

Cambridge Judge Business School

Macroeconomic Effects of Climate Change

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Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis*

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Abstract

We study the *long-term* impact of climate change on economic activity across countries, using a stochastic growth model where labour productivity is affected by country-specific climate variables—defined as deviations of temperature and precipitation from their historical norms. Using a panel data set of 174 countries over the years 1960 to 2014, we find that per-capita real output growth is adversely affected by persistent changes in the temperature above or below its historical norm, but we do not obtain any statistically significant effects for changes in precipitation. Our counterfactual analysis suggests that a persistent increase in average global temperature by 0.04°C per year, in the absence of mitigation policies, reduces world real GDP per capita by more than 7 percent by 2100. On the other hand, abiding by the Paris Agreement, thereby limiting the temperature increase to 0.01°C per annum, reduces the loss substantially to about 1 percent. These effects vary significantly across countries depending on the pace of temperature increases and variability of climate conditions. We also provide supplementary evidence using data on a sample of 48 U.S. states between 1963 and 2016, and show that climate change has a long-lasting adverse impact on real output in various states and economic sectors, and on labour productivity and employment.

JEL Classifications: C33, O40, O44, O51, Q51, Q54.

Keywords: Climate change, economic growth, adaptation, counterfactual analysis.

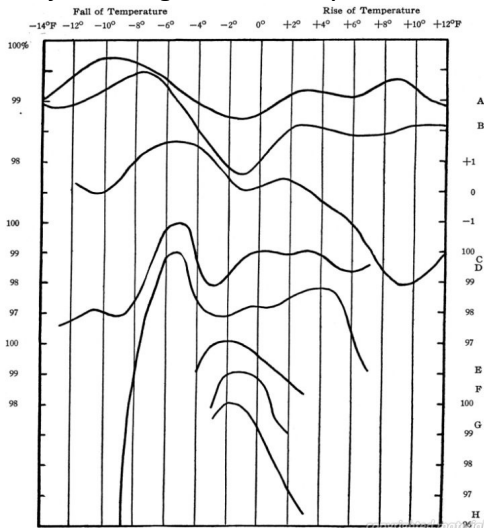
Some important questions:

- ▶ How large are the effects of **climate change** on **economic activity**?
- ▶ Does climate change have **long-term** or **short-term** growth effects?
- ▶ Are the effects larger for **poor (hot)** countries? Are they **asymmetric**?
- ▶ What are the **channels** of impact and which **sectors** are affected the most?
- ▶ What is the role of **climate variability**?

Have we just realised that this is an important problem (for the economy)?

- ▶ The **climate-economy relationship** has been discussed for many centuries and goes back to at least Ibn Khaldun's 14th Century *Muqaddimah*, in which he attributed **poverty** to the **climate**.
- ▶ In fact Montesquieu came to the same conclusion in the *Spirit of Laws* (1750):
 - ▶ "There are countries where the excess of heat enervates the body, and renders men so slothful and dispirited that nothing but the fear of chastisement can oblige them to perform any laborious duty..."
- ▶ A few centuries later Huntington's (1915) *Civilization and Climate* aims to quantify the effects of climate on economic activity.

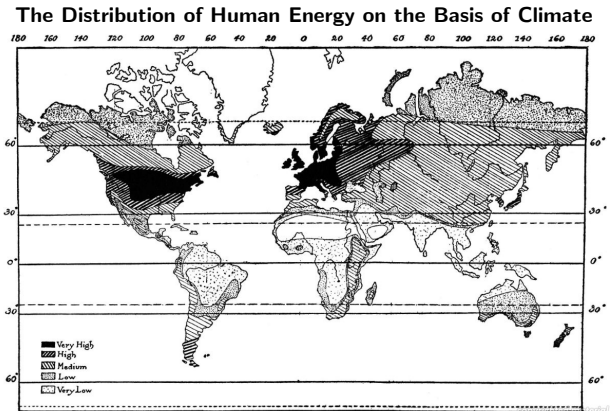
Human Activity and Changes of Mean Temperature from Day to Day



