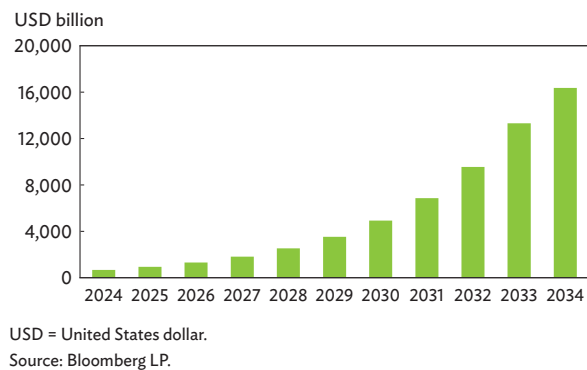


Risk Spillovers Between Carbon and Green Bond Markets: Implications for the Republic of Korea's Carbon Market

A carbon emissions trading system (ETS) is recognized as an efficient tool for curbing carbon dioxide (CO₂) emissions, drawing substantial global attention in recent years. In 2024, the global carbon credit market was valued at USD669.4 billion and projected to grow at an impressive annual rate of 37.7% to reach USD16,379.5 billion by 2034 (Figure 16). The European Union (EU) dominates the global ETS market, accounting for a 79.5% share in 2023. The market in the United States is also poised for strong growth and is expected to reach USD326.2 billion by 2032. This burgeoning interest in emissions trading reflects ETS markets' success in promoting low-carbon technologies and supporting economies to achieve their net-zero targets (Lyu, Shi, and Wang 2020; Guo et al. 2021). For example, since its inception in 2005, the EU ETS has helped reduce emissions from the power and industrial sectors by 37%.

Given the critical role of ETSs in reducing emissions from power generation, a growing body of literature has explored the pricing dynamics within carbon markets. Most existing research focuses on markets in the EU and the People's Republic of China (PRC). The Republic of Korea's ETS (KETS), launched in 2015, has also proven effective—reducing emissions by 676.6 metric tons of CO₂ equivalent in 2021 and significantly lowering compliance costs. Estimates suggest that emissions trading could help the Government of the Republic of Korea save 1.42% of gross domestic product (Wei, Li, and Wang 2022). This implies that without the emission trading system, the economy of the Republic of Korea could experience a larger downturn resulting from climate hazards due to its climate policies; however, using this cap-and-trade mechanism would allow the government to reduce such economic damage. Despite KETS' success, the carbon price behavior of market participants remains underexplored.

Figure 16: Global Carbon Credit Market Size

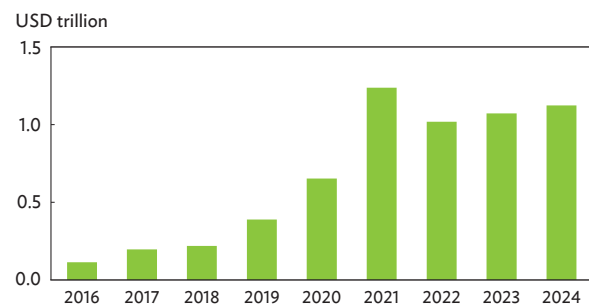


This study aims to address that gap by analyzing the volatility dynamics of carbon prices in the Republic of Korea. Specifically, we investigate the risk spillover effects between KETS and global green bond markets. As both ETSs and green bonds represent essential components of the sustainable finance ecosystem, understanding the risk transmission between them is crucial for facilitating a smooth energy transition.¹⁷

Recent studies—such as Mensah et al. (2018); McInerney and Bunn (2019); Kim, Dong, and Yoon (2024); and Bouteska, Harasheh, and Marzo (2025)—highlight potential interlinkages between an ETS and a green bond market, arguing that while green bonds fund low-carbon technologies, carbon allowance prices influence associated costs. Additionally, an expanding green bond market can reduce demand for carbon allowances, reflecting a complementary relationship. These connections are important for assessing risks associated with sustainable finance. Other recent studies—including Jin et al. (2020); Rannou, Boutabba, and Barneto (2021); Tiwari et al. (2022); Ren et al. (2022); Li et al. (2022);

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¹⁷ A recent report, published by the World Bank, reveals a continuing growth trend in the global green bond market. For instance, annual issuance in 2024 reached USD1.1 trillion, reflecting a 5% increase compared to 2023 (Figure 17). The report also predicts that the volume of green bond issuance in 2025 will increase, despite macroeconomic and geopolitical conditions.

Figure 17: Global Green Bond Annual Issuance

USD = United States dollar.
Source: Bloomberg LP.

