The Relative Role of Temperature and Precipitation in Global Economic Growth

Hande Karabiyik, Vrije Universiteit, Amsterdam

Menghan Yuan, Oxford University, England

Thomas Leirvik, Nord University, Norway

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Main Result in Short

Climatic conditions have effects on economic production (EP)

Two dimensions that significantly affect EP

1. Temperature
2. Precipitation

Understanding this relationship in detail is crucial for

1. Integrated Assessment Models
2. Climate policy

Optimal temperature around 14.75Celcius

Motivation

- Climate affects economic activity
  - Tourism, agriculture, energy use, supply chains, etc
- Previous studies find an optimal level for temperature (Burke et al. (2015, Nature) but also find that precipitation is *not* important.
- Precipitation is intuitively very important for many industries.
- We apply a method which allows for *global common shocks*
- Apply observations from 1961-2019 for all countries in the world for: temperature, precipitation, and GDP per capita.

Regression Framework

- We build upon a method derived in Bai (2009, ECTA)
- Panel data structure: observations over
  1. Units (countries)
  2. Time (year)
- The equation we use is:

$$GDPPC_{j,t} = \alpha + \underbrace{\beta_1 \cdot TEMP_{j,t} + \beta_2 \cdot TEMP_{j,t}^2}_{\text{Impact of temperature on economic production}} + \underbrace{\beta_3 \cdot PREC_{j,t} + \beta_4 \cdot PREC_{j,t}^2}_{\text{Impact of precipitation on economic production}} + \underbrace{\lambda_j \cdot F_t}_{\text{Global common shocks}} + \underbrace{\theta_1 t + \theta_2 t^2}_{\text{Technological and demographic time changes}} + \varepsilon_{j,t}$$

Estimation Results

- "Right" signs of coefficients:
- Implies an optimal level for:

1. Temperature
2. Precipitation

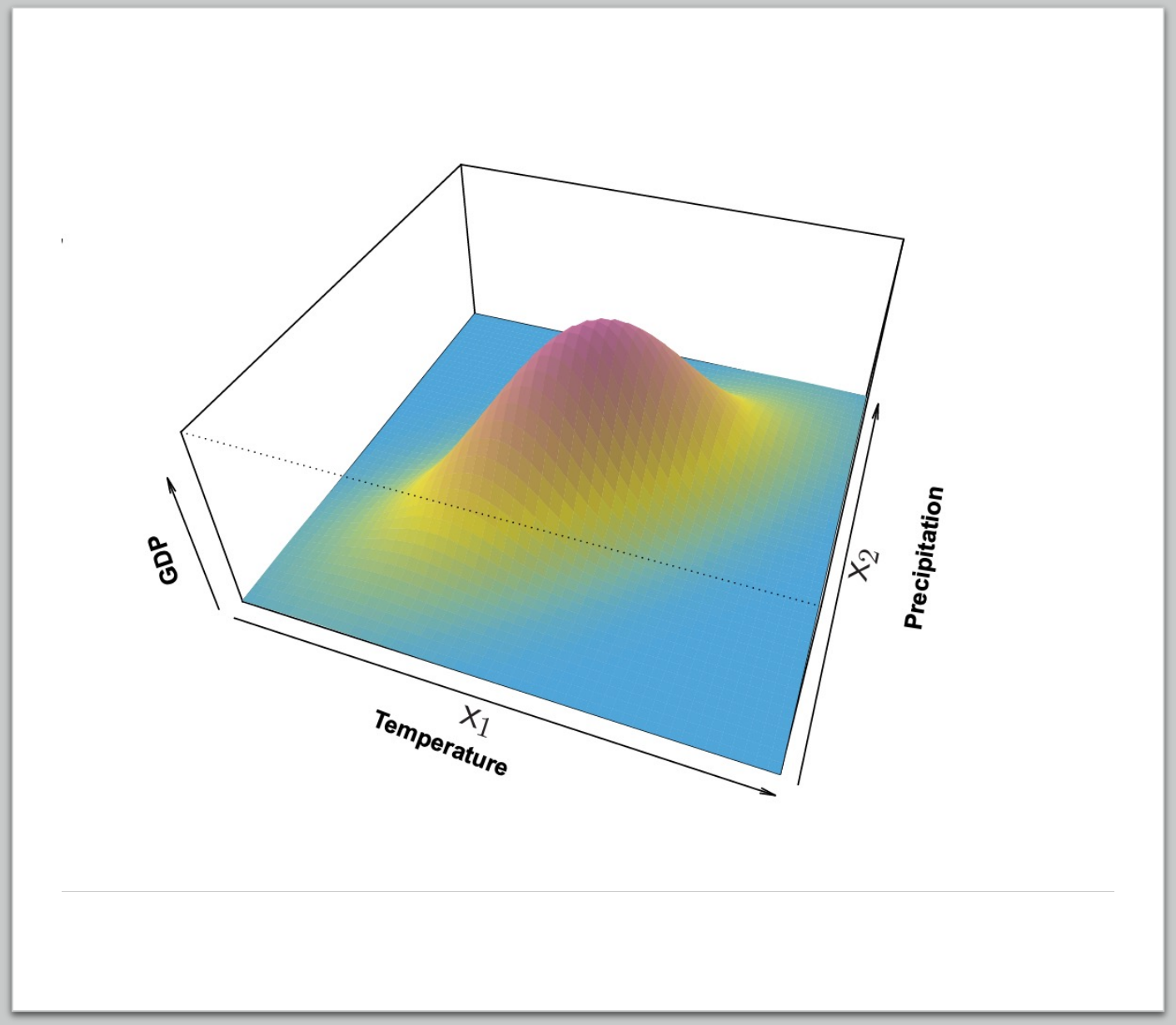
Table 3 Stationary GDP growth

	Coefficient	Std error	T-value	P-value	Sigfn
	Interactive fixed effects				
temperature	0.01032	0.00239	4.32454	0.00001	***
temperature sq.	-0.00035	0.00009	-3.95599	0.00004	***
precipitation	0.01705	0.00708	2.40652	0.00805	***
precipitation sq.	-0.00421	0.00159	-2.65389	0.00398	***

