One-day option-implied dividend rate reversals

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Highlights

- One-day implied dividend rate reversals exist in the KOSPI200 index options market.
- Reversals are significant for the shortest maturity but weaker as the maturity lengthens.
- Reversals become more concentrated in shorter maturities post-COVID.

Abstract.

This study examines whether the options market experiences implied dividend rate reversals similar to the return reversals in the underlying market and if there is a connection between the reversals in both markets. The findings show that the KOSPI200 index options market has one-day implied dividend rate reversals that are more significant than those in the underlying index, particularly for short-term maturities. These short-maturity reversals appear to be independent of the underlying index dynamics, suggesting that options market participants may overreact when forecasting future dividend rates for reasons not relevant to the underlying index. These reversals have become more concentrated in short-term maturities after COVID, indicating that irrational behavior has increased post-crisis. Overall, this study highlights the presence of implied dividend rate reversals in the KOSPI200 index options market that are unique and specific to the options market.

Keywords: Implied dividend rate; Options market; Overreaction; Price reversals

JEL Classification: G12, G13, G14

1. Introduction

In classic financial theories, which assume the rationality of market participants, asset prices are defined as the sum of discounted future cash flows, and therefore, theoretical stock price is the sum of discounted future dividend payments, as emphasized by several studies even recently (De La O and Myers, 2021; Kragt, De Jong, and Driessen, 2020; Krivenko, 2023). Therefore, the market price of stocks are closely related to the present value of expected dividend payments. Kothari and Shanken (1992) demonstrate that approximately ninety percent of portfolio return variation can be explained with dividend and expected return variables. Lee (1995) reveals that stock market responds significantly to both permanent and temporaryh shocks to dividends. Given the relationship between stock prices and dividend payments, if rational investors make well-aligned investment decisions across the markets for underlying assets and derivatives, the information on derivative market participants' expectations regarding future dividend rates may exhibit a close linkage with the underlying price dynamics.

However, a large strand of literature also reveals that irrational behavior exerts a significant influence on stock markets (Ameur, Ftiti, Louhichi, and Prigent, 2024; Baker and Wurgler, 2007; Summers, 1986). Therefore, there is a possibility that the underlying and derivatives markets may not demonstrate consistency in their dynamics. Specifically, if one of these markets shows a specific pattern in price dynamics known to be a consequence of irrational behavior, this pattern may not be associated with the other market. Since the pattern is not related to the fundamentals, it can be market-specific.

Price reversals are well-known phenomena related to irrationalities in financial markets. Jagadeesh and Titman (1995) demonstrate that stock markets tend to overreact by revealing that most of the contrarian profits can be attributed to stock price overreactions. Hameed and Mian (2015) reveal that there exists intra-industry return reversals that are larger in magnitude compared to market portfolio. Ham, Webb, and Ryu (2022) exhibit that investors are prone to overreacting overnight but respond more calmly during daytime trading hours.

If the reversals appear to be significant in both markets and are closely linked to each other, it can serve as meaningful evidence that market participants in the two markets are at least considering both markets simultaneously when evaluating prices, thereby being informed and rational to some degree. By contrast, if the reversals in one market are not related to the price dynamics in the other market, the idiosyncrasy may imply that the reversals are attributable to overreaction in that market. Based on this idea, we investigate whether the options market exhibits price reversals as seen in the underlying market and whether the reversals in the two markets are related to each other.

The empirical results reveal that the KOSPI200 index options market exhibits one-day implied dividend rate reversals that are more significant than those found in the underlying index, especially for short maturities. The reversals for the short maturities are found to be unrelated to the underlying index dynamics, implying that participants in the options market may overreact when estimating future dividend rates for reasons not closely related to the underlying index dynamics. Furthermore, the reversals become more concentrated in shorter maturities post-COVID, suggesting that irrational behavior has strengthened after the crisis.

The rest of this paper is organized as follows: Section 2 describes the sample data collected from the KOSPI200 index options market. Section 3 outlines the empirical methodology, and Section 4 explains the findings of the empirical analysis. Section 5 concludes the paper.

2. Data

The KOSPI200 index and options data employed in this study span 108 months, from January 2015 to December 2023. The daily observations are reconstructed from one-minute KOSPI200 index data and KOSPI200 index options tick data, both of which are obtained from the Korea Exchange. Since the options data contain information on actual transactions, we do not need to approximate the market price from quotes using methods such as mid-point approximation.

