



Economics of Climate Change: Global Trends, Country Specifics and Digital Perspectives of Climate Action

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Keywords: economics of climate change, global trends, COVID-19 pandemic and crisis, G7, BRICS, country specifics, digital perspectives on climate action

The Sustainable Development Goals (SDGs) are a symbol of progressiveness, humanity and unity of the modern world. Among them is SDG 13 “Climate action,” signaling the acute urgency of climate change issues. The value of the SDGs lies in the fact that they show the close connection and consistency of the social, economic and environmental spheres of economic activity. The presence of this link, officially recognized by the UN, indicates that climate change is not only an environmental problem, but also a social and economic problem, and the solution of this problem requires coordinated actions in all areas.

The economics of climate change is a field of scientific knowledge and economic practices at the intersection of economics and ecology, a special subsection of environmental economics. Typical topics in this field include carbon tax policies (including emission trading scheme), the economics of mitigation and adaptation, and more recently issues related to global environmental challenges emerged. Numerous existing literature on the economics of climate change (e.g., Popkova et al., 2021) provides a lot of evidence that climate change is changing the economic landscape. For example, unpredictable and unfavorable climates threaten agriculture and prevent food provision (Charnock and Hoskin, 2020). It is also noted that responsible and sustainable agriculture can help combat climate change (Bruce et al., 2018; de Albuquerque, 2020).

The available literature also provides extensive evidence of the strong impact of the functioning and development (growth) of the economy on climate change. For example, industrial production typically has high environmental costs, and economic decarbonization slows climate change (Aboulnaga et al., 2020). In this regard, it is necessary to harmonize the economic and environmental interests of modern economic systems and find ways to achieve these interests in a balanced way. Information pertaining to the costs and benefits of climate change and its countermeasures are key foundations of the field. Their qualification involves advanced measures such as non-market value (Cullen and Mansur, 2017) and the social cost of carbon (Nordhaus, 2019) and continuous advancement in research is needed.

METHODOLOGICAL APPROACH

There is a need for methodological pluralism in understanding the economics of climate change. To study it, we require a wide range of qualitative and quantitative (as well as qualitative-quantitative) methods, in particular multidisciplinary. The methodology of the study of the economics of climate change includes econometrics and experiments based on neoclassical economics, engineering studies, qualitative case studies, etc. Methodological pluralism is necessary for the systemic research of the economics of climate change and

OPEN ACCESS

Edited and reviewed by:

Rabindra Nepal,
University of Wollongong, Australia

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Specialty section:

This article was submitted to
Economics of Climate Change,
a section of the journal
Frontiers in Environmental Economics

Received: 03 May 2022

Accepted: 10 May 2022

Published: 01 June 2022

Citation:

Popkova EG and Shi X (2022)
Economics of Climate Change: Global
Trends, Country Specifics and Digital
Perspectives of Climate Action.
Front. Environ. Econ. 1:935368.
doi: 10.3389/frevc.2022.935368

the complex research of the regularities (causal connections) of its development in socio-economic and socio-environmental systems from the position of fundamental and applied science.

This is needed for a comprehensive study of the economics of climate change as a subject sphere at the joint of environmental economics, climatology, industrial and manufacturing engineering (which implies digital technologies for the monitoring and fight against climate change), environmental sociology (which studies climate-resilient communities), the economics of (responsible) entrepreneurship, regional economics (which studies climate-resilient territories), state management (of sustainable development) of economy, and other spheres of scientific knowledge.

COVID-19 AND GREEN RECOVERY

Despite the high degree of sophistication of the economics of climate change, many research gaps remain amid growing challenges. One of the challenges is the crisis in the economy and its cyclicity. In particular, the fight against climate change has been complicated by the pandemic and the COVID-19 crisis. Available papers, including Doni and Johannsdottir (2021), note that in the context of the COVID-19 pandemic and crisis in 2020-2021 the pace of implementation of SDG13 (combating climate change) has slowed down. In particular, this could be due to limited placement opportunities for ESG investments (Gao et al., 2021; Ngo et al., 2021; Tran, 2021).

The essence of this challenge is that financing for sustainable development plays an important role in making progress toward SDG13. In case of a budget deficit, typical of economic crises, there is a forced reduction in spending on improving the environmental efficiency of the economy, which slows down the fight against climate change. It is also necessary to note the social component of the challenge under consideration. Society's commitment to solving environmental problems of protecting the environment and combating climate change often fades into the background when solving pressing economic problems in times of crisis. The crisis, however, could create opportunities for integrating climate action into the much needed recovery. Therefore, the academic community needs to advance the knowledge that is required to promote green recovery (Pollitt et al., 2021) that can simultaneously deal with the two global crises.

COMPLEXITY OF CLIMATE ACTIONS

Also, attention should be paid to the increased complexity of the decarbonization of the economy due to the close relationship of various economic practices with climate change, as evidenced by the relationship between SDG13 and other SDGs. The transition to "clean" energy plays an important role in reducing carbon emissions into the atmosphere. This brings us to SDG7, which, on the one hand, assumes the absence of scarcity of energy resources, and, on the other hand, their savings, environmental safety and "cleanliness" of energy. The noted close relationship

between SDG13 and SDG7 requires coordinated actions and their systemic practical implementation.

