Technology, R&D, Endogenous Substitution, and Climate Change

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Overview

This paper investigates how technological change via R&D affects the resource use, economic growth, and climate change. The DICE model (Nordhaus, 1994) proposes an economic growth model with environmental constraints. The ENTICE model (Popp, 2004) and the ENTICE-BR model (Popp, 2006) extend the DICE model by including the endogenous substitution between technology and energy resource. This paper extends the existing work by answering the question how the technological change leads to the substitution among different resources, affects efforts of dealing with climate change and influences economic grwoth.

This study constructs an economic growth model with two sectors and multiple resources, incorporating environmental constraints from climate change. Multiple resources appear to substitute with each other following the premise that the cheapest resource is used first. Technological change influences the resource use through three channels: knowledge stock for energy, conversion efficiency, and energy price. The expenditure on energy R&D increases the energy knowledge stock and lowers the conversion efficiency factor, which translates into converting the raw energy to the useful energy at a lower cost and leads endogenous substitution in resource use to occur. The energy use pattern for the capital goods production sector and consumption goods production sector and the level of carbon emissions and the corresponding temperature change present how technology and R&D influence economic growth and climate change. The derived optimal trajectory of carbon tax rate indicates the cost of adapting to climate change.