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What are the economic costs of global warming? We don’t know

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Abstract

A new study seems to contradict the consensus on the negligible growth effect of global warming. However, the results align with the IPCC's (AR6) assessment: We don't know.

Zusammenfassung

Eine neue Studie scheint dem Konsens über den geringen Wachstumseffekt der globalen Erwärmung zu widersprechen. Tatsächlich passen die Ergebnisse zur Einschätzung des IPCC (AR6): Wir wissen es nicht.

A new study by two economists concludes that the economic impact of rising global average temperatures can be enormous. However, a closer look shows that their findings do not support this conclusion. All in all, the real message of the study is that we don't know. This ignorance should be reported honestly in media coverage.

We know that we don't know

The latest report by the Intergovernmental Panel on Climate Change (IPCC report AR6) summarizes the economic impact of global warming on the economic as follows: *"Estimates of the global effects of climate change on aggregate measures of economic performance and gross domestic product (GDP) range from negative to positive, in part due to uncertainty in how weather variability and climate impacts manifest in GDP."*[1]

A recent paper by two US based economists suggests that "[a] 1°C increase in global temperature leads to a 12% decline in world GDP".[2] The huge negative effect has triggered widespread media coverage, probably not only because of the dramatic nature of the report, which goes beyond the consensus, but also because it suggests an urgent need for political action. However, a closer look shows that the study does not provide any insights beyond the IPCC summary.

Where does the huge effect come from?

The authors follow a simple time series approach to estimate the impact of global warming on global GDP: They examine the co-movements of so-called "temperature shocks" with subsequent changes in global GDP per capita growth. The temperature shocks (Figure 1) are defined as deviations from the long-term global trend temperature, which has been increasing since the 1950s (Figure 2). The authors run several linear regressions of annual global GDP per capita growth on the global temperature shocks, each time increasing the time lag between the temperature shock and growth to capture the temporal impact of the shock. This approach allows them to estimate the effect of a temperature shock over a 10-year period. This process of repeated regressions with increasing time lag is at the heart of the method "local projections".[3] They also add dummy variables for the years of global economic crises and other control variables that are not specified.[4]

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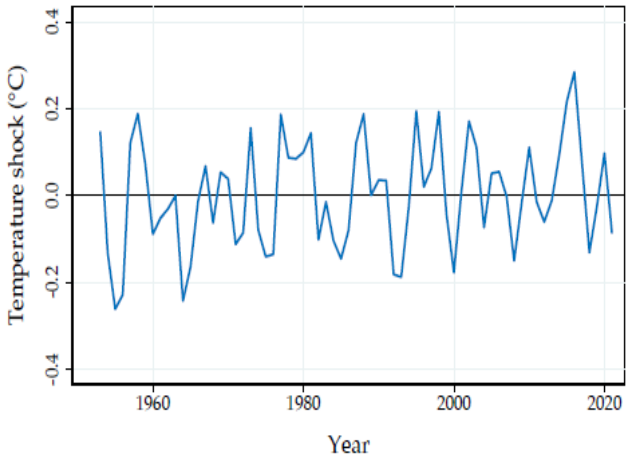
[1] See IPCC, 2022: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844. IPCC_AR6_WGII_FullReport.pdf, p. 54.

[2] See Bilal & Känzig (2024).

[3] See Jordà (2005).

[4] In particular, we control for global economic downturns, such as the large oil shocks in the 1970s or the Great Recession, using a set of dummy variables.2 Alternatively, we include a wider set of global macroeconomic and financial variables as additional controls." (p. 12).

