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Does information environment affect information spillover between the CDS and stock markets in Korea?

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Abstract
This study analyzes the impact of the information environment (IE) and credit default swap (CDS) transaction costs on information transmission between the stock and CDS markets. Using the daily regression analysis on the Korean firm's stock and CDS data from 2004 to 2023, the results show that companies with superior IE in the stock market exhibit a larger and more sensitive total information flow from the stock market to the CDS market. Companies with lower transaction costs in the CDS market demonstrate faster information flow. In the case of companies with superior IE, fundamental information is reflected in stock prices with high weight and thus the CDS spreads change reflecting information about stock prices. According to this study's findings, the primary factor influencing the information flow from the stock market to the CDS market is the information environment of the company in the stock market, rather than transaction costs in the CDS market.

Keywords CDS, Information flow, Information environment, Transaction cost
Paper type Research paper

1. Introduction

With recent rise in interest rates, concerns about economic downturns have increased, leading to increased attention in the credit default swap (CDS) markets. According to the Financial Supervisory Service (FSS) of Korea [1], the CDS trading volume in 2022 reached a historic high of 26.6tn won. This is approximately three times higher than 7.9tn won in 2021 and 10.1tn in 2020. If high-interest rates persist, and the likelihood of corporate insolvency increases, the CDS market is expected to garner even more attention.

The CDS is a derivative instrument that allows a company to trade credit events. It is standardized compared with corporate bonds, enabling it to serve as a proxy for corporate credit risk. The CDS spreads are determined by changes in the value of a company with the underlying asset, establishing an inherent correlation with the stock price of the same company. Numerous prior studies (e.g. Acharya and Johnson (2007), Norden and Weber (2009), Wang and Bhar (2014), Hilscher *et al.* (2015), Park *et al.* (2021)) have highlighted the existence of a lead-lag relationship between the US stock and CDS markets, indicating mutual information flow.

JEL Classification — G12, G14

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Acharya and Johnson (2007) discovered that during periods of overall credit market deterioration or for firms experiencing credit deterioration, information flows from the CDS market to the stock market. Wang and Bhar (2014) demonstrate that during high market volatility, there is significant information flow from the stock market to the CDS market for investment-grade firms, while during low market volatility; this flow is significant for non–investment-grade firms. While there are no consistent research results regarding the direction of information flow, a general observation from the analysis of a large dataset of the US firms by Hilscher *et al.* (2015) indicates that informed trades primarily occur in the stock market because of high transaction costs, leading to information flow from the stock market to the CDS market. Furthermore, Park *et al.* (2021) discovered, through the analysis of stock prices and CDS spreads of the US firms, that the information environment of a company significantly influences the information transmission from the stock market to the CDS market. Bae *et al.* (2010) find that, in Korea, stock prices predict the CDS spreads in a negative direction, indicating that the stock market leads the CDS market.

This study aims to build upon the insights of Park *et al.* (2021) and extend them beyond the findings of Bae *et al.* (2010) in the Korean market. Specifically, we examined how the information environment of companies in the Korean market influences price movements from the stock market to the CDS market. According to Easley *et al.* (2002), companies have distinct information environments in the stock markets. We aim to demonstrate that variations in the information environment of companies can significantly influence the flow of information from the stock market to the CDS market. As the fundamental information of companies is reflected more smoothly in the stock market, investors in the CDS market are also expected to engage in more sensitively reflected transactions. Consequently, it is anticipated that the sensitivity and quantity of the information flow will increase. Additionally, this study examines how information flow changes when arbitrage opportunities are limited because of increased transaction costs in the CDS market. This analysis was compared with the impact of the information environment. Through these investigations, we aim to enhance our understanding of the process by which information from the stock market is reflected in the CDS market.

Following the methodology of Park *et al.* (2021), we explore the foundations of the factors influencing the information flow from the stock market to the CDS market using the two key concepts. The first concept is sensitivity, which signifies the overall quantity of information flow. The CDS spreads change when the value of a company with an underlying asset fluctuates. If the intrinsic value of the company is appropriately reflected in the stock price, the CDS spread will also be influenced by stock market information. In other words, as the degree to which the intrinsic value of a company is reflected in the stock price increases, the total quantity and sensitivity of the information flow reflected from the stock price to the CDS spread will also increase. Conversely, if the stock market reflects a significant amount of noise beyond the intrinsic value of the company, the total quantity of information flow from the stock market to the CDS market is expected to decrease. The second concept is the speed of information flow. When there are changes in fundamental managerial information, such as sales, profits and risks, both stock prices and the CDS spreads are expected to reflect this information similarly. However, due to differences in transaction costs for each company, the speed at which information is reflected can vary. Changes in fundamental information of companies are likely to be prioritized in companies with lower transaction costs before being reflected in companies with higher transaction costs.

In particular, the difference in the speed of information transmission due to variations in transaction costs among the companies is more significantly influenced by transaction costs in the CDS market. Generally, transaction costs in the CDS market are higher than those in the stock market, and it takes longer for fundamental information of companies to be reflected in the CDS market. In other words, for companies with higher transaction costs in the CDS market, arbitrage opportunities diminish, and the speed of information reflection in the CDS spreads slows down. However, as changes in a company's fundamental information are ultimately reflected in the CDS spread of each company; differences exist only in the speed of information reflection, while the total quantity of information flow remains constant. We focus on the impact of a company's information environment and the CDS transaction costs on the sensitivity (total quantity) and speed of information flow.