Notes: A. 300 Men in Two Connecticut Factories, 1910-13. B. 256 Girls in Two Connecticut Factories, 1911-13. C. 460 Students in Mathematics and English at West Point and Annapolis, 1909-1913. D. 760 Cigar-makers at Tampa, Fla., in Winter (October-March), 1912 and 1913. Factory A. E. 400 Cigar-makers at Tampa in Winter, 1913. Factory B. F. 400 Cigar-makers at Tampa in Summer (April-September), 1913. Factory B. G. 380 Cigar-makers at Tampa in Summer, 1912. Factory A. H. 380 Cigar-makers at Tampa in Summer, 1913. Factory A.

Level of economic development vs. future growth

- ▶ Economists used to (and some still do) ask the question: Can **climate and/or the weather** explain why some countries are poor and others rich?



Could climate change lead to lower productivity?

- ▶ The question that more and more economists are now attempting to answer is: do **weather events and climate change** have consequences for **economic growth**?
- ▶ Investigating whether climate change has **long-term** (permanent) or **short-term** (temporary) growth effects is essential for designing mitigation and/or adaptation policies and supporting institutions.
- ▶ For example, the macro-climate estimates are a key input in calculating the social cost of carbon.

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By Catherine Dooley
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Warming Will Cost Rich and Poor Countries Alike

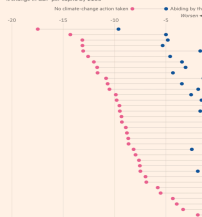
Limiting global temperature rise will substantially reduce the economic toll of climate change

By Andrea Thompson on November 1, 2019

Chart of the week

Impact of ignoring climate change

% change in GDP per capita by 2100



Source: Cambridge University Institute



Capital Weather Study
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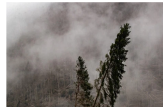
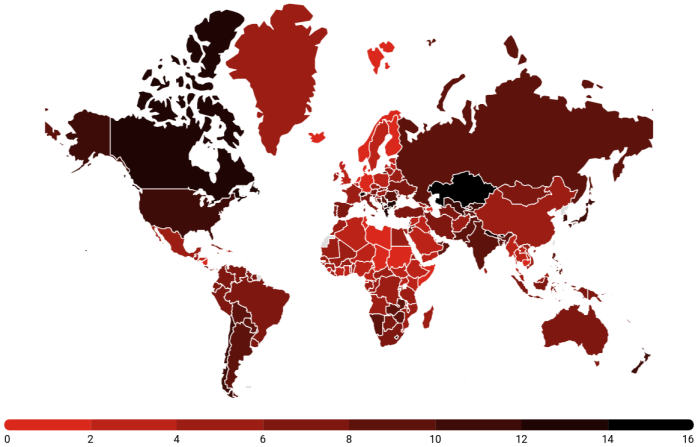
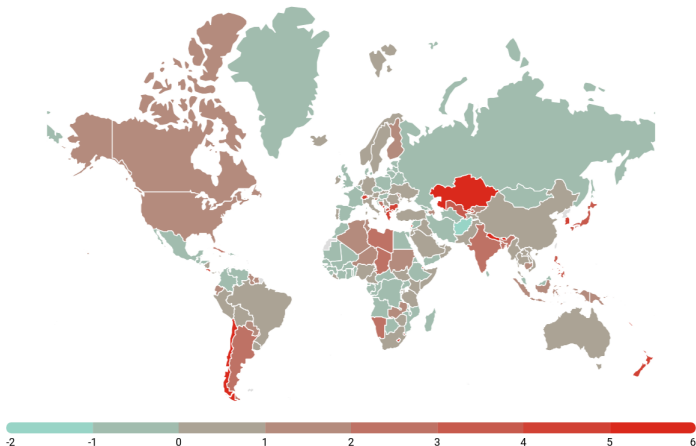


Figure 6: Percent Loss in GDP per capita by 2100 in the Absence of Climate Change Policies (RCP 8.5 Scenario)



Notes: The heat map shows $\Delta_{ih}(d_i)$, see equation (31), in year 2100 with $m = 30$, based on the RCP 8.5 scenario.

