High Frequency Order Flow Dynamics and Market Liquidity

Securities·Derivatives R&D Center

KRX KOREA EXCHANGE

◆ **A study on order flow dynamics plays an essential role**

· not only for the investigation on market microstructure from the academic aspect,
· but also for market regulation or market design from the practical point of view.

◆ **However, order flow dynamics in the high frequency world is too complicated to be described simply, because**

· high frequency data is too enormous to be handled properly,
· order flows are highly correlated with various market components such as liquidity and previous order flows, and
· order flows by each type of traders are highly correlated to each other.
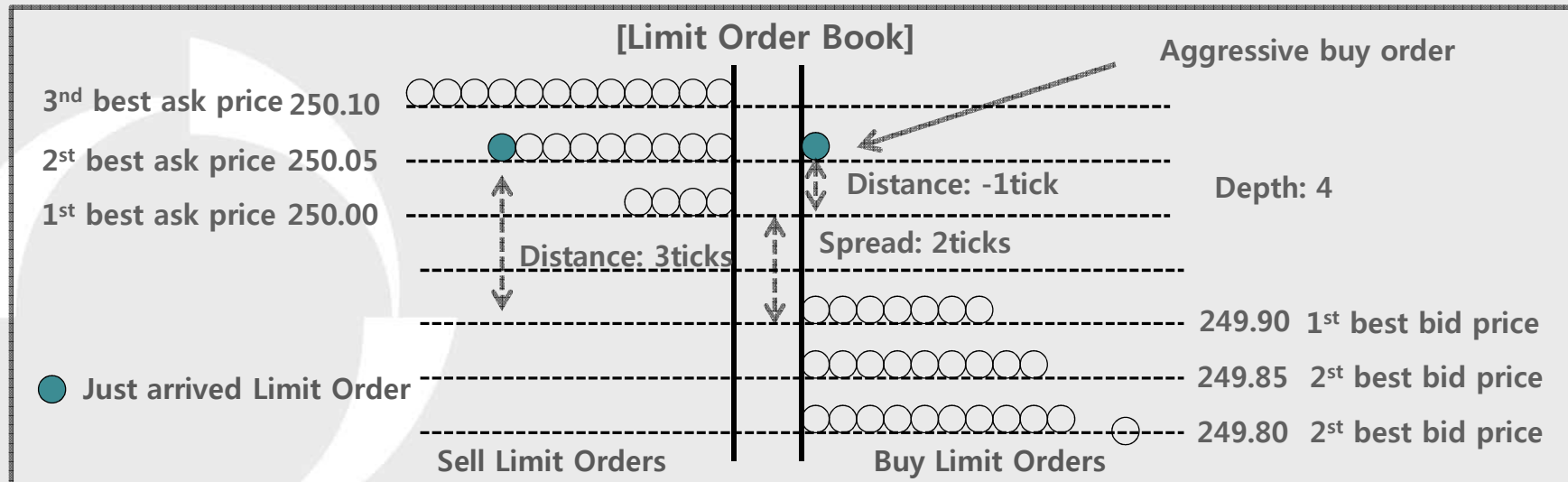

This presentation

· demonstrates some typical features of order flow dynamics,

· compares order flows of HF traders and traditional traders, and

· suggests challenges for sustainable growth of derivatives market.

Introduction

◆ **Data set**
 · **Trades and quotes records for the period: 2016.01.02~2016.12.29(09:00~15:00)**
   - For options: Items with daily trading volume ≥ 100,000 contracts
   - For futures and mini futures: Items with daily trading volume ≥ 10,000 contracts

◆ **Basic terminology**
 · **Immediate Or Cancel Order(IOC): An order to buy or sell a security that must be executed immediately, and any portion of the order that cannot be immediately filled is cancelled**
 · **Residual Order: Remaining order in limit order book in a given period of time**
 · **Quote Distance: difference between order price and the 1st best price of the opposite side**
 · **1st Quote Depth(Depth): Minimum of quote quantities at the 1st best quoted bid and ask prices**

[Limit Order Book]

Aggressive buy order

3nd best ask price 250.10
2st best ask price 250.05
Distance: -1tick
Depth: 4
1st best ask price 250.00
Distance: 3ticks
Spread: 2ticks
249.90 1st best bid price
○ Just arrived Limit Order
249.85 2st best bid price
249.80 2st best bid price
Sell Limit Orders
Buy Limit Orders