To choose the put-call pairs, we choose the strike price that is nearest-to-the-money at the time of snapshots. For each day we choose three maturities, which are the shortest, second-shortest, and third-shortest after discarding options for which the time to maturity is shorter than seven days. We do not consider the day-maturity pairs for which there are no available put-call pair observations for the nearest-to-the-money strike price so that we can address the illiquidity issue. As a result, there are 2,212, 2,178, and 1,407 observations for the shortest, second-shortest, and third-shortest observations in our final sample. We retrieve the 91-day CD rate, which we employ as the risk-free rate to calculate the implied dividend rate and introduce as a control variable, from the Bank of Korea Economic Statistics System. Table 1 presents the summary statistics for our daytime and overnight dividend rate changes.

[Table 1 about here]

3. Methodology

In this study, we examine the option-implied dividend rate that is derived based on the put-call parity, which is defined as:

$$C_{t,\tau,K} - P_{t,\tau,K} = e^{-q\tau} S_t - e^{-r\tau} K, \tag{1}$$

Where $C_{t,\tau,K}$ and $P_{t,\tau,K}$ are call and put prices for time to maturity τ and strike price K at time t, q and r are the dividend and risk-free rates that are assumed to be fixed, and S_t is the underlying price at time t, respectively. By rearranging Equation (1), we can derive the dividend rate implied by $C_{t,\tau,K}$, $P_{t,\tau,K}$, r, and S_t as follows:

$$q = -\frac{1}{\tau} \ln \left(\frac{C_{t,\tau,K} - P_{t,\tau,K} + e^{-r\tau} K}{S_t} \right). \tag{2}$$

Throughout this study, we calculate the implied dividend rate q with Equation (2).

From our dataset, we derive the daytime session and overnight changes in the option-implied dividend rate and the underlying index to investigate their existence and interrelationship. Hereafter, we refer to the changes in the underlying index as the underlying returns, defining them as percentages. The implied dividend rate changes and returns are defined as follows:

$$\Delta q_{daytime,t} = q_{C,t} - q_{O,t}, \tag{3}$$

$$\Delta q_{overnight,t} = q_{O,t} - q_{C,t-1}, \tag{4}$$

$$r_{daytime,t} = s_{C,t} / s_{O,t} - 1, \tag{5}$$

$$r_{overnight,t} = s_{O,t} / s_{C,t-1} - 1, \tag{6}$$

Where $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$ are the daytime session and overnight changes in implied dividend rate on day t, $q_{O,t}$ and $q_{C,t}$ are the opening and closing implied divided rate levels on day t, $r_{daytime,t}$ and $r_{overnight,t}$ are the daytime session and overnight underlying index returns on day t, $s_{O,t}$ and $s_{C,t}$ are the opening and closing underlying index levels on day t, respectively.

To determine the presence of reversals for implied dividend rate changes Δq and underlying returns r, we estimate the following baseline models:

$$\Delta q_{daytime,t} = \alpha + \beta \cdot \Delta q_{overnight,t} + \varepsilon_t, \tag{7}$$

$$r_{daytime,t} = \alpha + \beta \cdot r_{overnight,t} + \varepsilon_t. \tag{8}$$

Additionally, we estimate the following augmented models to consider the potential effects of relevant variables on the possible reversals:

$$\Delta q_{daytime,t} = \alpha + \beta \cdot \Delta q_{overnight,t} + \gamma \cdot r_{overnight,t} + \delta_0 \cdot r_{f,t} + \delta_1 \cdot \ln(k_{O,t}/s_{O,t}) + \varepsilon_t, \qquad (9)$$

$$r_{daytime,t} = \alpha + \beta \cdot r_{overnight,t} + \gamma \cdot \Delta q_{overnight,t} + \delta_0 \cdot r_{f,t} + \varepsilon_t, \qquad (10)$$

where $r_{f,t}$ is the risk-free rate on day t, and $k_{O,t}$ is the strike price of the calls and puts that are used to calculate implied dividend rate. Given the definition for $k_{O,t}$, $\ln(k_{O,t}/s_{O,t})$ in Equation (7) can be interpreted as the log-moneyness for which the implied dividend rate is calculated, as of the options market opening on day t. We include the log-moneyness as a control variable to consider the possibility that the observed level of implied dividend rate is a function of moneyness.

