OPTION PRICE ADJUSTMENTS AND MARKET REGULATION

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Abstract - This letter examines how the recent market reform affects the price disagreement and adjustment behaviors of the KOSPI200 options market. Our analyses indicate that the efficiency and information quality of out-of-the-money options trading has been increased since the reform.

Keywords - KOSPI200 option; market efficiency; market reform; price disagreement;
JEL Classification: G13, G14

I. INTRODUCTION

This study examines whether there are changes in the information efficiency and quality of KOSPI200 options market after the recent market reform that altered market liquidity and investor trading activities. As a step of market reform and regulation, the Korean government and Korea Exchange (KRX) increased the option multipliers and required level of margin account for KOSPI200 options trading in June 2012. They alsorequire individual investors desiring to participate in the index options trading to complete mandatory financial lecture courses, which poses entry barrier for small individual investors. By comparing option price disagreement and adjustment behaviors before and after the market reform, we investigate whether the reform effectively increases the efficiency and transparency of the liquid and speculative options market.[1] Our analyses on price disagreements and adjustments are motivated by Ryu and Yang (2017) and Yang, Kutan, and Ryu (2018), which trace how option prices adjust to eliminate mispricing. If the reform is successful, the increased market efficiency should be revealed by lower price disagreements and more resilient price adjustments.

Our empirical analyses based on the high-quality microstructure dataset indicate option price disagreement and adjustment behaviors have been changed after the market reform. These trading environmental changes are prominently observed in the out-of-the-money (OTM) options market where noisy individual trading prevailed before the reform. We find that options-implied futures prices adjust less for disagreement events related to OTM options trading after than before the reform.

II. DATA AND METHOD

We analyze thetrade and quote (TAQ) dataset on KOSPI200 futures and options from January 2010 to June 2014.FollowingYang, Kutan, and Ryu (2017), we process the raw data and filter out the microstructural biases and calculate an options-implied futures price ($P_{o,t}$) derived from put-call parity and cost-of-carry model under no-arbitrage assumption. Considering that investor participation ratesand trading purposes vary with option moneyness and that investor characteristics affect price dynamics and disagreements differently across the moneyness (Chung, Park, and Ryu, 2016),call and put matches are classifiedinto the following three moneynessgroups: 1) OTM call and ITM put pairs (*OTM Call*), 2) ATM call and ATM put pairs (*ATM*), and 3) ITM call and OTM put pairs (*OTM Put*). In a frictionless market, $P_{o,t}$ should be consistent with the corresponding actual mid-quotefutures price, $P_{f,t}$.If $P_{o,t}$and $P_{f,t}$differ by 0.05 points (i.e., *Threshold*=0.05), we identify it as a Type I ($P_{f,t}-P_{o,t}\geq$*Threshold*) or Type II ($P_{o,t}-P_{f,t}\geq$*Threshold*) price disagreement event.

Figure 1 illustrates how price disagreements and adjustments occur. If $P_{f,t}$ ($P_{o,t}$) is significantly greater than $P_{o,t}$ ($P_{f,t}$), a Type I (Type II) disagreement event occurs, at which point, the exact time and price levels are recorded. Then, the price changes from the time of the event occurrence to 30 seconds later are recorded in order to determine which price (actual or implied) is adjusted to eliminate the price disagreement. After the disagreement event, prices should converge so that arbitrage opportunity disappears. Analyzing how prices converge allows us to understand the price adjustment process that eliminates the temporary mispricing. For example, in a Type I (Type II) disagreement event, a futures price is greater (smaller) than the corresponding options-implied price; thus, the actual futures price should decrease (increase) or the implied price should increase (decrease) in order to resolve the disagreement. Tracing the adjustment process and dynamics of the actual and implied prices after each disagreement event yields us to determine how information flow and price discovery take place in the two related derivatives markets. If the implied (actual) price moves toward the actual (implied) price, the

[1]Muravyev, Pearson, and Broussard (2013) define option price disagreements.

options (futures) market follows the futures (options) market, indicating the information superiority (inferiority) of the latter market. We investigate the price-adjustment behavior using regression equation (1).

$$P_{i,t+\tau}-P_{i,t}=const+\beta_i D_t+\gamma X_t+\varepsilon_{t+\tau}. \quad (1)$$

Here, ibecomeso (options) or f (futures). τ is the evaluation period (i.e., 30 sec). Dt is a disagreement dummy variable taking 1 under the disagreement event and 0 otherwise. Xt is a vector of control variables including previous 30-second and two-minute futures returns and options-implied bid-ask spread. For Type I (Type II) events, a positive (negative)βo implies an increase (decrease) in options prices, indicating that the options prices adjust to eliminate the disagreement. In this case, we interpret that the actual futures price (Pf,t)serves as a reference, and contains information about the true value of the underlying asset that options prices (Po,t)do not possess. In contrast, a negative(positive) βf implies the information inferiority of the futures market.