Typical Features of Order Flows
KOSPI200 Futures

◆ **Market states are classified into Equilibrium , Transition and Transaction Phases, according to Order flows and liquidity.**
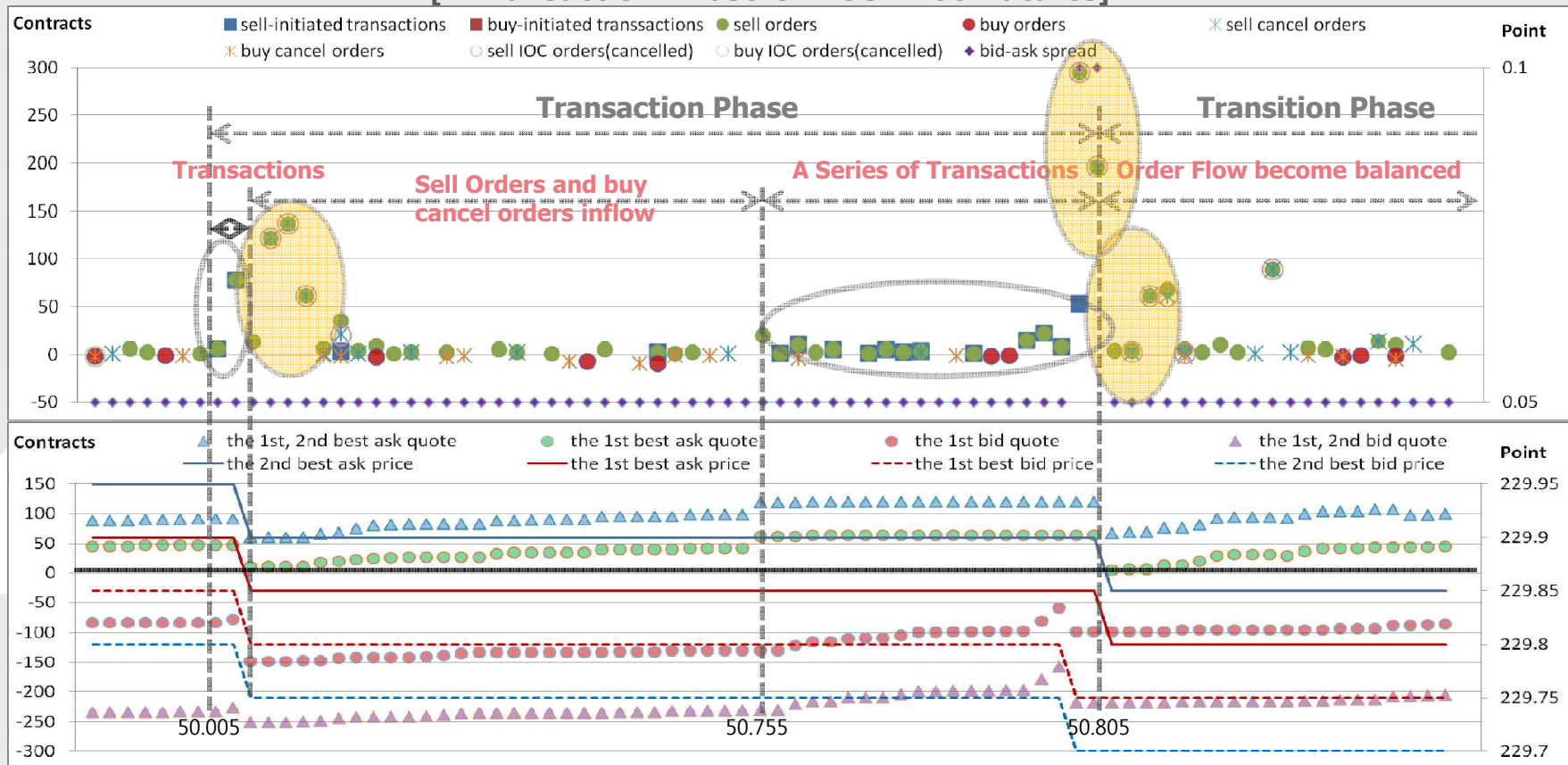
[Order Flows of KOSPI200 Futures]
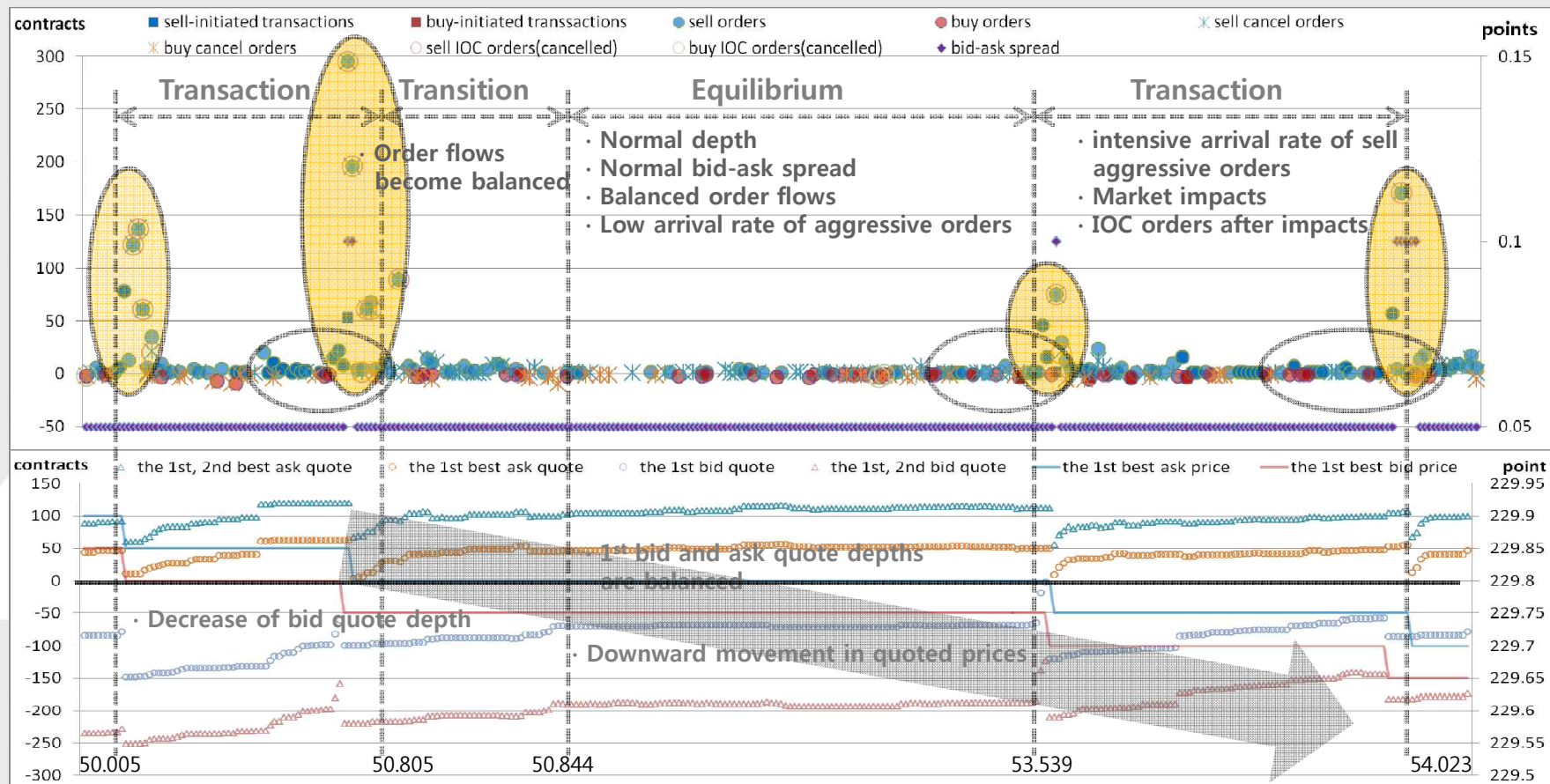
* Minus sign means orders in buy side.