4. Empirical results

Table 2 provides a correlation matrix of $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$ for the shortest, second-shortest, and thrid-shortest maturities, revealing three notable features. First, $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$ tend to be negatively correlated to each other, suggesting an existence of implied dividend rate reversal. Particularly, when we limit our focus on the $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$ pair for a single maturity, the correlation coefficients range between -0.2 and -0.6, which can be interpreted as reliable evidence of implied dividend reversals for the all maturities of interest in this study. Second, the negative correlation between $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$ for a single maturity becomes more significant as the maturity becomes shorter. The correlation coefficient is -0.555 for the shortest maturity, -0.455 for the second-shortest maturity, and -0.229 for the third-shortest maturity. This trend implies that the implied dividend rate reversals are stronger for shorter maturities. Third, $\Delta q_{daytime,t}$ is positively correlated across different maturities, as is the case with $\Delta q_{overnight,t}$. This positive correlation suggests that implied dividend rate dynamics are consistent across maturities.

[Table 2 about here]

To investigate the presence of implied dividend rate reversals in more detail, we estimate the regression models, which are defined by Equations (7) and (9). Table 3 demonstrates the estimation result, which exhibits two noteworthy characteristics. First, the result reveals a significantly negative relationship between $\Delta q_{daytime,t}$ and $\Delta q_{overnight,t}$, which can be regarded as evidence of implied dividend rate reversals in the KOSPI 200 index options market as demonstrated in Table 2. Second, the relationship between $\Delta q_{daytime,t}$ and $r_{overnight,t}$ are significantly negative for the third-shortest maturity but insignificant for the shorter maturities, implying that the strong implied dividend rate reversals for short maturities may not be closely related to the underlying index return dynamics. Third, the negative relationship persists even after controlling for additional variables. Although the coefficient estimate for log-moneyness is significantly positive for the shortest maturity, the control variables are found to have insignificant relationship with the implied dividend rate reversals in the other cases.

[Table 3 about here]

We next determine whether return reversals exist in the underlying KOSPI 200 index by estimating models defined by Equations (8) and (10). Table 4 presents the estimation result, which shows two interesting properties. First, the return reversals in the KOSPI 200 index is marginally insignificant at the 10% significance level, which is weaker than the implied dividend rate reversals. Given the previous studies which show that stock price dynamics are more volatile than dividend rate dynamics (Malmendier, Pouzo, and Vanasco, 2020; Quaye and Tunaru, 2022), the more significant reversals in implied dividend rates suggests that the implied dividend rate reversals can be market-specific and not be driven by return reversals, which is consistent with the results for short-term maturities in Table 3. Second, the overnight implied dividend rate change, $\Delta q_{overnight,t}$, is not found to have a significant relationship with the daytime session index returns, $r_{daytime,t}$. Given that the overnight index returns, $r_{overnight,t}$, have a significantly negative relationship with daytime implied dividend rate change, $\Delta q_{daytime,t}$, for longer maturities, the relationship between implied dividend rate and underlying index returns is consistent to some degree with the fact that implied dividend rates are forecasts but index values are realizations.

[Table 4 about here]

We finally investigate whether there exists a difference in implied dividend rate reversals between two suberiods, which are the pre-COVID period from 2015 to 2019 and the post-

COVID period from 2020 to 2023. We choose COVID-19 as the reference point given the findings of recent studies revealing that both actual dividend payouts and dividend forecast have been affected by the pandemic (Cejnek, Randl, and Zechner, 2021; Gormsen and Koijen, 2020). We estimate the models defined by Equations (7) and (9) for each subperiod. Table 5 demonstrate the estimation result, in which two notable characteristics can be highlighted. First, the reversals become more concentrated in shorter maturities post-COVID, suggesting that irrational behavior has strengthened after the crisis. The coefficient estimates for $\Delta q_{overnight,t}$ almost doubles in magnitude post-COVID for the shortest and second-shortest maturities, whereas the estimate becomes insignificant for the third-shortest maturity. Second, the relationship between implied dividend rate change and underlying index returns becomes significant for longer maturities but turns insignificant for shorter maturities. The coefficent estimate for $r_{overnight,t}$ for the third-shortest maturity becomes significant at the 10% level in the post-COVID period, whereas the same estimate for the second-shortest maturity becomes insignificant.

[Table 5 about here]

Overall, the empirical findings suggest the presence of one-day implied dividend rate reversals in the KOSPI200 index options market, and the reversals are particularly significant for shorter maturities. A comparison with return reversals in the underlying KOSPI200 index reveals that the implied dividend rate reversals are stronger than the underlying return reversals. The empirical results provide no evidence of an interrelationship between implied dividend rate reversals and underlying index dynamics for shorter maturities, which can be interpreted as a results of options market overreaction for reasons not significantly relevant to the underlying return dynamics.