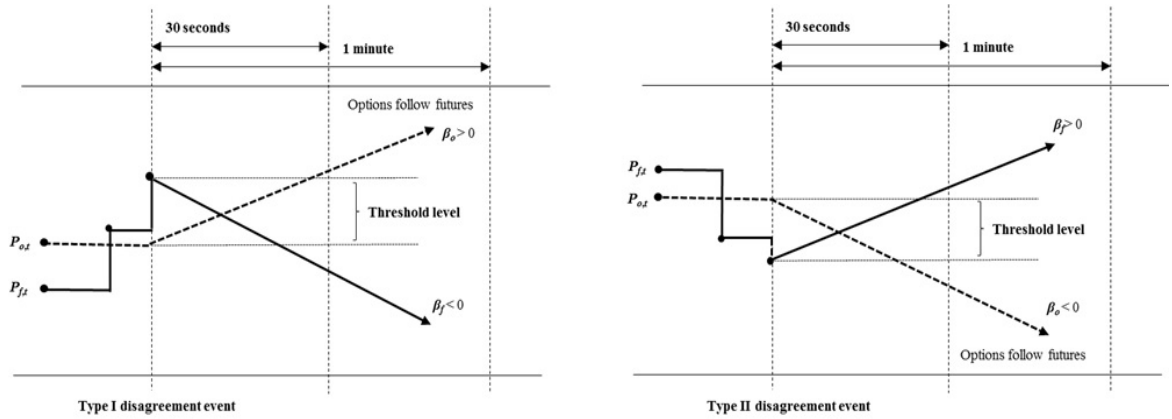


Figure1.Dynamics of Type I and Type II disagreement events

III. Empirical findings

Panel Aof Table 1 compares price disagreement occurrence rates before and after the market reform, by moneyness group(i.e., *OTM Call*, *ATM*, or *OTM Put*).It shows the numbers (*# of events*) and rates (*Prop.*) of price disagreement events and the total number of observations (*Total*) for subsamples classified by the market reform. The columns *Before* (*After*) present the periods before the reform, which is from April 1, 2010 to June 14, 2012 (from June 15, 2012 to June 30, 2014). For all optionmoneyness, disagreement occurrence rates are decreased after the reform, implying the increase in market efficiency.

Panel A. Disagreementoccurrences

	Type I			Type II		
	Before	After	Overall	Before	After	Overall
OTM Call						
Total	495,544	257,425	752,969	505,784	251,231	757,015
# of events	15,228	7,127	22,355	15,564	7,458	23,022
Prop.	(3.07%)	(2.77%)	(2.97%)	(3.08%)	(2.97%)	(3.04%)
ATM						
Total	1,202,572	1,076,692	2,279,264	1,238,440	1,075,458	2,313,898
# of events	7,225	860	8,085	4,936	1,145	6,081
Prop.	(0.60%)	(0.08%)	(0.35%)	(0.40%)	(0.11%)	(0.26%)
OTM Put						
Total	485,859	287,772	773,631	496,083	290,564	786,647
# of events	17,017	8,338	25,355	16,294	7,916	24,210
Prop.	(3.50%)	(2.90%)	(3.28%)	(3.28%)	(2.72%)	(3.08%)

Panel B.Price adjustments

	Type I			Type II		
	Before	After	Diff	Before	After	Diff
OTM Call						
β_o	0.0388***	0.0314***	0.0075	-0.0446***	-0.0347***	-0.0099**

β_f	-0.024***	-0.0243***	0.0003	0.0193***	0.0269***	-0.0076***
ATM						
β_o	0.0101***	0.0212***	-0.0111	-0.0152***	-0.0143**	-0.0009
β_f	-0.0433***	-0.0317***	-0.0117	0.0393***	0.0368***	0.0026
OTM Put						
β_o	0.0457***	0.0254***	0.0203**	-0.0442***	-0.0337***	-0.0104*
β_f	-0.0236***	-0.025***	0.0015	0.0180***	0.0233***	-0.0053*

Table 1 Price disagreementsand adjustments

By estimating equation (1), Panel Bcompares price adjustment behaviors before and after the reform. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively, with Newey and West *t*-statistics with seven lags.The signs and significances of β_o and $\beta_f$indicate that both futures and options prices adjust to eliminate the disagreement, and that price discovery occurs in both markets. We also find that OTM options prices move much more than the ATM options prices do toward the futures market prices. For example, for Type II events before the reform, the β_o (β_f) estimates of *OTM Call* and *OTM Put* groups are -0.0446 (0.0193) and -0.0442 (0.0180), respectively, while that of *ATM* group is -0.0152(0.0393), indicating thatOTM options tradingoffers relatively little price discovery and is inferior. However, after the reform, the absolute values of $\beta_o$sin both*OTM* groups significantly decrease. In the case of Type I (Type II) events, since the reform, the β_o estimates of *OTM Call*and *OTM Put* groups have decrease by 0.0075 and 0.0203 (0.0099 and 0.0104), respectively. These decreases (see *Diff*) are statistically significant for all OTM groups (just except for Type I *OTM Call* case). A higher β_o estimate is translated into a greater option price adjustment toward the reference futures price, indicating the inferiority of options trading. Therefore, Panel B suggests that trades in the OTM options market becomemore informative after the reform, reflecting the discouraged participation ofsmallindividual investors, who are normally noisy and uninformed, in the OTM options market (Yang, Choi, and Ryu, 2017).