◆ **Transaction Phase: Transaction ⇒ Market impacts ⇒ IOC Orders ⇒ Imbalanced order flows**

◆**Market Impacts take one of the following forms:**
Increase of spread, decrease of quote depth or changes in quoted prices

[A Transaction Phase of KOSPI200 Futures]

Typical Features of Order Flows
KOSPI200 Options

◆ **Order flows in options market are more dynamic and stylized than those in futures market.**
· **Highly intensive arrival rate of limit orders accompanies a large number of cancel orders in the opposite side.**
· **IOC orders are submitted intensively during a market impact.**

[Order Flows of KOSPI200 Options]
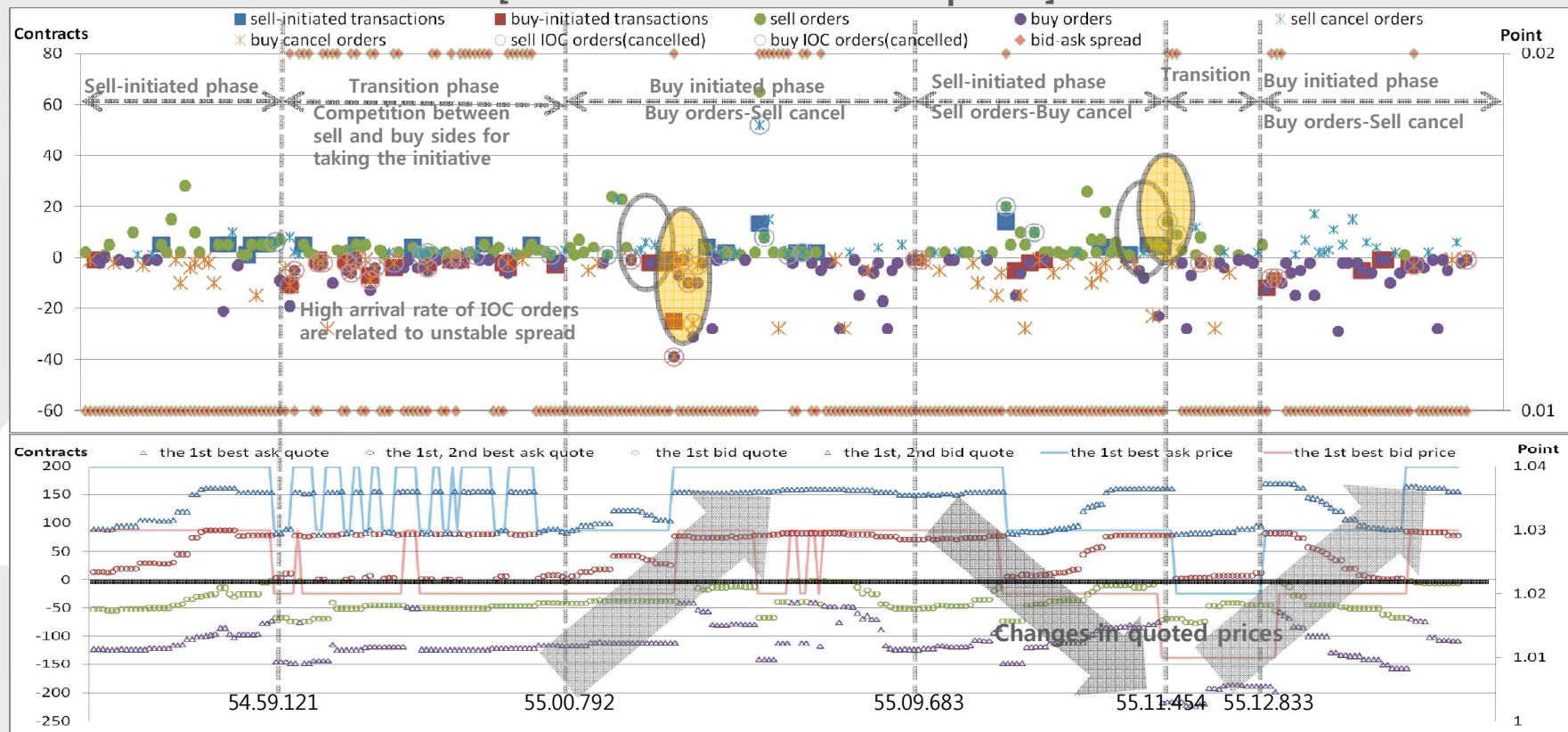
Typical Features of Order Flows
HF traders vs. Traditional traders

◆ Order flows by HF traders are more intensive than those by traditional traders.

◆ HF traders change rapidly their order flows according to the change of the market state.

◆ Order flows by each type of traders are correlated to each other.