This study analyzes Korean companies with both the CDS spreads and stock prices from 2004 to 2023. The information flow between the CDS and stock markets was examined through the lead-lag relationship between credit protection return (CPR), a surrogate for CDS returns and stock returns. The corporate information environment was assessed using R^2 (Dasgupta *et al.*, 2010; Rajgopal and Venkatachalam, 2011; Li *et al.*, 2014). Additionally, DELAY, which was influenced by Hou and Moskowitz (2005), was used in the analysis. R^2 is a value obtained when conducting a regression analysis of a firm's stock returns against the market and industry returns. A low R^2 value indicates that the firm has a higher number of errors not reflected in its stock returns, implying a less favorable information environment. Furthermore, a high DELAY signifies lower liquidity and higher transaction costs, indicating an unfavorable information environment for the stock market.

The main findings of this study are summarized as follows: first, using recent data from our daily regression analysis, we discovered that stock returns significantly predict CPRs, with an approximate lag of five days in the Korean market. Second, when dividing companies based on their information environments and conducting the regression analysis, the sensitivity (total effect) of information transmission was higher for companies with favorable information environments. Third, as the transaction cost in the CDS market, represented by the CDS bid-ask spread, decreased, information in the stock market was reflected more rapidly in the CDS market.

The originality of this study lies in the following: first, it analyzes the sample with the longest period among studies on CDS for Korean firms, incorporating recent data. Second, while Park *et al.* (2021) explore the impact of asymmetric information on the information transmission from the stock market to the CDS market based on the US company data, this study analyzes the impact of a company's information environment on the information transmission using Korean company data. Third, this is the first study to explore the impact of a company's information environment on the information transmission from the stock market to the Korean CDS market. Studies on individual companies' CDS, including those by Bae *et al.* (2010), generally have shorter sample periods and often do not incorporate recent data. Moreover, recent studies using current data have primarily focused on analyzing the information transmission between stock market indices and sovereign CDS spreads, rather than conducting analyses specifically related to individual companies. In addition, no existing studies have intricately analyzed information transmission from both speed and total effect perspectives, as conducted in this study. This study contributes significantly to the literature by utilizing recent Korean CDS data when interest in the CDS market is high, enhancing our understanding of price correlations between the stock and CDS markets.

The remainder of this paper is organized as follows: in Section 2, we explain the stock and CDS data used in our analysis as well as the variables related to the information environment. Section 3 conducts a daily regression analysis to analyze the information flow between the stock and CDS markets. Additionally, we examine how the results of the regression analysis vary based on a company's information environment and CDS transaction costs. Finally, Section 4 summarizes the study and reviews its findings.

2. Data and variable description

2.1 CDS and stock price

We focused on 17 Korean companies for which the stock prices and CDS data were available simultaneously. The analysis covers October 2004–February 2023 and examines daily data for both CDS and stock prices. The CDS data used in the analysis pertain to unsecured senior US dollar-denominated bonds as the underlying assets, collected through Bloomberg. Daily CDS spreads were used for the five-year maturity spreads, which were the most actively traded and listed for the most prominent companies. The CDS bid-ask spread was computed using monthly data, with the calculation performed at the end of each month by dividing the difference between the ask and bid spreads by the average of the two values.

The yield generated in the CDS market is defined as CPR. CPR represents the inherent return obtained based on spread changes when trading a CDS. Following Hilscher *et al.* (2015), the CPR at time *t* is calculated as the yield from buying the CDS spreads at time *t-1* and selling them at time *t*. This formula is expressed as follows:

$$CPR_t = \frac{CDS\ Spread_t - CDS\ Spread_{t-1}}{CDS\ Spread_{t-1}} \quad (1)$$

We use CPR as the CDS return concept that corresponds to stock returns. Daily data on individual company stock, market and sector-specific index returns were collected using the Korea Exchange (KRX) information data system. Market returns are based on the KOSPI, whereas sector-specific index returns are derived from the industry-specific indices among the KOSPI constituents.

2.2 Information environment

The corporate information environment (IE) variable is computed using R^2 and DELAY. R^2 and DELAY indicate the high or low information environment of a company in the stock market, and they are derived through regression analysis formulas, such as Equations (2) and (3).

$$RET_{i,t} = \alpha_i + \beta_1 RET_{mkt,t} + \beta_2 RET_{ind,t} + \varepsilon_{i,t} \quad (2)$$

Here, $RET_{i,t}$ represents the daily stock returns for company *i* on day *t*, $RET_{mkt,t}$ denotes the market returns on day *t*, and $RET_{ind,t}$ signifies the sector-specific index returns on day *t*. The adjusted R^2 in Equation (2) was defined as the R^2 used in this study. The regression analysis is conducted monthly for individual companies and market/sector indices, utilizing daily returns over the preceding three months. Companies with fewer than 50 daily observations during this period are excluded from the calculation.

