Environmental and economic impact of the Kyoto Protocol

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Abstract

This study empirically investigates both the environmental and economic impacts of the Kyoto Protocol. This study is the first to empirically investigate both the environmental and economic impacts of the Protocol using the same microeconometric modeling approach. First, it investigates the Protocol's environmental impact via CO_2 emissions reductions, especially the contribution of Annex I parties toward these. Second, it estimates the net differences in the economic performance of each Annex I party before and after agreeing to participate in the Protocol.

Combining the propensity score matching (PSM) and difference-in-difference (DID) methods, we conduct an impact assessment. This approach helps control the unobserved internal and external effects. This study also provides the simulation results of predicting the impacts of the Protocol to capture the differences between the actual and counterfactual situations. Two models—the environmental as well as the economic equations—are proposed to investigate the consequences of the Protocol.

The results of impact evaluation suggest that participating as Annex I parties has a significantly positive impact on CO_2 emissions reductions, but a negative impact on the GDP. These results indicate that, between 2005 and 2008, Annex I parties accomplished greater CO_2 emissions reductions than non-Annex I parties. These highly significant results suggest that it takes time for the Protocol to reduce the emissions of Annex I parties. It also indicates that imposing emissions reduction targets has a beneficial impact on reducing CO_2 emissions in the long run. However, the result of the economic impacts of the Protocol shows that the negative impact of being an Annex I party on economic performance takes effect after having participated for a certain period. The economic performance of Annex I parties deteriorated by approximately 7% in 2005–2008. This means that Annex I parties, which are bound by reductions obligations, recorded lower economic growth than other (i.e., non-Annex I) countries.

The economic loss and environmental benefit are directly compared using monetary measures. The total loss of GDP is estimated to be US$ 2,273 billion per year. Base on the marginal damage cost of carbon emissions by Tol (2005), the total CO_2, reduction (2,995 MT per year), can be transformed into a monetary value. Using the median value (US$ 14 per ton), the total marginal benefit from mitigating CO_2 emissions is approximately US$ 42

billion, or approximately 2 percent of the total GDP loss. If the mean (US$ 93 per ton), is used instead, the benefit increases to US$ 279 billion or approximately 12 percent of the marginal damage to total GDP.

This study provides some policy implications to the Paris Agreement, a post-Kyoto regime for global climate change. First, in this agreement, no party has legally binding targets for emissions reductions. The principle of the nationally determined contributions (NDCs) itself does not contain any obligations and sanctions. These results indicate that participating as an Annex I party has a beneficial impact on reducing CO_2 emissions. In other words, imposing a duty is an effective way in which to achieve UNFCCC's global goal. In this respect, there is concern that the Paris Agreement remains an ineffective IEA. Next, although a legally binding framework for emissions reductions benefits the effective implementation of the Protocol, this finding shows a significant negative impact on economic performance among participants. It is expected that low-income countries that have a low capacity to mitigate emissions may experience difficulties in adjusting to this new climate regime. Therefore, further global climate change frameworks require balancing the impacts on economic and environmental performance.

To secure the effectiveness of the Paris Agreement, the implications of this study mentioned above should be fully considered. To make a voluntary mechanism—NDCs in the Paris Agreement—effective, a systematic monitoring and evaluation mechanism must be established. A practical consideration for developing countries (e.g., a technical assistant) is also a crucial factor for improving the effectiveness of the agreement. The results show the significant negative impact of the Protocol on economic performance. The decline in GDP is thus a critical obstacle, especially for developing countries.

Keywords
CO_2 emissions; GDP loss; impact evaluation; Kyoto Protocol; marginal damage cost of carbon emissions; sustainable development