[HF traders vs. Traditional traders: KOSPI200 Options]
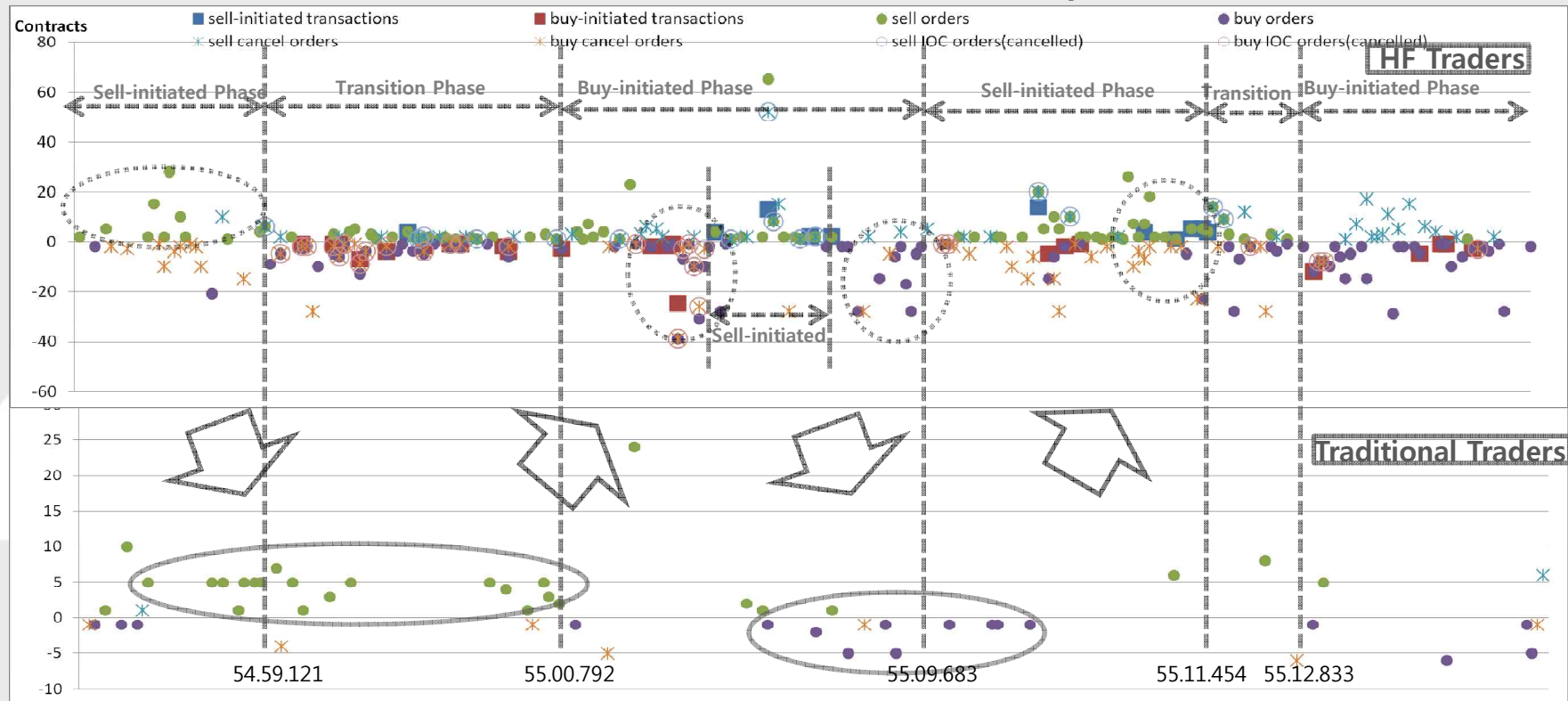
Market Liquidity and Order Flows

Order Distance

◆ **Limit orders are mostly posted at the 1st best quoted prices.**

· **HF traders use various types of orders such as market/limit/IOC/cancel orders fully.**
· **Traditional traders use mostly market/limit orders, and use cancel orders/IOC orders restrictively. All traders increase quantity of residual orders, especially in the 1st best queue.**

[Order Distance and Order Flows] (Unit: mil. contracts)

distance	HF Traders				Traditional Traders			
	order	IOC	cancel	Δ(res ord)	order	IOC	cancel	Δ(res ord)
KOSPI200 Futures								
1tick	100.9	48.5	44.8	6.7	24.46	5.59	14.41	4.4
2ticks	17.0	6.6	9.4	0.8	9.50	0.08	4.93	4.5
3ticks	6.8	0.9	3.9	2.0	4.31	0.02	3.08	1.2
4ticks	2.7	0.3	2.2	0.2	2.65	0.11	1.96	0.6
5ticks	1.9	0.4	1.4	0.0	2.24	0.07	1.46	0.8
≥6ticks	14.3	7.6	6.6	-0.0	7.07	0.12	5.60	1.3
KOSPI200 Options								
1tick	523.5	237.8	267.5	16.8	148.78	1.26	88.20	57.4
2ticks	68.2	30.7	26.8	10.3	32.14	0.02	17.94	14.1
3ticks	18.6	5.3	8.6	4.7	14.41	0.00	9.15	5.2
4ticks	11.5	1.8	9.0	0.7	7.59	0.00	5.12	2.5
5ticks	8.5	1.1	4.4	3.0	5.68	0.00	3.58	2.1
≥6ticks	12.8	3.2	16.7	-7.2	18.73	0.00	18.73	3.5

• **Automatically cancelled IOC orders are excluded from cancel orders.**
• **Δ(res ord) means the change of residual order quantity**

Market Liquidity and Order Flows

Bid-Ask Spread

◆ **Most limit/IOC/cancel orders are submitted during the spread ≤2 ticks.**

◆ **During the 2ticks spread, order activities of traditional traders decrease drastically, whereas those of HF traders are even high.**