Regarding R^2, various studies on the information environment have been conducted. Li *et al.* (2014) empirically find that companies with a high R^2 have a superior information environment. Rajgopal and Venkatachalam (2011) demonstrate that companies with low R^2 or high idiosyncratic volatility of stock returns have a poorer information environment. Dasgupta *et al.* (2010) argue that R^2 tends to be higher when the information environment of stock prices is favorable. Kelly (2014) empirically demonstrates that in stocks with low R^2, information-based investing becomes challenging, leading to reduced liquidity. In summary, a higher R^2 value indicates a superior information environment for a company [2].

The second regression analysis equation is as follows:

$$RET_{i,t} = \alpha_i + \beta_1 RET_{mkt,t} + \sum_{n=1}^{4} \beta_{2,n} RET_{mkt,t-n} + \varepsilon_{i,t} \quad (3)$$

Here, $RET_{i,t}$ represents the daily stock returns for company i on day t, $RET_{mkt,t}$ denotes the market returns on day t and $RET_{mkt,t-n}$ denotes the market returns on days t-n. In Equation (3), a monthly regression analysis is conducted using the daily returns of individual companies and the market for the preceding three months. This calculation was not performed for companies with less than 50 daily observations. The DELAY was computed based on the results of Equation (3) as follows:

$$\text{DELAY} = 1 - \frac{R^2_{\beta_{2,n}=0,\forall n\in[1,5]}}{R^2} \quad (4)$$

According to Hou and Moskowitz (2005), when market frictions significantly impact stocks, there is a considerable delay in reflecting market information in stock prices. In other words, when market friction is high, DELAY tends to increase. Consequently, companies with high DELAY values are considered to have lower liquidity and incur higher transaction costs, indicating a less favorable information environment.

In this study, we referred to Park *et al.* (2021) to calculate the information environment (IE) variables using R^2 and DELAY. Monthly rankings of the companies based on R^2 (denoted as $RANK\ R^2$) and DELAY (denoted as $RANK\ DELAY$) were determined. The IE is defined as the sum of $RANK\ R^2$ and $-RANK\ DELAY$. As R^2 increases and DELAY decreases, this indicates a better information environment for companies. Therefore, a higher IE suggests a superior information environment for a company.

2.3 Descriptive statistics

In Table 1, we examine the descriptive statistics of companies with high and low IE to understand the differences in their characteristics based on the corporate IE. High and low IE companies were defined each month using the median IE value for all companies. Panels A and B provide the descriptive statistics for these groups.

	Mean	P25	Median	P75
Panel A: High IE firms				
CDS spread(bp)	71.3	41.0	64.1	85.4
Size(trillion won)	51.7	13.9	20.8	34.4
CDS bid-ask spread(bp)	0.18	0.12	0.16	0.21
Trading volume(billion won)	148.4	39.1	60.4	134.9
Beta	1.00	0.62	0.99	1.37
Leverage ratio(%)	130	65	92	154
Amihud illiquidity(10^-6)	26.1	10.7	20.9	31.8
R2	0.75	0.62	0.77	0.90
DELAY	0.19	0.06	0.13	0.24
Panel B: Low IE firms				
CDS Spread(bp)	80.2	44.2	69.6	94.7
Size(trillion won)	14.5	8.7	12.3	18.5
CDS bid-ask spread(bp)	0.22	0.13	0.18	0.25
Trading volume(billion won)	64.0	27.6	42.0	70.9
Beta	0.78	0.36	0.75	1.17
Leverage ratio(%)	181	78	119	174
Amihud illiquidity(10^-6)	35.1	18.2	28.3	42.7
R2	0.45	0.24	0.47	0.63
DELAY	0.43	0.21	0.36	0.61

Source(s): Table by authors

Table 1. Summary statistics

Table 1 presents the mean, first-quartile, median and third-quartile values for companies with high IE (Panel A) and low IE (Panel B) across various variables. The variables include CDS spread, market capitalization, CDS bid-ask spread, trading volume (daily averaged), market beta, leverage ratio, Amihud illiquidity index, R^2 and DELAY. Market capitalization, trading volume, market beta and the Amihud illiquidity index were collected using the KRX information data system. The debt ratio is calculated as the ratio of total debt to total equity, using the data provided by FnGuide. The debt ratio was computed using annual financial information after excluding financial institutions.

The summary of the results from Table 1 is as follows: In Panel A, companies with high IE exhibit lower CDS spread, CDS bid-ask spread, debt ratio, Amihud illiquidity index and DELAY than those with low IE in Panel B. Additionally, Panel A shows higher market capitalization, trading volume, market beta and R^2. In other words, companies with high IE appear to have characteristics such as larger market capitalization, higher trading volume and a lower illiquidity index.