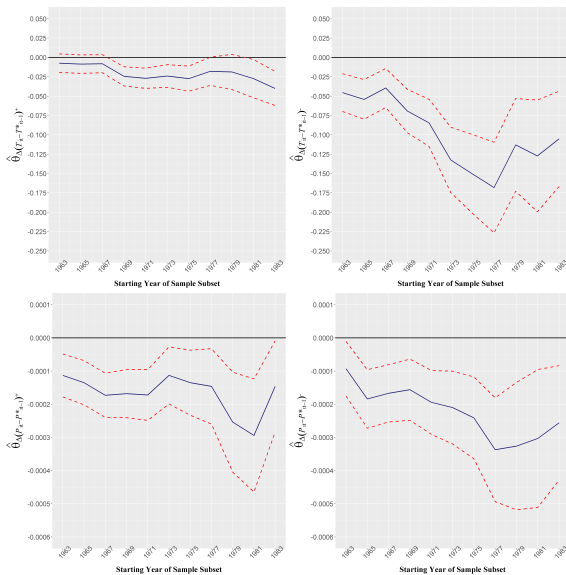
Figure 7: Percent Loss in GDP per capita by 2100 Abiding by the Paris Agreement (RCP 2.6 Scenario)



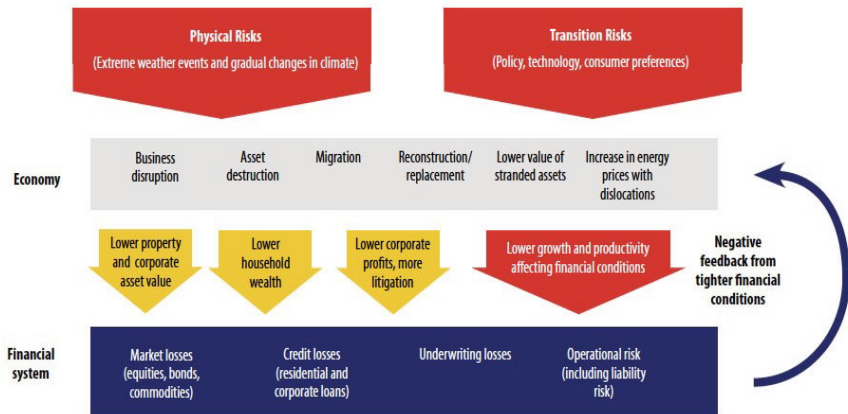
Notes: The heat map shows $\Delta_{ih}(d_i)$, see equation (31), in year 2100 with $m = 30$, based on the RCP 2.6 scenario.

Long-Run Effects of Climate Change on Growth in the U.S.

- ▶ If the U.S. economy was adapting should we not expect the negative effects of deviations from their historical norms to be shrinking over time?



The risks from climate change to the economy have two basic channels, but many potential impacts!



Concluding Remarks

- ▶ We showed that climate change has a **long-term negative impact on economic growth**. If temperature deviates from its historical norm by 0.01 °C annually, economic growth will be permanently lower by 0.06 percentage points per year.
- ▶ Our counterfactual analysis suggests that without adaptation and mitigation, the loss in real GDP per capita is large (varying significantly across countries).
- ▶ We also provided evidence for the **substantial costs of climate change for the United States** and across all economic performance measures as well as across various economic sectors.
- ▶ Acknowledging past adaptation efforts, the evidence from our cross-country and within-country analyses suggests **limited success in reducing the negative economic effects of climate change in various sectors and at the macro level across countries**.
- ▶ Our findings call for a more forceful policy response to the threat of climate change.

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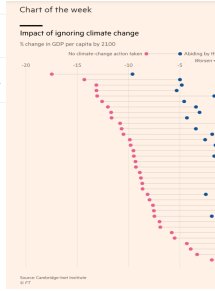
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