Zhang and Umair (2023); Zhang, Baloch, and Niu (2023); Zhang et al. (2023); Wang et al. (2023); Li et al. (2023); and Wu and Qin (2024)—explore risk transmission between carbon markets and green bonds. Jin et al. (2020) find green bonds to be an effective hedge for EU carbon markets, while Ren et al. (2022), using a wavelet quantile-on-quantile approach, show that EU carbon prices positively influence green bond prices. Similarly, Zhang et al. (2023) document a strong link between the PRC's carbon and green bond markets, shaped by global events such as COVID-19 and Russia's war in Ukraine. Applying a time-varying parameter, vector autoregression model, Li et al. (2023) find a negative correlation between green bonds and carbon prices in the PRC.

Importantly, these studies concentrate on the EU and PRC markets, leaving the risk transmission between green bonds and carbon prices in the Republic of Korea largely unexplored. This study seeks to fill that void and make several key contributions. First, we shift the focus from traditional volatility spillovers to jump-induced volatility between carbon and green bond markets. Jumps, representing abrupt and unforeseen shocks, are critical as they often trigger extreme market movements. Understanding these jumps is particularly useful during turbulent periods, helping market participants make better-informed investment decisions (Dutta and Das 2022). Second, we analyze spillover effects between carbon markets in the EU and the Republic of Korea. This is particularly relevant given the challenges KETS has faced, including limited market liquidity and uncertainty around carbon pricing. Despite additional

government-issued allowances, trading volumes have remained low—highlighting that the issue extends beyond mere supply–demand adjustments. Linking with global markets could enhance KETS' efficiency and help the Republic of Korea meet its climate commitments cost-effectively. Understanding how global carbon markets interact is therefore essential. Third, we examine whether the correlation of jump intensities—either between green bonds and carbon markets, or between KETS and the EU ETS—is influenced by geopolitical risk. Rising geopolitical tensions can affect both green and carbon markets in various ways. For example, the shift toward energy independence under net-zero policies might buffer oil markets from geopolitical shocks, potentially increasing demand for green finance. At the same time, disruptions caused by geopolitical instability can ripple across financial markets, including carbon markets (Aysan et al. 2019). Yet, the impact of geopolitical risk on carbon markets remains underexplored (Lu et al. 2024, Dutta et al. 2025). Methodologically, we apply a generalized autoregressive conditional heteroskedasticity jump-model to estimate jump-induced volatility in carbon and green bond markets. We then employ a vector autoregressive model to assess jump spillover effects.

Our sample period spans from January 2015 to October 2024, yielding a total of 2,374 daily observations. We selected this period based on data availability. Specifically, we collected emissions trading data for the Republic of Korea from the website of the International Carbon Action Partnership.¹⁸ Information on the S&P Green Bond Index was retrieved from the Bloomberg terminal (Bloomberg Finance L.P. 2024). All prices are considered in United States dollars.

The findings of this empirical research reveal the existence of volatility jumps in KETS, driven by events such as the COVID-19 pandemic and heightened geopolitical tensions. These jumps are influenced by shocks from the EU ETS and other global green bond markets. We also find that geopolitical risk significantly explains volatility jumps in both emissions and in green bond markets. Moreover, an additional analysis indicates that the jump-induced volatility of Shenzhen's carbon market can predict jump behavior for carbon prices in the Republic of Korea.

¹⁸ International Carbon Action Partnership. Korea Emissions Trading System. <https://icapcarbonaction.com/en/ets/korea-emissions-trading-system-k-ets>.

Our results have several policy implications. First, policymakers can better assess the economic consequences of geopolitical risk and prepare responsive measures for CO₂ mitigation. For a major oil-importing economy like the Republic of Korea, geopolitical instability could hinder progress in clean technology deployment. Strategies such as implementing or increasing carbon taxes and promoting clean energy investments could help offset these adverse effects. An efficient carbon market is crucial for both policymakers and sustainable investors. A robust ETS can reduce emissions, enhance investor confidence, improve returns, and lower market volatility. Accurately identifying the factors that drive volatility—particularly jump-induced volatility—is key to strengthening market performance. Our findings can inform such efforts and support the development of a more effective ETS in the Republic of Korea. Further, we recommend that the Republic of Korea consider establishing a carbon futures market to stabilize price fluctuations. A well-designed futures market can enhance liquidity, attract environmentally conscious investors, and reduce overall market volatility.

For investors, our results suggest the importance of monitoring global carbon and green bond markets, as KETS is sensitive to developments in both. Additionally, during periods of geopolitical tension, investors should actively manage and hedge their portfolios. However, if emissions trading prices remain highly susceptible to geopolitical risks, even hedging strategies may prove insufficient. In such cases, proactive government intervention is essential to reassure investors and stabilize the market.

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