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## The real economic dimensions of climate change

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<b>Abstract:</b>	The impacts of COVID-19 and efforts to stimulate recovery from the pandemic have highlighted the need for information about how disasters affect the real economy: temporal and spatial dynamics, cascading risks of disruption to employment, debt, trade, investments, bond markets, and real estate markets, among others. This commentary explores what information on the economic dimensions of climate change is needed to inform decisions about adapting to and effectively averting, minimizing, and addressing climate risks. We review the economic information presented in special reports from the IPCC AR6 cycle (SR1.5, SROCC, and SRCCL). We find that the information presented in these reports focuses primarily on the costs of mitigation options, and the potential negative GDP effects of climate impacts, particularly the direct costs of extreme events. Emerging literature addresses a wider spectrum of economic and financial aspects relevant to climate change and national and regional priorities. This more recent empirical and modeling-based literature provides essential additional information for decisions about efforts at all levels to achieve the objectives of the Paris Agreement and the overall objective of the UNFCCC Convention. Insights from economic analysis of the coronavirus pandemic--a sustained, complex disaster with global consequences across the real economy and financial services--can help highlight useful areas of research and debate for policy makers considering climate impacts, vulnerabilities and risks.
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## The real economic dimensions of climate change

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### Abstract

The impacts of COVID-19 and efforts to stimulate recovery from the pandemic have highlighted the need for information about how disasters affect the real economy: temporal and spatial dynamics, cascading risks of disruption to employment, debt, trade, investments, bond markets, and real estate markets, among others. This commentary explores what information on the economic dimensions of climate change is needed to inform decisions about adapting to and effectively averting, minimizing, and addressing climate risks. We review the economic information presented in special reports from the IPCC AR6 cycle (SR1.5, SROCC, and SRCCL). We find that the information presented in these reports focuses primarily on the costs of mitigation options, and the potential negative GDP effects of climate impacts, particularly the direct costs of extreme events. Emerging literature addresses a wider spectrum of economic and financial aspects relevant to climate change and national and regional priorities. This more recent empirical and modeling-based literature provides essential additional information for decisions about efforts at all levels to achieve the objectives of the Paris Agreement and the overall objective of the UNFCCC Convention. Insights from economic analysis of the coronavirus pandemic--a sustained, complex disaster with global consequences across the real economy and financial services--can help highlight useful areas of research and debate for policy makers considering climate impacts, vulnerabilities and risks.

**Insights from economic dimensions of COVID-19.** The COVID-19 pandemic has transformed the world, with profound economic and social consequences almost independent of the actual spread of the virus (McKibben and Fernando 2020). Governments have deployed trillion-dollar economic stimulus packages in the face of sustained, disastrous impacts on the real economy of production and consumption, and financial services (Altig et al. 2020, Sharif et al. 2020). At the same time, the risks from climate change grow increasingly apparent. Action to address anthropogenic climate change is urgently required and demands further economic transformation (Roglej et al. 2018). The UN Secretary-General, in his address to the General Assembly on September 22, 2020, called for all nations to take climate positive actions as they rescue and attempt to rebuild their economies--through fiscal policy (tax, subsidy, investment for employment and a green recovery) and monetary policy (financial and regulation for equity and stability). A recent report of financial regulators stated "the COVID-19 pandemic is likely to leave behind stressed balance sheets, strained government budgets, and depleted household wealth, which, taken together, undermine the resilience of the financial system to future shocks" (Climate-Related Market Risk Subcommittee 2020). Yet analysis of these dynamic risks associated with the pandemic illustrate potential weaknesses in models that assume that no "co-morbidities" exist alongside climate stressors (Chen et al. 2020, Delink et al. 2019, Tol 2018). As governments plan economic recovery efforts, there is a growing demand for accurate information on the full economic dimensions of these cascading and compound disasters.