Previous marketmicrostructure studies consistently report the intraday patterns of informed and liquidity trading (Malinova, and Park, 2014;Ozturk et al., 2017), which can affect price discovery processes. For a robustness check, we examine how the market reform affects the option price adjustment behaviors for detailed intraday intervals. In Table 2, we estimate equation (1) for six unequal intraday continuous trading intervals covering from 9:10 to 14:50. For the majority intervals, $\beta_o$estimates of the *OTM* groups substantially decrease after the reform, which confirms the increase in option market efficiency caused by the market reform. Interestingly, while the L or inverse L-shaped intraday patterns of the $\beta_o$estimates are observed before the reform, these intraday patterns are significantly mitigated after the reform. This might be because the market reform makes the market participants and characteristics of KOSPI200 options trading relatively homogenous.Namely, both inexperienced and noisy traders and professional investors tookbalanced positions in the options market, and the investor compositions were relatively heterogeneous before the market reform.If the market reform excludes a substantial portion of novice individual investors from the KOSPI200 options market and professional and experienced investors become dominant as the options market is getting matured, the survivedsophisticated options trades might have less incentive to habitually concentrate on specific intraday time intervals.

	Type I				Type II			
	Before		After		Before		After	
Time	β_o	β_f	β_o	β_f	β_o	β_f	β_o	β_f
Panel A: OTM Call								
09:10-09:30	0.0446***	-0.0265***	0.0244**	-0.0323***	-0.0459***	0.0193***	-0.0325***	0.0292***
09:30-10:00	0.0483***	-0.0209***	0.0204	-0.0200***	-0.0483***	0.0220***	-0.0318***	0.0280***
10:00-12:00	0.0358***	-0.0244***	0.049***	-0.0195***	-0.0407***	0.0205***	-0.0414***	0.0259***
12:00-14:00	0.0449***	-0.0196***	0.0205**	-0.0274***	-0.0468***	0.0178***	-0.0274***	0.0276***
14:00-14:30	0.0270***	-0.0333***	0.0433***	-0.0224***	-0.0443***	0.0152***	-0.0372***	0.0204***
14:30-	0.0268***	-0.0245***	0.0209	-0.0307***	-0.0536***	0.0162***	-0.0282**	0.0277***

14:50								
Panel B: ATM								
09:10-09:30	0.0134**	-0.0427***	0.0169	-0.0357**	-0.0111*	0.0453***	-0.0175	0.0364***
09:30-10:00	0.0095	-0.0427***	0.0340	-0.0219	-0.0018	0.0525***	-0.0108	0.0411***
10:00-12:00	0.0135***	-0.0411***	0.0275**	-0.0249**	-0.016***	0.0396***	-0.0081	0.0391***
12:00-14:00	0.0059	-0.0459***	0.0226	-0.0327**	-0.0232***	0.0303***	-0.0297	0.0222
14:00-14:30	0.0100	-0.042***	-0.0204	-0.0827***	-0.0112	0.0409***	-0.0134	0.0389**
14:30-14:50	0.0041	-0.0483***	-0.0327	-0.0572**	-0.0246***	0.0282***	-0.014	0.0426***
Panel C: OTM Put								
09:10-09:30	0.0317***	-0.0318***	0.0368***	-0.0252***	-0.0455***	0.0187***	-0.0375***	0.0241***
09:30-10:00	0.0439***	-0.0265***	0.0274***	-0.0346***	-0.0396***	0.0217***	-0.0233**	0.0330***
10:00-12:00	0.0440***	-0.0225***	0.0218*	-0.0201***	-0.0451***	0.0185***	-0.0429***	0.0228***
12:00-14:00	0.0507***	-0.0206***	0.0423***	-0.0229***	-0.0500***	0.0109***	-0.0270***	0.0215***
14:00-14:30	0.0518***	-0.0217***	0.0273***	-0.0296***	-0.0397***	0.0222***	-0.0430***	0.0120**
14:30-14:50	0.0577***	-0.0235***	0.0299**	-0.0279***	-0.0381***	0.0256***	-0.0399***	0.0192**

Table 2.Intraday analyses

CONCLUSION

The KRX and market practitioners claim that the recent option market reform successfully discourages the participation of noisy and inexperience individual investors into the KOSPI200 options market. Though the reform seems to decrease market liquidity and speculative trading and change the trading activities and motives of options market participants, it is open empirical question whether the reform effectively market efficiency and information quality of options trading. We find the increases in the efficiency and information quality of out-of-the-money options trading by analyzing the option price disagreement and adjustment behaviors after the market reform. Future research may examine the additional effects of the market reform on the options trading details, such as day trading, behavioral biases, and investor performance, in order to the illuminate the policy implications of the market reform.

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