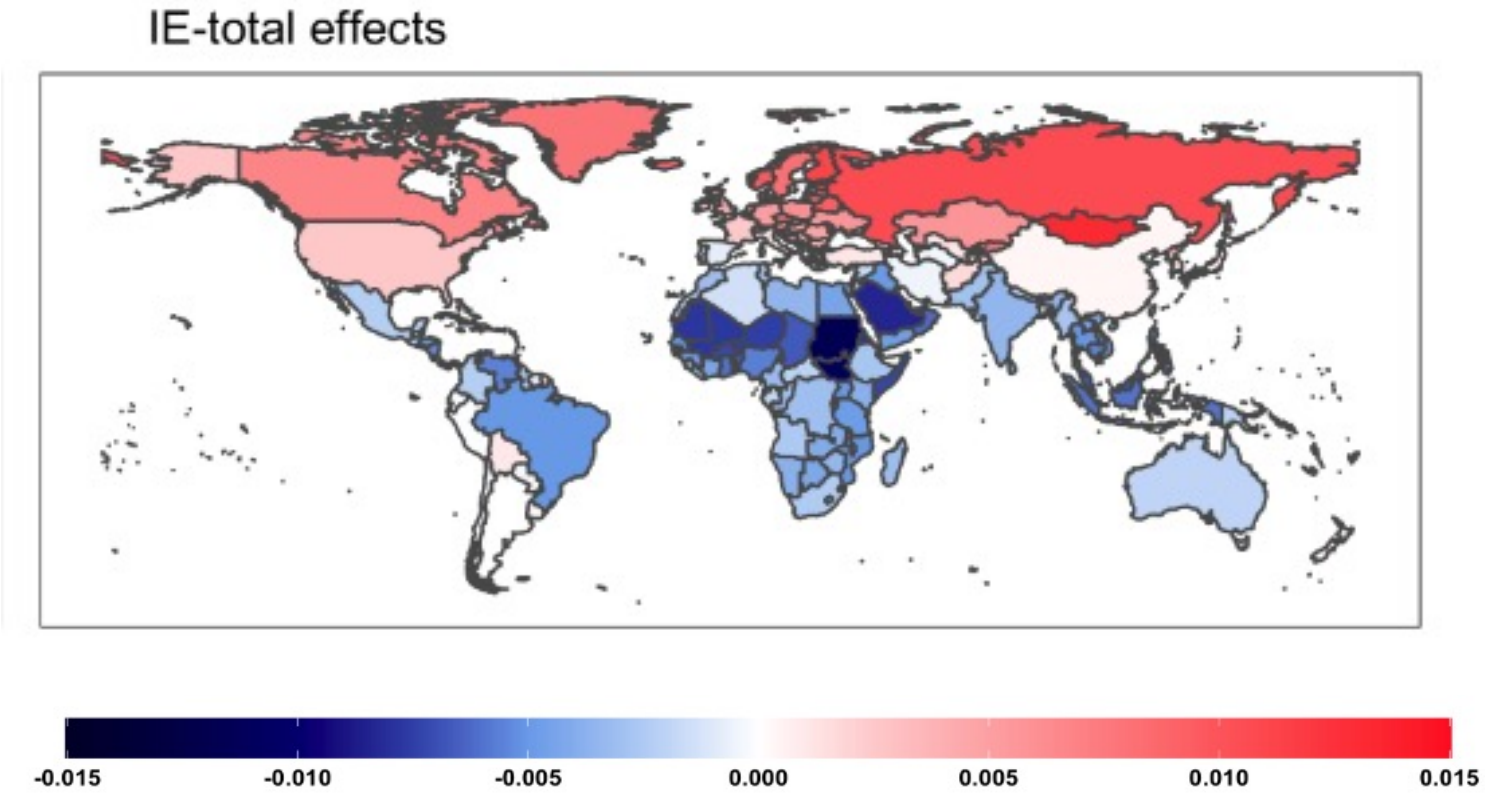
[a] Asterisks indicate significance at 1%(***), 5%(**), and 10%(*).
[b] Temperature is measured in $^{\circ}C$, representing for annual average temperature. Precipitation is measured in metres, standing for annual total precipitation.

GDP and Climate

- GDP increases in temperature and precipitation to a given point
- Decreases when beyond the optimal level
- Countries can experience a net zero effect: increase in temperature is offset by decrease in precipitation



Impact on GDP Per Capita



Future Work

- No interaction effects: optimal levels of temperature (precipitation) is independent of precipitation (temperature).
  - Makes more sense that for a given level of precipitation, there is an optimal level of temperature