But which dimensions of economic information might be particularly useful to avoid, reduce, and manage adverse climate impacts, alongside the economic impacts of COVID? Global policy agreements hint at some important components but are not explicit. UNFCCC Article 2 points out that efforts to avoid dangerous anthropogenic climate change “should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner” (UNFCCC 1992). The Paris Agreement “aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty” including by reducing the risks and impacts of climate change, increasing adaptive capacity and fostering climate-resilient and low greenhouse gas emissions development “in a manner that does not threaten food production” (PA Article 2.1(a-c)). In the Sendai Framework for Disaster Risk Reduction, governments committed to reduce economic loss from disasters, climate related or otherwise. This is measured through losses in GDP and through “damage to critical infrastructure and disruption of basic services, among them health and educational facilities.”

**Economic dimensions of climate change.** This commentary examines literature reflecting economic dimensions of climate change found in the IPCC’s AR6 special reports and discusses what emerging and additional economic information IPCC assessments could draw upon to inform governments about climate risks going forwards. IPCC assessments inform governments at all levels with scientific, technical and socioeconomic information relevant to understanding and addressing climate risks. Policy makers utilize the information in IPCC reports as a baseline on the state of knowledge on climate change when making science-informed decisions including how to manage possible climate impacts on economic activity. A review of the economic information provided in the special reports of the IPCC 6th Assessment cycle shows that of these many dimensions, primarily Gross Domestic Product (GDP) impacts from extreme events are presented. Economic dimensions of climate change in special reports from the IPCC AR6 cycle (SR1.5, SROCC) focus primarily on the costs of mitigation options, and the potential negative GDP effects of climate impacts. This focus on literature modeling GDP impacts mirrors academic debate among some environmental economists about how to reflect climate impacts referred to in some policy *frameworks* but does not fully capture the breadth of economic impacts relevant to *policy makers*.

Broadly, the purpose of a country’s economy is to manage all resources to fulfill the needs of those living in that system. In the context of climate change, this occurs through human decisions about distribution of resources, and complex processes of production, and consumption of food and water, and other needs. Thus, microeconomic literature that explores climate impacts on topics such as human behavior and decisions about resource allocation and consumption, how and why different goods are valued differently, coordination and cooperation in the face of uncertainty and risk would help inform IPCC assessments. Similarly, macroeconomic dimensions of climate risks which consider overall economic systems in distinct geographical units, foreign trade, fiscal and monetary policy, unemployment, inflation and interest rates, and business cycles would be illuminating.

**The IPCC Global Warming of 1.5 degree report (2018)** highlights the economic and investment implications of limiting warming to 1.5 degrees and the gap between current investment patterns and those compatible with 1.5 or 2 degrees pathways (Rogelj et al. 2018). It also emphasises the risks to global aggregate economic growth are lower for 1.5 degrees than 2 degrees of warming (Hoegh-Guldberg et al. 2018). The level of analysis is regional and aggregate.

**The IPCC Special Report on Climate Change and Land (2019)** assessed the growing literature considered to include ecological economics, and aspects of land and societal issues. The SRCCL report focused on four concepts for considering the economic implications of land-based climate action (Warner et al. 2019). These were (1) the value of healthy functioning land and ecosystems to all aspects of society, and the challenges associated with assigning monetary values to

incommensurable values; (2) the currently understood costs of damages from climate and land-induced interventions in land ecosystems; and (3) the relative costs of action and inaction, and emphasising that preventing damage occurring is considered more cost-effective in the long term compared to restoration of already degraded land. The report highlights that there is a lack of quantitative analysis across sectors and regions and relies on a handful of studies (Warner et al. 2019).

**The IPCC Special Report on Climate Change, Cryosphere and the Ocean (2019)** synthesizes the costs of impacts on areas including coastal flooding, cryosphere related landslides and flooding, loss of snow in alpine areas, loss of ecosystems. The costs are either at localized levels or global annual damage costs. Where available the report identifies the economic benefits of different forms of adaptation. It emphasizes that strengthening precautionary approaches will reduce the negative impacts of climate change with benefits for regional economies and livelihoods. The report also identifies the benefits of investments in a range of capacity-building measures. The report-notes the limitations of existing studies considering the social costs and benefits of different management options.