This is an incentive to conduct further research of various focus and scale on the topic of the relationship between economic cyclicity and the fight against climate change. Environmental innovation (SDG9) plays an important role in the topic of the relationship between economic cyclicity and the fight against climate change. The first successes in the field of creation and launch of carbon polygons are impressive. Carbon polygons allow collecting Big data on carbon emissions and conduct automated monitoring of the state of the climate. They can also be used by universities for scientific experiments when testing various environmental technologies in support of climate change.

Climate change also has a close relationship with several other SDGs, such as poverty (SDG1) (Hubacek et al., 2017; Soergel et al., 2021), health and well-being (SDG3) (Deschênes et al., 2009; Pecl et al., 2017; Jones, 2019; Barreca and Schaller, 2020), cities and communities (SDG11) (Kennedy et al., 2014; Lin et al., 2021). To answer this challenge, it is necessary to form a clear quantitative idea of the scale of the climate change problem and the progress achieved in its solution. Due to the complexity involved in climate change, interdisciplinary approaches and interdisciplinary collaboration are required (Yoo et al., 2021).

COUNTRY HETEROGENEITY AND DIVERSITY

Another challenge lies in the differences in the economics of climate change among countries. The entrenched generally recognized classifications of countries show serious differences between country categories, which are manifested in various areas of economic activity. Obviously, these differences are also characteristic of the economics of climate change. In the available literature, Alvarado et al. (2016), Hwang et al. (2021), Inshakova et al. (2020), and Maupin (2017) noted that the economics of climate change has distinct characteristics in developed and developing countries.

The reduction of environmental costs of the economies of developing countries deserves special attention since they demonstrate the most dynamic growth rate of the economy. Many developing countries are large energy economies, in the structure of which the extraction and export of energy resources play an important role. Solving the problems of climate change in developing countries is hindered by their reduced (compared to developed countries) investment attractiveness and lesser availability of environmental investments.

Along with this, the implementation of the expanded reproduction model actualizes the search for mechanisms to reduce the environmental costs of the growth of the world economy, in the structure of which (according to the GDP criterion) the main share belongs to developed countries. The wide spread of global value chains (Li et al., 2021; Pan et al., 2022) further complicates the climate change implications across countries. To answer the described challenge, it is advisable to conduct an in-depth and comprehensive study of the cause-and-effect relationships of combating climate change based on various

mechanisms, taking into account the characteristics of developed and developing countries.

The heterogeneity across countries creates an additional challenge for climate governance, in addition to the externalities. Since countries have different circumstances, it is difficult for them to agree on common actions. Article 6 of the Paris Agreement that governs international cooperation (Edmonds et al., 2019) thus was only agreed several years after the Paris Agreement was signed. Further studies on issues related to international climate government are still required.

TOOLKIT TO COMBAT CLIMATE CHANGE

Another challenge is related to the limited tools available to combat climate change. Some tools (for example, the installation of innovative treatment facilities with the tightening of environmental standards for production, the transition to more environmentally friendly transport, improving the environmental safety of the disposal of production and consumption waste) require a high amount of financial resources and are not widely available.

Other instruments have a limited and delayed effect and require additional measures. For example, moving away from non-environmentally friendly gasoline transport in favor of electric transport (ferries, cars, trolleybuses, trams) does reduce carbon emissions, but significantly increases the electricity demand and causes its scarcity, while this energy is quite expensive.

The third tools need to be improved and are not prepared for practical implementation. For example, the widespread call to phase out unsustainable products (the consumption of which carries carbon emissions and exacerbates the problem of climate change) and unsustainable economic practices does not reveal the further consequences for society. For example, not all cities are suitable for walking, and not everyone can get to work by bike, etc. Recommendations should be more detailed, and undesirable practices should be a worthy alternative.

The answer to this challenge involves the search for new tools to combat climate change. McLean and Fuller (2016), Lawrence et al. (2017), Dwivedi et al. (2022), Gunster (2022), Popkova et al. (2022), Skains et al. (2022) argue that the digital economy opens up new and broader prospects for combating climate change.

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Digitalization creates unprecedented prospects for combating climate change through economic tools that definitely deserve attention and scientific study.

CLIMATE CHANGE AND AGRICULTURE

Another challenge is related to adapting the economy to climate change. A prime example here is agriculture, which indicates the close linkage of SDG2 with SDG13. Food security is essential to the sustainable development of the economy, and adverse climate change and its very unpredictability increase uncertainty and entrepreneurial risks in agriculture. Climate-sustainable smart innovations for agriculture provide a highly effective response to this challenge, and they need further scientific development.

In turn, agriculture can play a much larger role in addressing climate change. Together with forestry, and land, agriculture contributes to around 25% of global GHG emissions (Smith et al., 2008). The prospects for establishing restorative nature management are highest in the field of agriculture, which can and should become regenerative. Rural areas are designed to become areas attractive for rural tourism due to improved climatic characteristics (fresher air).

Thus, the economics of climate change faces a whole range of challenges. The efforts of modern science should be focused on a detailed study of the international experience of the economics of climate change. Prospects in the field of research require taking into account the sectoral specifics of the economy of certain regions of the world, countries and territories, as well as attention to new opportunities that open up as technology develops.

Additional, more detailed and in-depth (including case studies) studies of these prospects are required. It is also advisable to clarify the experience of developing countries and develop applied implementations for them to unlock the potential of the digital economy to contribute to the implementation of SDG13. It is proposed to devote future scientific research to this.

AUTHOR CONTRIBUTIONS

EP: writing—original draft. XS: writing—review and editing. All authors contributed to the article and approved the submitted version.

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