio and bid limit order volume



* The time zones colored in gray show the periods that the circuit breaker was activated (i.e. 13:26-13:36 and 14:27-14:37). To see more on the Circuit Breaker Rule, see JPX website.

** Calculation are made for a one-minute period. For Figures 1 and 2, indicators calculated every minute are leveled using a 10-minute moving average (MA) for the purpose of making it easier to understand the trends.

Key Takeaways and Next Steps



- The paper presents a detailed analysis of the sharp swings that occurred in the Japanese stock market on August 5, 2024, using granular data and indicators.

⚠ *The analysis is obliged to focus on the Japanese stock market. While other domestic and overseas market (e.g. bond, forex and derivatives) should be analyzed all together, it was not possible due to the lack of data availability.*

1) Year-to-date (until early August) Analysis

- On a daily basis from mid-July to early August, excessive imbalances were not observed but the market liquidity was markedly declining, making prices more susceptible to fluctuations.

2) August 5 Intraday Analysis

- Market liquidity subsided rapidly toward afternoon session. At these hours, take orders were found to be concentrated on the seller side.
- This suggests that the imbalance between supply and demand on the seller side was amplified by a shortage of market liquidity, which may be one of the factors of the rapid market turbulence.

One implication: Amid a decline in the market liquidity, a large amount of selling demand that occurred at a specific period caused a shortage of market liquidity provided by buyers, resulting in rapid market turbulence in which sell orders call sell orders.

✓ *Evaluating the impact of market fluctuations on financial stability is an important issue on the regulatory agenda.*

✓ ***The FSA will continue to analyze the mechanism of sharp market turbulence and its impact on financial stability by enhancing analytical capabilities and expanding of its analysis.***

Appendix: Terms and Definitions

Terms	Definitions
Take Orders	Market orders and limit orders that can be executed immediately. Take orders demand the liquidity of the market, which has been supplied by the "make orders". Take orders by sellers (buyers) lead to price decrease (increase).
Aggressive Buy Volume Ratio	Imbalance between supply and demand (i.e., whether buyers dominate or not). If the buyer's take order and the seller's take order are balanced, the indicator will become 0.5. If the buyer's (seller's) take order is more dominant, the indicator approaches 1 (0). $$\frac{Total\ Aggressive\ Buy\ Volume\ by\ all\ buyers}{Total\ Aggressive\ Buy\ Volume\ by\ all\ buyers + Total\ Aggressive\ Sell\ Volume\ by\ all\ sellers}$$
Aggressive Buy (Sell) Volume	The amount committed on the buyer's (seller's) take orders
Aggressive Buy (Sell) Volume HHI	Degree of concentration of execution amounts of take orders by buying (selling) entities (i.e., to what extent transactions by specific entities were concentrated). When a particular trading entity has a large share (monopoly) in the market, the HHI approaches 1. On the other hand, when there is little concentration, the HHI approaches 0. $$\sum_{i=1}^{n} \left(\frac{Aggressive\ Buy\ (Sell)\ Volume\ of\ trader\ i}{Total\ Aggressive\ Buy\ (Sell)\ Volume}\right)^2$$
Herfindahl-Hirschman Index (HHI)	A measure of market share concentration. In this paper, we use the HHI as an index to measure concentration of trading activities in the Nikkei 225 Futures market.
Range of scale up (down) HHI	Concentration of price fluctuations by buying (selling) entities (i.e., to what extent price increases/decreases were concentrated in transactions by specific entities). If the share of this degree of impact is dispersed (HHI becomes close to 0), the impact of a specific trading entity on price fluctuations is relatively small, and if it is concentrated (HHI becomes close to 1), the impact of transactions of a specific trading entity on price fluctuations is relatively large. $$\sum_{i=1}^{n} \left(\frac{Range\ of\ scale\ up\ (down)\ by\ trading\ entity\ i}{Total\ range\ of\ scale\ up\ (down)}\right)^2$$
Range of scale up (down)	The cumulative total of price movements when each trading entity sells (buys) and lowers (rises) prices. For more detail, see Ohyama et al. (2021)
Buy (Sell) Price Impact Ratio	Likelihood of price movements due to buy (sell) orders (i.e., the extent to which prices moved per contract amount). The larger the ratio of the Range of scale up (down) to the Aggressive Buy (Sell) Volume, the more likely for price fluctuations to occur due to liquidity demands from take orders, and that prices will be more likely to respond to imbalances in the supply-demand balance. $$\frac{Total\ Range\ of\ scale\ up\ (down)\ by\ trading\ entities}{Total\ Aggressive\ Buy\ (Sell)\ Volume\ by\ all\ trading\ entities}$$
Number of quotations indicated within five ticks around the best quote price for each transaction	Liquidity around the best quote (i.e., whether there were a lot of orders around the best quote prices). In general, price fluctuations are considered to be less likely to occur if many limit orders are placed near the best quote, as thick orders absorb the price fluctuations caused by liquidity demand from take orders, and vice versa. For the calculation of the ratio of order volume placed by HFTs within the five ticks from the best quotes, see FSA Analytical Notes (2024.7).