The economic information synthesized in these reports builds on AR5 and, due to the nature of the topics of the special reports, draws to a degree on additional fields of literature in exploring the magnitude of what is at stake and the need for urgent action. These recent reports have extended assessment beyond adverse GDP impacts, to include examining economic dimensions in land use (forestry and agriculture), coastal areas and fisheries, among others. The reports largely do not draw on the array of grey literature from public agencies about broader economic dimensions of climate change such as the trade-offs of difference choices and timing of action; questions critical to current policy decisions.

**Future directions.** Systemic shocks are more likely in a context in which financial assets do not fully reflect climate-related physical and transition risks (Keenan and Bradt 2020). Additional emerging information from empirical and modeling studies can provide enhanced understanding of climate impacts across parts of the economy which policy makers and their constituencies care about. Several emerging areas of work related to climate impacts on the real economy and on financial services could expand and be useful to inform decision-making:

1. Literature could be cited which clarifies **distributional impacts of climate-related sub-national shocks** such as the production and consumption of foodstuffs, freshwater, ecosystem performance, and critical public services such as healthcare under different climatic conditions (Glotter and Elliott 2017, Huber et al. 2017) could provide substantial real economy insights. Analyses of distributional impacts of climate impacts on the financial health of formal and informal community banks, agricultural finance institutions, local insurance and safety-net institutions that affect the well-being of farmers, small businesses, and households may provide deeper insights into vulnerability (Ansah and Gardebroeck 2020).
2. Literature could be cited which **critically assesses valuation and societal risk tolerance** vis-a-vis the economic impacts of climate change are needed. Literature on different ways to value could help accelerate transition and resilience related to slow onset events, non-economic losses, and unanticipated climate and disaster impacts (Costanza 2018). Such literature could help **inform market and finance regulatory aims** including data and tools to monitor, analyze, and quantify a range of extreme and slow onset climate risks to sector-specific production and consumption (Neuman et al. 2020), and financial institution responses would be helpful (Issler et al. 2020, Lamperti et al. 2019).

3. Literature could be cited about **financial innovations** used to help countries manage and adapt to climate risk (Esposito et al. 2020). Scenarios and modeling could help understand the interaction of climate impacts and structural change (Ciarli and Savona 2019), such as the role of market perceptions about climate risk in (re)pricing of assets and potential cascading effects system-wide financial stability (through portfolios and balance sheets) (Duan and Li 2019).
4. Literature could be cited about **use of policy tools** could provide adaptation insights, such as risk management of markets and financial institutions, disclosure and consumer and investor protection, oversight of systemic financial risk (Feridun and Güngör, 2020), and experiences using legislation to ensure coordinated national economic responses to climate impact (Campiglio et al. 2018). There is a large grey literature, often produced by independent public agencies, providing evidence of outcomes of these tools.
5. Literature could be cited about **interactions of climate change impacts and other market dynamics on different asset classes, geographies, and sectors** (Hsiang et al. 2017). Literature is becoming available which assesses unanticipated climate impacts in labor, investments, bonds, stock, real estate, pensions, and supply chain dynamics (Farmer et al. 2015). Research is emerging about interactions of climate risks with transitional risks, amplifying shocks and stresses. Research is needed to illuminate the meaning of climate adaptation for banking and transactional finance, accounting, monetary and fiscal policy, labor markets and demographic change, stock markets, commodity markets, insurance / risk finance markets, real estate markets and land tenure and zoning, bond markets and publicly financed infrastructure (Capasso et al. 2020).

Development and inclusion of these types of newer adaptation-relevant literature would expand understanding of questions such as where the economic impacts may occur, what the rate of change might be over time, and how economic impacts may affect decisions about public safety, food security and ecosystem and land management, and economic development. Inclusion of a wide variety of economic and financial disciplines in IPCC reviews and chapter teams could also aid in identification and assessment of the above-mentioned clusters of economic research. Addressing current crises - be they COVID-19 or climate related - requires a broader understanding of the interactions of these risks with the full dimensions of economic activity that affect people's lives and livelihoods. It will also require us to rethink traditional economic metrics used in policy to more fully explore the real economic dimensions of disasters.

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