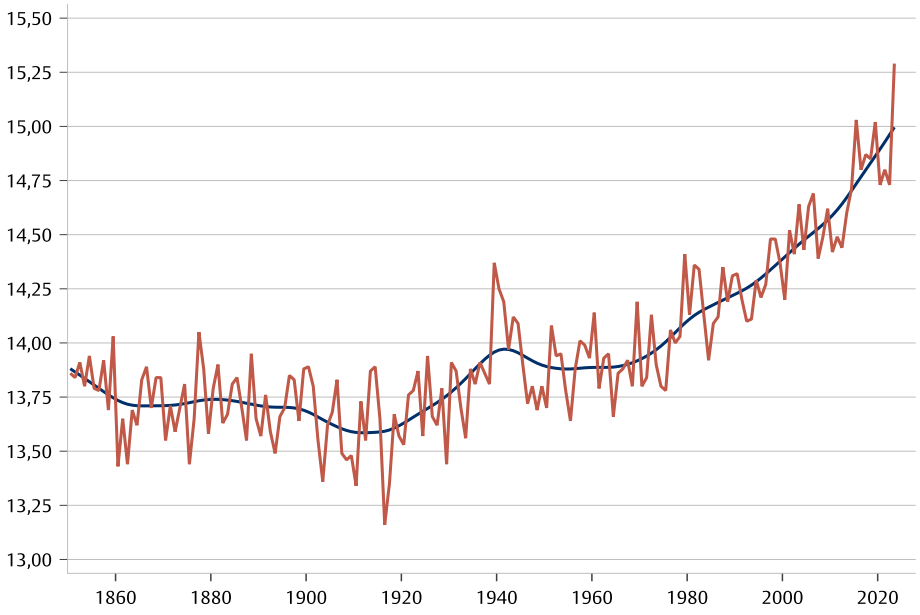
Figure 1: "Global Temperature Shocks"



Notes: The figure shows the global temperature shocks, computed as in Hamilton (2018) with ($h = 2$, $p = 2$), over the post-World War II era.

Source: Bilal & Känzig (2024, Fig. 2).

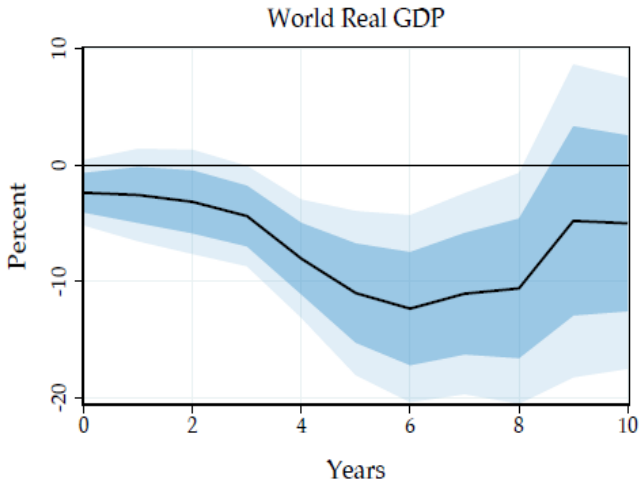
Figure 2: Average global temperature



Source: Flossbach von Storch Research Institute, Macrobond, NOAA. The average global temperature is calculated by adding 13.9, the average temperature between 1901 and 2000, to the temperature anomalies, originally defined as deviations from such average.

Figure 3 shows the main result of their statistical analysis, from which the enormous impact of global warming on growth is derived. The dark blue line shows the point estimate of the coefficient of the temperature shock in each of the linear regressions for the period between the shock and the effect on growth. Therefore, each data point corresponding to the blue line can be interpreted as the effect of a temperature shock of one degree Celsius on global growth *t* years later. The estimated impact after six years is the largest, with a growth effect of 12 percentage points.

Figure 3: "The effect of Global Temperature Shocks on World Output"



Notes: The figure shows the impulse responses of world real GDP per capita to a global temperature shock, estimated based on (2). The solid line is the point estimate and the dark and light shaded areas are 68 and 90% confidence bands, respectively.