⇒ **HF traders stimulate trading activities by using IOC orders during a small sized impact.**

[Bid-Ask Spreads and Order Flows] (Unit: mil. contracts)

spread	HF Traders				Traditional Traders			
	trdvol	ord	IOC	cancel	aggvol	ord	IOC	cancel
KOSPI200 Futures								
1tick	10.1	133.9	52.2	64.7	12.62	58.97	5.90	29.86
2ticks	2.1	19.8	17.1	4.8	1.45	3.89	2.91	1.66
3ticks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
≥4ticks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KOSPI200 Options								
1tick	55.5	546.4	185.5	307.7	62.49	290.56	1.03	138.64
2ticks	20.5	152.8	135.0	31.4	1.24	8.86	0.73	4.28
3ticks	0.2	2.1	1.5	0.6	0.03	0.20	0.01	0.08
≥4ticks	0.0	0.8	0.5	0.3	0.02	0.18	0.00	0.06

Market Liquidity and Order Flows

The 1st Best Quote Depth

◆ **HF traders tend to submit orders more intensively, when the depth has become lowered by a small sized impact.**

· **During a small sized impact, the price can be easily moved even by a small order, so one can expect profit, if one takes a position in the right direction.**

⇒ **Especially, use of IOC orders by HF traders increases significantly during a small sized impact.**

[Depth and Order Flows] (Unit: mil. contracts)

| depth	HF traders				Traditional Traders			
	trdvol	ord	IOC	cancel	aggvol	ord	IOC	cancel
KOSPI200 Futures								
0~20	4.9	58.8	32.4	18.2	2.65	13.52	2.72	4.62
20~40	2.5	29.5	10.7	14.4	2.88	13.09	1.33	6.42
40~60	1.6	20.2	6.2	12.4	2.73	12.11	1.03	7.04
60~80	1.1	15.6	5.0	10.1	2.18	9.81	0.83	5.78
80~100	0.7	11.2	4.3	6.6	1.50	6.39	0.79	3.55
≥100	1.5	18.5	10.8	7.9	4.38	2.14	1.82	5.83
KOSPI200 Options								
0~20	20.6	191.6	96.5	77.9	8.23	42.30	0.68	16.23
20~40	11.1	99.5	48.2	40.9	5.49	24.91	0.30	9.65
40~60	6.8	59.5	27.4	26.4	3.53	15.74	0.17	6.55
60~80	4.7	41.4	17.8	19.9	2.64	11.54	0.11	5.18
80~100	3.5	31.8	13.0	16.2	2.21	9.34	0.08	4.31
≥100	29.6	278.3	119.7	148.7	41.69	195.98	0.42	101.14

Market Liquidity and Order Flows
KOSPI200 Mini Futures

◆ **Participants in KOSPI200 mini futures market consist mainly of HF traders and liquidity providers.**

⇒ **Quote quantities at each quoted prices are small and most limit orders are cancelled, so liquidity in the market is insufficient to activate trading.**

[Order Flows of KOSPI200 Mini Futures]