3. Empirical analysis

3.1 Analysis for information flow from stock market to CDS market

In this section, we analyze the information flow from the stock market to the CDS market by examining the reaction of CPR to changes in stock returns. Numerous studies have reported on information flows from the US stock market to the CDS market. Hilscher *et al.* (2015) argue that this phenomenon in the CDS market is attributed to higher transaction costs than the the stock market, making arbitrage difficult and a slower speed of information reflection. Therefore, we investigate whether a similar lead-lag relationship in information reflection exists in the Korean stock and CDS markets. Specifically, we can examine the lead-lag relationship between the stock returns and CPR by conducting a regression analysis with CPR as the dependent variable.

$$CPR_{i,t} = \alpha_i + \sum_{p=1}^{10} \beta_{1,p} CPR_{i,t-p} + \sum_{s=0}^{10} \beta_{2,s} RET_{i,t-s} + \varepsilon_{i,t} \tag{5}$$

where $CPR_{i,t}$ represents the CPR of firm i on day t and $CPR_{i,t-p}$ represents the CPR of firm i on day t-p, where p takes values from 1 to 10. Additionally, $RET_{i,t-s}$ denotes the stock return of firm i on day t-s, where s varies from 0 to 10. The regression analysis includes fixed effects for both firms and time.

$\beta_{2,s}$ represents the coefficient indicating the sensitivity of CPR on day t to changes in stock returns on day t-s. To assess the significance of the information flow from the stock market to the CDS market, particular attention should be given to $\beta_{2,s}$. If $\beta_{2,s}$ holds a statistically significant negative coefficient, it implies that firm information is initially reflected in the stock market, followed by a significant reflection in the CDS market with a lag of s days.

Table 2 presents the coefficients $\beta_{2,s}$, t-values, and the cumulative sum of coefficients for Equation (5) across values of s from 0 to 10 over the entire analysis period. The first row

Table 2.
Effects of equity returns on CPRs

Lag	0	1	2	3	4	5	6	7	8	9	10
$\beta_{2,s}$	−0.218	−0.178	−0.084	−0.063	−0.043	−0.041	−0.017	0.039	0.013	−0.019	−0.005
	(−6.45)***	(−6.07)***	(−4.29)***	(−3.16)***	(−2.71)***	(−2.78)***	(−0.98)	(1.58)	(0.74)	(−1.25)	(−0.28)
	−0.218	−0.395	−0.479	−0.542	−0.585	−0.625	−0.643	−0.603	−0.591	−0.609	−0.614

Source(s): Table by authors

depicts the coefficients $\beta_{2,s}$ for the stock returns on day t-s concerning CPR on day t. The second row displays the t-values corresponding to each coefficient and the final third row presents the cumulative sum of $\beta_{2,s}$ values up to the lag s indicated in the first row. The t-values were computed using the methodology outlined in Petersen (2009), incorporating fixed effects for firms and time into the regression analysis. Significance levels ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively.

The interpretation of Table 2 can be illustrated with a simple example as follows: examining the results for a lag of five days ($s = 5$), the value of $\beta_{2,s}$ is −0.041. The cumulative sum of the coefficients for lags 0–5 was −0.625 and the t-value was −2.78, indicating statistical significance at the 1% level. In other words, the information flow from the stock market to the CDS market is significant, with a lag of five days. Similar interpretations are made for each s.

In Table 2, $\beta_{2,s}$ exhibits statistically significant negative values for lags 0–5. This implies that when positive information about firm value emerges, stock returns first increase, followed by a subsequent decrease in CPR. In other words, when the lag is 0, $\beta_{2,s}$ is −0.218 with a significant t-value of −6.45. As the lag increases from 1 to 5, both the coefficient values and t-values gradually decrease, ranging from −0.178 to −0.041. Information transfer from the stock market to the CDS market occurs most rapidly during the contemporaneous period (lag 0) and progressively slows down with a lag of up to five days. Meanwhile, $\beta_{1,p}$ in Equation (5) measures the linear relationship between CPR_t and CPR_{t-p} for a lag of p days. This was statistically significant only for a lag of one day ($p = 1$). However, as $\beta_{1,p}$ is not the primary focus of the analysis, it is not presented in the table.

Moreover, the cumulative sum of coefficients $\beta_{2,s}$ shows little variation beyond $s = 5$. The cumulative sum is −0.218 when the lag is 0 days, −0.625 at a lag of five days and remains similar at approximately −0.614, even when the lag extends to 10 days. This is because $\beta_{2,s}$ for lags beyond $s = 5$ is either not statistically significant or very small in magnitude. Information about the firm reflected in the stock market is transmitted to the CDS market with a maximum lag of five days. Beyond a lag of six days, the information has already been incorporated or the observed flow may be non-significant due to noise. In summary, according to Table 2, similar to the findings of Hilscher *et al.* (2015) and Park *et al.* (2021), who analyzed the US firms, the results suggest that in Korea, stock market information is significantly reflected in the CDS market.

3.2 The impact of information environment

The information flow from the stock market to the CDS market can vary depending on how effectively a firm's fundamental information is reflected in its stock prices. In other words, the extent to which intrinsic information is incorporated into stock prices may differ based on the informational environment of the firm in the stock market. The speed and sensitivity (magnitude) of the information transmission can vary accordingly.

In this study, we define the informational environment as a firm's informational environment in the stock market. We examine how variations in stock returns contingent on IE manifest in differences, such as the lag in reflection on CPR, significance and other related aspects.