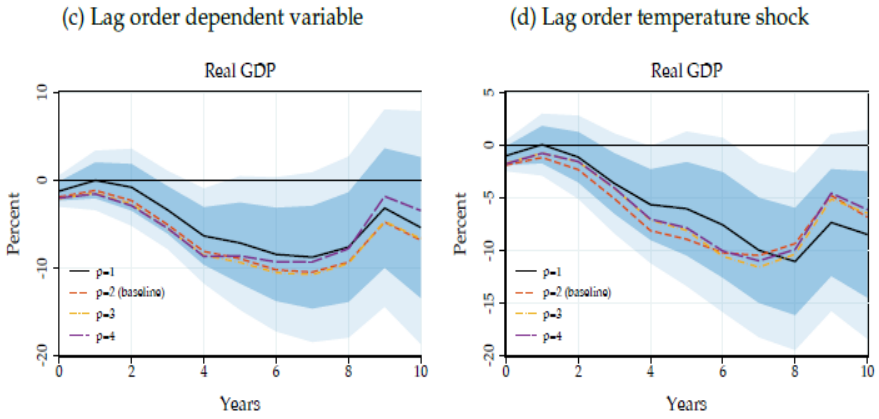
Source: Bilal & Känzig (2024, Fig. 3).

Assessment of the results

This reading is exaggerated for at least two reasons. First, choosing a deviation of 1°C over the long-term trend in one year as a benchmark shock of comparison is unrealistic. The earth's temperature has risen by 0.20°C per decade since 1982, i.e. about 0.02°C per year. A "temperature shock" of 1°C would mean that in one year the average temperature of the earth would have to be 1.02°C higher than in the previous year. This sounds implausible. Their own calculations of temperature shocks show the maximum shock size has only once slightly been above 0.2°C (Figure 1). The authors do mention this magnitude issue but argue that shocks can be cumulated over time to arrive at the 1°C increase. This, however, invalidates the interpretation of the coefficients because the model was estimated with annual data. Also, because positive shocks are usually followed by negative shocks (Figure. 1), which would have a positive impact on growth. For a realistic interpretation of the results, the size of the shock would have to be divided by 10 to obtain a plausible shock size of 0.1 °C above the trend. Then the effect on GDP would not be 12 %, but 1.2 %.

Second, the estimates could be much smaller even zero. As in every estimation, the coefficients could be smaller or larger and therefore a confidence interval is estimated. Interestingly, the authors did not show the usual 99%, 95% and 90% confidence intervals, but 90% and 68%. The authors do not explain why, but they presumably did not want to get too wide confidence bands that would include the zero and make the results statistically insignificant. Presumably, the 99% band even includes the zero. Hence, the effect could be 1.2%, but it could also be nonexistet. In the appendix the authors test for the sensibility of the results to changes in the specification of the model and show estimates for which the zero is even within the 90% confidence band.

Figure 4: "Sensitivity of the average effect of global temperature shocks"



Source: Bilal & Känzig (2024, Fig. A.7).

All in all, this estimate provides an effect of a temperature shock that is not huge if you assume plausible temperature changes. Also, the estimate is quite imprecise such that effect could just be nonexistent.

Conclusion

The recent study by Bilal & Känzig (2024) has attracted a lot of attention because it seems to contradict the consensus that global warming has a negligible effect on growth. However, the study was misinterpreted - presumably with political ulterior motives. The results actually fit with the rather unspectacular assessment of the IPCC in its last report (AR6): We do not know how climate change affects growth.

The complex phenomena at the heart of the climate and economic debates are always presented as simple questions with a single correct answer. As the scientist and former advisor to the US Obama administration Steven Koonin (2021) vividly illustrated, the uncertainty surrounding climate science is often misrepresented by the media and politicians, either due to a lack of knowledge about what climate science says or due to political ideologies and interests. The study by Bilal & Känzig (2024) has a high potential for ideological and political misuse, especially because

the authors themselves conceal the uncertainty of their main empirical finding. But without this ambiguity, this analysis would hardly have received the media coverage that the authors were apparently aiming for.

References

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Koonin, S. E. (2021). *Unsettled: What climate science tells us, what it doesn't, and why it matters*. BenBella Books.

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