Market Liquidity and Order Flows
KOSPI200 Mini Futures

KRX
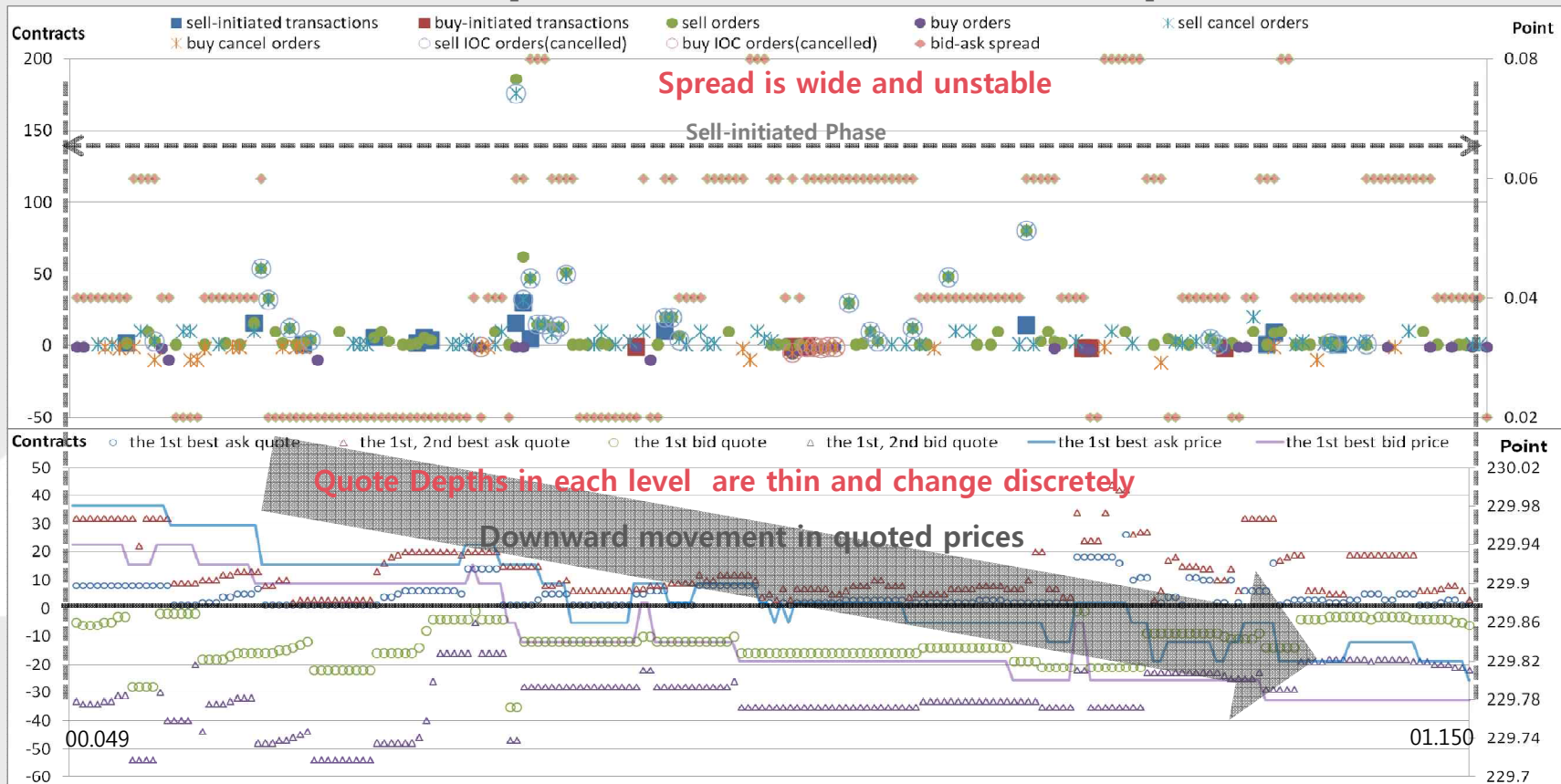
◆ **LPs submit only small sized orders and cancel those orders repeatedly, whereas HF traders submit various types of orders actively.**

◆ **This is, because market making against HF traders is highly risky in the market, where there are few traditional traders.**

· **Order activities by traditional traders (especially noise traders) reduce market making costs.**

[Order Flows of KOSPI200 Mini Futures: HF traders vs. Traditional traders]
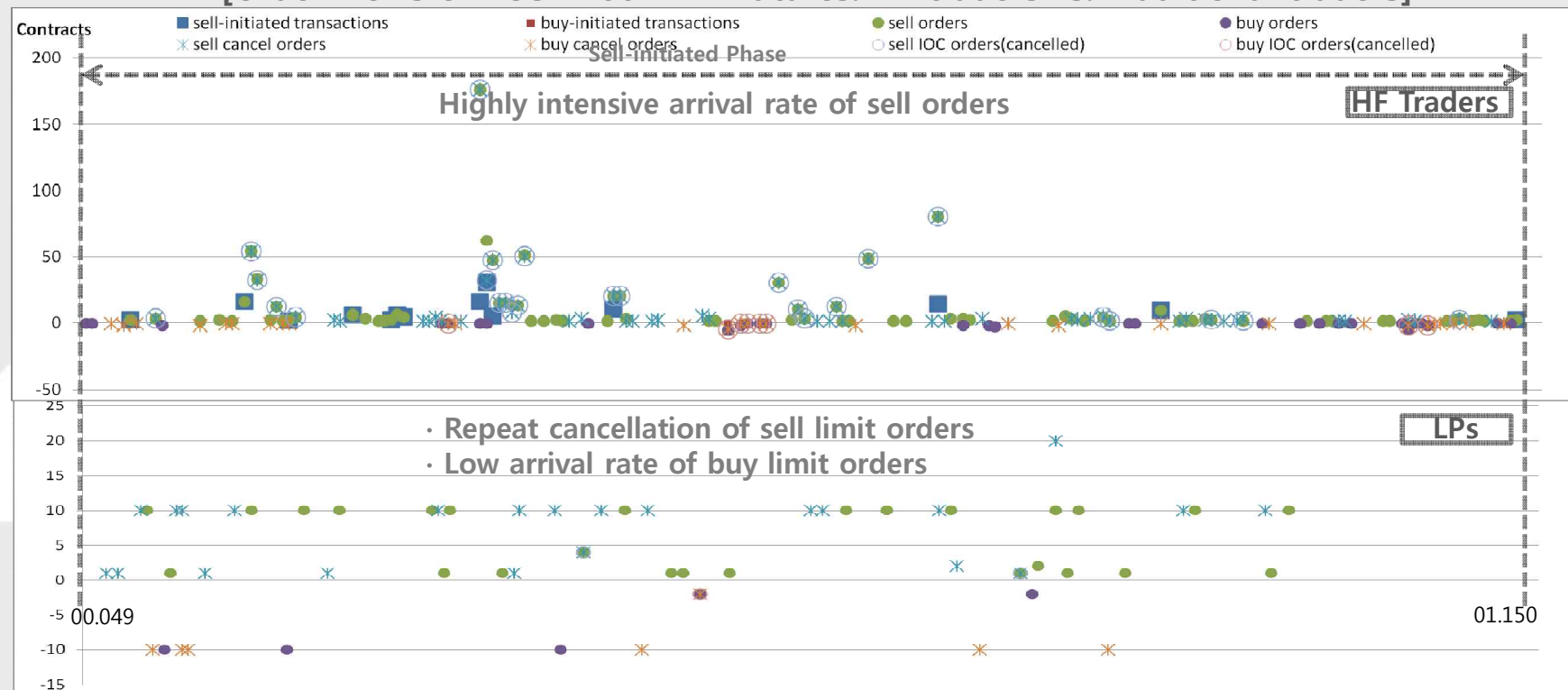
Challenges for Sustainable Growth of Markets
Roles of HF traders