Table 3 presents the results of the regression analysis (Equation 5) for firms with high and low IE levels in the stock market. Specifically, each month, firms with an IE above the median are defined as those with a high informational environment, while those with an IE below the median are defined as those with a low informational environment. The regression coefficients $\beta_{2,s}$ for each category are then calculated using Equation (5).

Table 3.
Effects of the equity returns of high- and low-IE firms on CPRs

Lag	High		Low		High – Low
0	−0.267 (−6.07)***	−0.27	−0.153 (−7.41)***	−0.15	−0.114
1	−0.207 (−5.94)***	−0.47	−0.151 (−4.59)***	−0.30	−0.057
2	−0.100 (−4.44)***	−0.57	−0.064 (−3.47)***	−0.37	−0.036
3	−0.060 (−2.12)**	−0.63	−0.055 (−2.17)**	−0.42	−0.005
4	−0.054 (−3.09)***	−0.69	−0.026 (−1.61)	−0.45	−0.027
5	−0.045 (−2.89)***	−0.73	−0.041 (−2.46)**	−0.49	−0.004
6	−0.020 (−0.89)	−0.75	0.004 (0.24)	−0.49	−0.024
7	0.021 (1.34)	−0.73	0.070 (1.32)	−0.42	−0.049
8	0.043 (2.11)**	−0.69	−0.026 (−1.32)	−0.44	0.069
9	−0.004 (−0.16)	−0.69	−0.035 (−2.03)**	−0.48	0.031
10	0.012 (0.59)	−0.68	−0.025 (−1.35)	−0.50	0.037

Source(s): Table by authors

In $\beta_{2,s}$, s takes values from 0 to 10, and Table 3 displays coefficients and t-values for each s, along with the cumulative sum of coefficients from 0 to s. The last column indicates the difference in coefficients between firms with high and low information environments.

The regression results in Table 3 exhibit a similar pattern to Table 2 overall. The absolute value of the coefficient $\beta_{2,s}$ is the largest and statistically significant when the lag s is 0. As the lag s increases for $\beta_{2,s}$, the absolute value of the coefficient diminishes, and the statistical significance decreases. The cumulative sum of coefficients also maintains a relatively constant value after a certain lag. However, it is noteworthy that the cumulative sum is consistently larger for firms with a high IE than those with a low IE across all s.

When examining the results of Table 3 for companies with high and low levels of IE, the absolute values of the coefficient $\beta_{2,s}$ are generally higher for companies with high IE. For $\beta_{2,0}$, the values for companies with high and low IE are −0.267 and −0.153, respectively. Moreover, as the time lag increases from s = 1 to 6, the absolute values of $\beta_{2,s}$ are consistently larger for companies with a higher level of information environment. For time lags s = 7 and beyond, the absolute values of $\beta_{2,s}$ sometimes become larger for companies with low IE, but for the most part, $\beta_{2,s}$ values are either very small or positive, lacking meaningful significance.

The cumulative sum of the coefficients indicates that, overall, higher absolute values are observed for companies with high IE. For instance, at s = 5, the cumulative sum of coefficients for companies with high IE is −0.73, whereas for those with low IE, it is −0.49. Similarly, at s = 10, the cumulative sum of coefficients for companies with high and low IE is −0.68 and −0.50, respectively. In other words, higher absolute values of the cumulative sum result from a larger total amount of information transfer in companies with high IE. The flow of information from the stock market to the CDS market is more active in companies with high IE.

Examining the t-values, companies with high IE show statistical significance from s = 0 to 5, whereas for companies with low IE, significance is observed from s = 0 to 5, excluding s = 4. Moreover, for time lags of s = 6 and above, most values were either not statistically significant or exhibited positive values, lacking meaningful results. Essentially, there is a higher frequency of statistically significant outcomes for companies with high IE.

Furthermore, the absolute values of the coefficient differences presented in the last column tend to decrease as the time lag increases. For s = 0 and 1, the difference in coefficients is noted as −0.114 and −0.057, respectively, but for s = 5, this absolute value decreases to −0.004. Although there is a slight increase in the absolute values of coefficients for s = 6 and 7, interpreting these results as intuitively meaningful is challenging due to the lack of statistical significance in $\beta_{2,s}$ for these time lags. Moreover, for s = 8, 9 and 10, the differences in the coefficients are positive and this also does not yield a statistically significant interpretation.

In summary, companies with a higher level of IE in the stock market exhibit a more sensitive and statistically significant flow of information from the stock market to the CDS market than do companies with a lower IE level. This significance was particularly pronounced when the time lag was smaller. However, the cumulative sum of the coefficients indicates that, across all time lags, companies with a higher information environment consistently demonstrate a larger total flow of information. Therefore, the overall quantity of information flows is higher for companies in superior information environments.

The heightened sensitivity and substantial quantity of the information transmission from the stock market to the CDS market in companies with a high information environment can be attributed to the following reason: in stock markets, companies with a high-information environment witness a more accurate reflection of essential information related to changes in their business activities in stock prices. Consequently, stock price mispricing is reduced.

