Temperature Shocks and Climate Change: A Conceptual Analysis*

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Abstract: This paper addresses the challenge of accurately modeling and estimating climate change damages. Time series approaches rely on weather shocks, while cross-sectional analyses capture climatic differences but suffer from omitted variable bias. Climate is defined as the statistical pattern of weather that persists over time and allows for adaptation, unlike unpredictable weather realizations. To assess econometric approaches, I (i) integrate forward-looking adaptation into a full-fledged integrated assessment model of climate change permitting an analytic solution and (ii) generalize the insights based on a dynamic stochastic envelope argument. I show how a carefully designed time series (or panel) estimation strategy can comprehensively identify the costs of climate change, including the indirect identification of unobserved adaptation costs. The paper also presents the first explicit formula for the social cost of carbon under forward-looking adaptation. This result is not only insightful in its own right but also valuable for clarifying and refining prevailing envelope-theorem arguments in the literature and for emphasizing that adaptation costs are part of the social cost of carbon.

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