◆ **HFT is an optimal trading form in modern exchange environments.**

· **Various types of strategies by HF traders are based on statistical arbitrage.**
· **A short holding period reduces trading risk and an extremely low latency increases trading opportunities.**

◆ **HFT plays an essential role in modern exchange markets and contribute to enhancement of trading activities and market efficiency.**

· **HFT stimulates trading activities by submitting various types of orders actively.**
· **HF traders reflect the changes in market information to price efficiently.**
· **HF traders contribute to fast recovery from small sized market impact through stimulation of trading activities.**

◆ **However, contributions of HF traders are achieved, based on the liquidity provided by traditional investors.**

· **HF traders mainly take liquidity provided by traditional investors.**
· **HF traders increase risk of LPs when there are few traditional investors in the market.**
· **If a large impact occurs in the market, HF traders could amplify the impact by increasing order flow imbalance in a short period of time.**

Challenges for Sustainable Growth of Markets
Roles of HF traders

A Big Question

How to design the market, where high frequency traders and traditional traders coexist, playing complementary role for each other.

◆ **It's a big challenge for modern exchanges, how to regulate HFT.**
  The purpose of the regulation on HFT is similar in each exchange:

· **Increasing the stability and integrity of the market**
· **Minimizing market risks**
· **Preventing market manipulation**
· **Protection of long-term investor**

◆ **But, it's very difficult to find proper regulations on HFT, because**

· **high performance of HFT are mainly based on extremely low latency and free cancellation, and**
· **any restriction on cancellation or speed will reduce the trading performance of HFT severely.**

◆ **A market will be degraded, if activities of HFT decrease considerably.**

· **Market impacts by large aggressive orders will increase.**
· **Price movements will be coarse.**
· **Diffusion of information is delayed, and market efficiency will be reduced.**

Challenges for Sustainable Growth of Markets
Market Design

KRX

> **Improve market making systems and create various derivative-related markets**

◆ **Activate high frequency market making.**

· Introduce or improve Designated Market Makers more widely.
  - It's important to design proper obligations and incentive systems.
· Induce HF traders to voluntary market makers by introduction of new fee and incentive systems.

⇒ High frequency market making is becoming an important business area in the modern exchange.

◆ **Create various derivatives-related markets.**

· Creation of various derivatives-related markets will enlarge demands for derivatives.
· Order flow imbalance can be lowered by orders from various trading positions, which will provide proper environments for market making.

⇒ Creation and vitalization of ETF, ETN markets will enlarge demand for derivatives and stimulate position trading between ETF, ETN markets and derivatives markets.

◆ **Prepare infrastructures for multi-venue trading in global markets.**

· Advances of IT have connected local markets globally, and created virtually one market.
· Demand of investors has been enlarged to portfolio management in a global level.
· In the near future, business of HFT may be extended to brokerage to deliver orders from traditional investors to exchanges worldwide.

14/14

Thank you