Certainly, investors in the CDS market are more likely to base their investments on fundamental information changes related to a company's business activities rather than information already reflected in the stock market. However, as the information environment becomes more robust, resulting in reduced pricing errors in stock markets and more accurate reflections of fundamental company information, the CDS market tends to closely align with and reflect information from the stock market to a greater extent.

In essence, the total quantity of information flow is higher in companies with high IE, where fundamental information is fully reflected in stock prices. On the other hand, in companies with a low IE, even when there are changes in the business environment, fundamental information may not be smoothly reflected in stock prices, leading to a higher proportion of errors. Consequently, investors in the CDS market, focusing on fundamental information rather than stock prices, result in a decreased total quantity of information flow from the stock market to the CDS market.

Meanwhile, IE is derived from R^2 and DELAY, defined as the sum of $RANK\ R^2$ and $-RANK\ DELAY$. Although R^2 and DELAY are likely to encompass similar information, it is essential to verify the robustness of the results by separately defining R^2 and DELAY as information environment variables. This would involve conducting regression analyses similar to those in Table 3 to ensure the consistency of the results with Table 3, thereby demonstrating the robustness of the findings. In the appendix, R^2 and DELAY are separately defined as information environment variables and the results of regression equation (5) for companies with high and low levels of information environments are presented.

3.3 The impact of CDS bid-ask spread

Differences in the transaction costs of individual companies in the CDS market can be a crucial factor influencing the information flow from the stock market to the CDS market. As transaction costs increase in the CDS market, it becomes more challenging for information reflected in the stock market to be readily incorporated into the CDS market. In other words, even if informed traders identify arbitrage opportunities in the CDS market, they engage in trading only if they can generate profits that exceed transaction costs. Various variables could represent transaction costs in the CDS market, but the bid-ask spread can serve as a direct indicator of transaction costs, representing the additional costs investors actually incur when buying or selling. We aim to investigate how the bid-ask spread among the individual companies in the CDS market influences the transmission of information from the stock market to the CDS market.

Table 4 presents the results of the regression analyses for companies with high and low CDS bid-ask spreads based on Equation (5). In this context, companies with high and low CDS bid-ask spreads are classified using the median of the monthly bid-ask spreads for all companies as the threshold. In Table 4, similar to Table 3, it presents regression analysis

Table 4.
Effects of the equity returns of high- and low-bid ask spread firms on CPRs

Lag	High		Low		High – Low
0	−0.201 (−5.65)***	−0.20	−0.273 (−5.66)***	−0.27	0.072
1	−0.143 (−3.44)***	−0.34	−0.175 (−5.17)***	−0.45	0.033
2	−0.048 (−2.24)**	−0.39	−0.077 (−2.78)***	−0.53	0.029
3	−0.072 (−2.99)***	−0.46	−0.067 (−2.88)***	−0.59	−0.004
4	−0.022 (−0.92)	−0.48	−0.014 (−0.63)	−0.61	−0.008
5	−0.071 (−2.48)**	−0.56	−0.014 (−0.72)	−0.62	−0.057
6	0.002 (0.09)	−0.55	−0.028 (−1.30)	−0.65	0.030
7	0.037 (1.53)	−0.52	0.085 (1.53)	−0.56	−0.047
8	0.003 (0.1)	−0.51	0.017 (0.74)	−0.55	−0.015
9	−0.026 (−1.63)	−0.54	−0.005 (−0.26)	−0.55	−0.021
10	−0.004 (−0.15)	−0.54	−0.007 (−0.29)	−0.56	0.003

Source(s): Table by authors

results, showing $\beta_{2,s}$, t-values and the cumulative sum of coefficients up to s. Here, s takes values from 0 to 10, and the last column calculates the coefficient differences between companies with high and low CDS bid-ask spreads.

Table 4 presents results that differ from those in Table 3. In Table 3, companies with high IE mostly exhibited larger absolute values for $\beta_{2,s}$, while in Table 4, the magnitude difference of $\beta_{2,s}$ between companies with high and low CDS bid-ask spreads varies with the time lag s. At s = 0, $\beta_{2,0}$ appears as −0.201 for companies with high CDS bid-ask spreads and −0.273 for those with low CDS bid-ask spreads, indicating larger absolute values for companies with lower transaction costs in the CDS market. Similarly, at s = 1 and 2, $\beta_{2,s}$ for companies with high and low CDS bid-ask spreads, respectively, are −0.143, −0.048 and −0.175, −0.077. This suggests that when transaction costs are lower, there is a higher sensitivity in the flow of information. This is because lower transaction costs in the CDS market lead to increased arbitrage opportunities based on the information reflected in stock prices, resulting in a faster transmission of information from the stock market to the CDS market.

On the contrary, as the time lag s increases, the magnitude of $\beta_{2,s}$ shows an opposite trend, and beyond a certain lag, the cumulative sum of $\beta_{2,s}$ for companies with high and low CDS bid-ask spreads becomes similar. In other words, from s = 0 to 6, the cumulative sum of $\beta_{2,s}$ is consistently more than 0.06 larger in absolute value for companies with low CDS bid-ask spreads. However, as s increases up to 10, the cumulative sum diminishes, reaching −0.54 and −0.56, indicating a nearly negligible difference. In contrast, in Table 3, when s = 10, there is a difference in the cumulative sum of the coefficients. For companies with high IE, the cumulative sum is −0.68, while for those with low IE, it is −0.50, indicating a difference of 0.18.