5. Conclusion

This study explores the presence and interrelationship of reversals in the KOSPI 200 index options market, where we examine the implied dividend rate reversals, and the underlying KOSPI 200 index. We analyze the one-day reversals by how the overnight implied dividend rate changes and underlying returns affect the implied dividend rate and price dynamics during the following daytime trading session. The empirical findings suggest the the presence of implied dividend rate reversals in the KOSPI200 index options market that are unique and specific to the options market. We show that KOSPI200 index options market exhibit one-day implied dividend rate reversals, which are stronger than the return reversals in the underlying index. It is noteworthy that the implied dividend rate reversals are particularly significant for short-term maturities. Additionally, the implied dividend rate reversal for the short maturities is found to be independent of the underlying index dynamics, and are more concentrated post-COVID.

We suggest three relevant potential topics for future research. First, the relationship between implied dividend rate reversals and other option-implied information measures can be further explored. Second, the association between implied dividend rate and underlying return reversals can be examined in individual stock options markets. Third, the future-implied dividend rate can be examined together to determine whether futures market exhibits another idiosyncratic strand of implied dividend rate reversals.

References

Ameur, H.B., Ftiti, Z., Louhichi, W., Prigent, J-L., 2024. Financial crisis and investor behavior. *Journal of Economic Behavior and Organization 223*, 307–310. https://doi.org/10.1016/j.jebo.2024.05.014

Baker, M., Wurgler, J., 2007. Investor sentiment in the stock market. *Journal of Economics Perspectives 21*(2), 129–152. https://doi.org/10.1257/jep.21.2.129

Cejnek, G., Randl, O., Zechner, J., 2021. The COVID-19 pandemic and corporate dividend policy. *Journal of Financial and Quantitative Analysis 56*(7), 2389–2410. https://doi.org/10.1017/S0022109021000533

De la O, R., Myers, S., 2021. Subjective cash flow and discount rate expectations. *Journal of Finance 76*(3), 1339–1387. https://doi.org/10.1111/jofi.13016

Gormsen, N.J., Koijen, R.S.J., 2020. Coronavirus: Impact on Stock Prices and Growth Expectations. *Review of Asset Pricing Studies 10*(4), 574–597. https://doi.org/10.1016/j.irfa.2022.102228

Ham, H., Ryu, D., Webb, R.I., 2022. The effects of overnight events on daytime trading sessions. *International Review of Financial Analysis 83*, 102228. https://doi.org/10.1016/j.irfa.2022.102228

Hameed, A., Mian, G.M., 2015. Industries and stock return reversals. *Journal of Financial and Quantitative Analysis* 50(1–2), 89–117. https://doi.org/10.1017/S0022109014000404

Jegadeesh, N., Titman, S., 1995. Overreaction, delayed reaction, and contrarian profits. *Review of Financial Studies 8*(4), 973–993. https://doi.org/10.1093/rfs/8.4.973

Kothari, S.P., Shanken, J., 1992. Stock return variation and expected dividends: A time-series and cross-sectional analysis. *Journal of Financial Economics 31*(2), 177–210. https://doi.org/10.1016/0304-405X(92)90003-G

Kragt, J., de Jong, F., Driessen, J., 2020. The Dividend Term Structure. *Journal of Financial and Quantitative Analysis 55*(3), 829–867. https://doi.org/10.1017/S002210901900036X

Krivenko, P., 2023. Asset prices in a labor search model with confidence shocks. *Journal of Economic Dynamics and Control 146*, 104564. https://doi.org/10.1016/j.jedc.2022.104564

Lee, B.S., 1995. The response of stock prices to permanent and temporary shocks to dividends. *Journal of Financial and Quantitative Analysis 30*(1), 1–22. https://doi.org/10.2307/2331250

Malmendier, U., Pouzo, D., Vanasco, V., 2020. Investor experiences and financial market dynamics. *Journal of Financial Economic 136*(3), 597–622. https://doi.org/10.1016/j.jfineco.2019.11.002

Quaye, E., Tunaru, R., 2022. The stock implied volatility and the implied dividend volatility. *Journal of Economic Dynamics and Control 134*, 104276. https://doi.org/10.1016/j.jedc.2021.104276

Summers, L.H., 1986. Does the stock market rationally reflect fundamental values? *Journal of Finance 41*(3), 591–601. https://doi.org/10.1111/j.1540-6261.1986.tb04519.x

Table 1. Summary statistics

	$\Delta q_{daytime,t}$			$\Delta q_{overnight,t}$		
	Nearest maturity	Second-nearest	Third-nearest	Nearest maturity	Second-nearest	Third-nearest
Mean	-0.006	-0.001	0.000	0.006	0.001	0.000
Median	-0.005	-0.001	0.000	0.005	0.001	0.000
1st pct.	-0.121	-0.054	-0.060	-0.115	-0.063	-0.066
99th pct.	0.097	0.052	0.060	0.118	0.067	0.059
Std. dev.	0.039	0.022	0.023	0.043	0.023	0.022
Skewness	2.186	-5.707	1.384	-1.973	4.352	-1.108
Kurtosis	70.385	162.932	33.340	37.394	123.722	23.230
# of obs.	2,212	2,178	1,407	2,212	2,178	1,407

