An Economic Analysis of Heatwave Climate Resilience Technologies in South Korea

: Focusing on rooftop and wall greening, cool roofs, cooling fogs, and pergola technologies.

by

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Worldwide, there has been a trend of breaking historical temperature records due to climate change. South Korea is also being affected by this. A year of 2018 is recorded as the hottest year of South Korea. In the southern part of Korea, daily high temperature reached 30°C in April, and Hongcheon recorded 41.0°C in August, the highest temperature ever recorded in South Korea. In 2024, there were also 17 consecutive days of tropical nights, and average maximum temperature of Seoul in June exceeded 30°C for the first time since weather records began. These more intense and frequent heatwaves are taking a greater toll on urban areas. Heatwave causes a variety of damages, including labor productivity decrease due to reduced concentration and fatigue among workers, infrastructure damage such as deformation of road pavements, railways, and buildings, and heat-related illnesses such as heat stroke, dehydration, and cardiovascular disease.

Climate resilience is essential to reduce heatwave damages, and to this end, the Korean government has been installing various heatwave response technologies such as rooftop and wall greening, cool roofs, cooling fogs, and pergolas. As heatwave adaptation technologies are a way to building climate resilience capacity to heatwave, it is important to evaluate the effectiveness of each technology by assessing its cost-effectiveness. However, there are relatively few studies that comprehensively evaluate the economic benefits and costs of each technology

Given this research gap, this paper estimates the degree of labor productivity losses due to heatwave using the panel dataset which contains weather variables such as daily temperature and relative humidity, wage, number of workers by industry, and the number of installations of heat mitigation technologies in each region. The economic benefits of heatwave response technologies are then measured by implementing a 2-step regression analysis: (i) the impact of heatwave response technologies on the Heatwave Resilience Index (HWRI) is estimated and (ii) the impact of HWRI on heatwave damages is estimated. In the estimation, we measure the sum of labor productivity losses and heat illness medical expenditures as the heatwave damages. Based on the estimated benefits and collected costs of the technologies, a BCR analysis is conducted to evaluate the economic benefits of heatwave response technologies.

The estimation results show that the loss of labor productivity in South Korea due to heatwave from 2016 to 2024 is about KRW 265.1 billion (USD 184 million), and it is 0.18% of total wage payments. In 2024, the BCR for cooling fogs technology is recovered to be 0.81, 1.68 for cool roofs technology, 2.63 for rooftop/wall greening technology, and 0.87 for pergolas technology, indicating that rooftop/wall greening technology reduced heatwave damages in the most effective way.

The contribution of this paper can be summarized as follows: (i) the originality of the panel dataset we constructed and (ii) a 2-step estimation strategy capable of incorporating both climate resilience index and adoption technologies when it comes to estimating the benefits of each technology in reducing damage costs related to heatwave. Our analysis is expected to provide a useful information to policy makers for cost-effective introduction of heatwave response technologies.