The results from Table 4 suggest that, unlike Table 3, the transaction costs in the CDS market may not significantly impact the overall quantity of information flowing from the entire stock market to the CDS market. However, it can be interpreted that these transaction costs influence the speed of information flow. If transaction costs are low in the CDS market, investors can swiftly engage in arbitrage in the CDS market and thus, information reflected in stock prices is quickly incorporated without significant time lags, also reflecting in the CPR. Conversely, when transaction costs are high, investors face challenges in swift arbitrage, resulting in inadequate information transmission from the stock market to the CDS market for small time lags (s = 0, 1 and 2). In other words, a delay in information transmission occurs because of elevated transaction costs in the CDS market, leading to a difference in the speed of information flow. However, as discussed earlier in Table 3, companies with a superior information environment in the stock market have a higher proportion of fundamental information reflected directly in stock prices, leading to an increase in the quantity of information flow. In summary, the transaction costs in the CDS market influence the speed of information flow from the stock market to the CDS market. However, they do not have a significant impact on the overall quantity of the ultimate information flow.

3.4 Analysis for information flow from the CDS market to stock market

Until now, we have continued the discussion on the information flow from the stock market to the CDS market. However, it is also essential to examine the reverse direction information flow from the CDS market to the stock market. Wang and Bhar (2014) and Hilscher *et al.* (2015) demonstrate that the information flow from the CDS market to the stock market is not statistically significant. In contrast, Acharya and Johnson (2007) argue for the significance of information flow based on their analysis of 79 companies over specific points in time from 2001 to 2004. In our study, we investigate whether the CDS market leads the stock market during the analysis period for the selected Korean companies. We also explore how this information flow is influenced by changes in IE in the stock market. Specifically, we can examine the lead-lag relationship between stock returns and CPR through the following regression equation (6)

$$RET_{i,t} = \alpha_i + \sum_{p=1}^{10} \beta_{1,p} RET_{i,t-p} + \sum_{s=0}^{10} \beta_{2,s} CPR_{i,t-s} + \varepsilon_{i,t} \tag{6}$$

Here, $RET_{i,t}$ represents the stock return of firm i on day t and $RET_{i,t-p}$ represents the stock return of firm i on day t-p, where p takes values from 1 to 10. Additionally, $CPR_{i,t-s}$ denotes the CPR of firm i on day t-s, where s varies from 0 to 10. The regression analysis includes fixed effects for both firms and time. $\beta_{2,s}$ represents the coefficient indicating the sensitivity of stock returns on day t to the CPR variation at t-s days. This is a key parameter for examining information flows from the CDS market to the stock market.

Table 5 presents the coefficients $\beta_{2,s}$, t-values, and the cumulative sum of coefficients for Equation (6) across values of s from 0 to 10. In the first row, we depict the coefficients $\beta_{2,s}$ for the CPR on day t-s concerning stock return on day t. The second row displays the t-values corresponding to each coefficient and the final third row presents the cumulative sum of $\beta_{2,s}$ values up to the lag s indicated in the first row. The t-values are computed using Petersen's (2009) methodology, incorporating fixed effects for firms and time into the regression analysis. Significance levels ***, ** and * indicate statistical significance at the 1, 5 and 10% levels, respectively.

In Table 5, only $\beta_{2,s}$ with a lag of 0 (s = 0) exhibits statistically significant values. All other coefficients of s, excluding 0, are statistically insignificant, and their magnitudes are very small and lack intuitive significance. This is consistent with the results reported by Hilscher *et al.* (2015) and Wang and Bhar (2014). In other words, the information reflected in the CDS market does not precede that in the stock market; instead, it is contemporaneously reflected in the stock market on the same day.

Lag	0	1	2	3	4	5	6	7	8	9	10
$\beta_{2,s}$	−0.025	−0.007	−0.001	−0.001	−0.002	−0.001	−0.003	0.000	−0.006	−0.001	0.004
	(−1.74)*	(−1.55)	(−0.62)	(−0.32)	(−0.55)	(−0.21)	(−0.66)	(−0.09)	(−1.52)	(−0.31)	(1.21)
	−0.025	−0.032	−0.033	−0.034	−0.036	−0.037	−0.040	−0.040	−0.046	−0.047	−0.043

Source(s): Table by authors

Table 5. Effects of CPRs on equity returns

Table 6 presents the results of regression equation (6) for companies with high and low IE levels in stock markets. Each month, companies with an IE above the median are defined as those with a high IE while those with IE below the median are defined as those with a low IE. The table shows the $\beta_{2,s}$ for each of these categories in regression equation (6). In Table 6, it presents not only the coefficients for each s in $\beta_{2,s}$ but also t-values and the cumulative sum of $\beta_{2,s}$ up to s. The last column shows the coefficient differences between the companies in high-information and low-information environments.