Table 2. Correlation matrix

		$\Delta q_{daytime,t}$			$\Delta q_{overnight,t}$		
		Shortest maturity	Second-shortest	Third-shortest	Shortest maturity	Second-shortest	Third-shortest
$\Delta q_{daytime,t}$	Shortest maturity	1.000					
	Second-shortest	0.301	1.000				
	Third-shortest	0.201	0.270	1.000			
$\Delta q_{overnight,t}$	Shortest maturity	-0.555	-0.166	-0.155	1.000		
	Second-shortest	-0.045	-0.455	0.058	0.279	1.000	
	Third-shortest	0.089	-0.008	-0.229	0.105	0.262	1.000

Table 3. One-day option-implied dividend rate reversals

	Shortest maturity		Second-shortest		Third-shortest	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta q_{overnight,t}$	-0.512***	-0.505***	-0.560***	-0.554***	-0.234**	-0.216**
	(-6.46)	(-5.99)	(-4.80)	(-4.63)	(-2.32)	(-2.02)
$r_{overnight,t}$		-0.151		-0.100		-0.348**
		(-0.65)		(-0.79)		(-2.02)
Risk-free rate		0.030		-0.009		-0.046
		(-0.42)		(-0.22)		(-0.75)
Log-moneyness		0.063*		-0.002		0.012
		(1.79)		(-0.15)		(-0.57)
Intercept	-0.003***	-0.007**	-0.001*	0.000	0.000	-0.002
	(-3.08)	(-2.25)	(-1.73)	(-0.06)	(-0.03)	(-0.37)
Adj. R^2	0.311	0.313	0.338	0.339	0.053	0.068
# of obs.	2,212	2,212	2,178	2,178	1,407	1,407

Table 4. One-day underlying asset return reversals

	(1)	(2)
$r_{overnight,t}$	-0.068	-0.073
	(-1.60)	(-1.58)
$\Delta q_{overnight,t}$		0.007
		(0.49)
Risk-free rate		0.000
		(-0.01)
Intercept	0.000*	0.000
	(-1.96)	(-0.84)
Adj. R^2	0.003	0.005
# of obs.	2,212	2,212

Table 5. One-day option-implied dividend rate reversals: Pre- and post-COVID periods

Panel A. Pre-COVID period (2015–2019)

	Shortest maturity		Second-shortest		Third-shortest	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta q_{overnight,t}$	-0.336***	-0.331***	-0.372***	-0.356***	-0.475***	-0.465***
	(-5.26)	(-5.02)	(-7.53)	(-7.13)	(-3.32)	(-3.08)
$r_{overnight,t}$		-0.034		-0.206***		-0.210
		(-0.17)		(-2.68)		(-1.42)
Risk-free rate		-0.366		-0.171		-0.121
		(-0.76)		(-0.89)		(-0.36)
Log-moneyness		0.080*		-0.011		0.014
		(1.75)		(-0.65)		(0.59)
Intercept	-0.003***	-0.002	-0.001	0.004	0.000	-0.001
	(-3.52)	(-0.29)	(-1.33)	(0.95)	(0.09)	(-0.13)
Adj. R^2	0.145	0.149	0.183	0.189	0.227	0.233
# of obs.	1,226	1,226	1,222	1,222	856	856

Panel B. Post-COVID period (2020–2023)

	Shortest maturity		Second-shortest		Third-shortest	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta q_{overnight,t}$	-0.658***	-0.651***	-0.639***	-0.636***	-0.042	-0.017
	(-6.03)	(-5.64)	(-4.54)	(-4.45)	(-0.43)	(-0.17)
$r_{overnight,t}$		-0.297		-0.078		-0.449*
		(-1.11)		(-0.44)		(-1.86)
Risk-free rate		0.025		0.000		-0.046
		(0.32)		(0.01)		(-0.54)
Log-moneyness		0.037		0.006		0.011
		(0.74)		(0.21)		(0.30)
Intercept		-0.005	-0.001	-0.002	0.000	-0.002
		(-1.05)	(-1.21)	(-0.42)	(-0.21)	(-0.19)
Adj. R^2	0.484	0.487	0.410	0.410	0.002	0.027
# of obs.	986	986	956	956	551	551