In Table 6, statistically significant $\beta_{2,s}$ values are observed for companies with a superior IE at s = 0 and 1, with values of −0.055 and −0.015, respectively. For the remaining regression results, there is no statistical significance for $\beta_{2,s}$ at any s. The magnitudes of $\beta_{2,s}$, cumulative sum of $\beta_{2,s}$ and the coefficient differences between companies with high and low IE are very small, making it challenging to attribute intuitive significance to them.

The reason for significant regression coefficients only appearing for companies with high IE (s = 0,1) is believed to be associated with informed trading in the CDS market. In companies with high IE, informed trading is likely to occur in both the CDS and stock markets. This suggests that there is a lead time of approximately one day for information flow from the CDS market to the stock market, indicating that trading activities in the CDS market precede those in the stock market for high IE companies.

Although the regression coefficients for such information flow may be very small, suggesting limited economic significance, the results in Table 6 are intriguing in indicating that variations in the IE in the stock market may influence the information flow from the CDS market to the stock market.

4. Conclusion

This study analyzes the impact of a firm's information environment on the information flow between the stock and CDS markets. Using the data from Korean companies spanning the period from 2004 to 2023, the analysis reveals that in companies with a superior information environment in the stock market, there is more pronounced sensitivity in the information transmission from the stock market to the CDS market. Furthermore, for companies with low CDS bid-ask spreads, the speed of information transmission was faster.

We examined the lead-lag relationship between the stock returns and CPR through a daily regression analysis. When exploring the changes in CPR in response to variations in stock

Lag	High		Low		High – Low
0	−0.055 (−3.71)***	−0.05	−0.011 (−1.27)	−0.01	−0.044
1	−0.015 (−3.78)***	−0.07	−0.003 (−0.90)	−0.01	−0.012
2	−0.002 (−0.48)	−0.07	0.000 (−0.18)	−0.01	−0.002
3	−0.001 (−0.19)	−0.07	−0.001 (−0.53)	−0.01	0.000
4	−0.003 (−0.57)	−0.07	−0.001 (−0.40)	−0.02	−0.001
5	−0.002 (−0.24)	−0.08	0.001 (0.27)	−0.02	−0.003
6	0.001 (0.14)	−0.08	−0.008 (−1.30)	−0.02	0.008
7	0.000 (−0.06)	−0.08	−0.003 (−0.56)	−0.03	0.002
8	−0.005 (−0.93)	−0.08	−0.004 (−0.62)	−0.03	−0.002
9	0.001 (0.15)	−0.08	−0.007 (−1.02)	−0.04	0.007
10	0.002 (0.63)	−0.08	0.007 (1.34)	−0.03	−0.005

Source(s): Table by authors

Table 6.
Effects of the CPRs for high- and low-IE firms on equity returns

returns, we observed that companies with high IE exhibited larger absolute values of regression coefficients and higher significance. This suggests that in companies with a superior information environment, where stock prices reflect fewer errors, the CDS market reacts more strongly to information in the stock market, leading to an increase in the overall volume of information transmission.

Companies with low CDS bid-ask spreads exhibit significantly larger absolute values of regression coefficients in the negative direction than companies with high CDS bid-ask spreads only when the time lag is small. In contrast, the cumulative sum of the coefficients considering a 10-day lag did not show any significant differences based on CDS bid-ask spreads. The transaction costs in the CDS market do not affect the overall volume of information transmission from the stock market to the CDS market. However, this creates a significant difference in the speed of information transmission.

We also examined the changes in stock returns in response to variations in CPR, but it was evident that the information flow from the CDS market to the stock market exists only on the concurrent days. However, in companies with a superior information environment in the stock market, we discover that information flow is significant up to a one-day lag.

This study is meaningful in discovering that the information environment in the stock market and the transaction costs in the CDS market have different impacts on the information flow from the stock market to the CDS market, using the data from Korean companies. In companies with low CDS bid-ask spreads, the speed of information flow from the stock market to the CDS market was shortened. Additionally, for companies with a superior information environment in the stock market, it was found that not only the speed of information flow but also the overall volume of information transmission increased. Therefore, the findings of this study suggest that the information environment of the company has a greater impact on the information flow from the stock market to the CDS market than the transaction costs in the CDS market.

Notes

1. The CDS trading volume is based on the financial derivatives trading status statistics table reported by the FSS. The financial institutions included in the FSS's transaction performance aggregation are banks (domestic and foreign branches), financial investment firms (domestic and foreign), insurance companies and others (collective investment managers, futures companies, securities firms and credit card companies).
2. Meanwhile, according to prior studies such as Morck *et al.* (2000), Durnev *et al.* (2003) and Durnev *et al.* (2004), for companies with high R^2, stock price movements do not reflect intrinsic fundamental information specific to the company, distinct from market returns. This suggests that the information environment may not be favorable in such cases. However, in this study, we aim to interpret the meaning of R^2 following prior research such as Li *et al.* (2014), Rajgopal and Venkatachalam (2011), Dasgupta *et al.* (2010) and Kelly (2014), which argue that companies with low R^2 indicate a poor information environment due to significant pricing errors, in addition to considering the results of basic statistics presented in Table 1.

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Appendix

The supplementary material for this article can be found online.

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