Danchen Zhao

Notre Dame, IN 46556 • (737) 529-4830 • dzhao@nd.edu

EDUCATION

University of Notre Dame — Notre Dame, IN
Ph.D., Economics — Expected, May 2025

The University of Texas at Austin — Austin, TX
B.A., Economics — May 2019
Minor: Mathematics,
Graduating with Highest Honors

RESEARCH

Technology Choice, Energy Efficiency, and Second-Best Climate Policy 2024

Abstract: I study the effectiveness of subsidies as an alternative to carbon taxes to reduce carbon emissions in a quantitative climate-economy model. The energy firm uses brown and green energy to pro-duce energy. The firm-household then combines energy with capital and labor to produce the final goods. The short-run elasticity between energy and capital/labor is low. However, the firm-household's technology choice on a technology frontier can change the energy efficiency of the production process, leading to a unitary elasticity in the long run. If the government can subsidize green energy usage and energy-efficient technology choices simultaneously, the optimal subsidies could be nearly as effective in reducing emissions as the first-best brown energy taxes. Under this approach, cumulative carbon emissions are reduced by 22% by the end of the century compared to the Business-as-Usual scenario. However, without subsidies on energy-efficient technology choices, green energy subsidies would reduce energy prices and deter the adoption of energy-efficient technologies. This energy inefficiency undermines the effectiveness of green subsidies alone. Relying solely on optimal green subsidies results in a modest 1.4% decrease in emissions.

Agriculture, Relative Prices, and Climate Policy 2023

Abstract: I study a two-region (North and South), two-sector (agriculture and non-agriculture) Integrated Assessment Model (IAM). The household's utility is Stone-Geary utility with subsistence food consumption. Because the South and agriculture are more exposed and to satisfy the subsistence requirement for food, climate change raises the relative price of agriculture, resulting in a large loss to the South and a smaller loss in the North. I compare my model-based loss calculations with the commonly used "enumerative method," which is calculated using pre-climate change prices. I find that the South's climate-driven utility loss is 39% greater than that of the enumerative approach, while the North's loss is 85% lower. Optimal climate policy and policies under an uncooperative Nash equilibrium are also studied.

Presented at 20th Annual GEP/CEPR Post-Graduate Conference – 28-30 April 2022

Striking a Right Balance: Adaptation Investment in Agriculture (with Chen Chen and Koralai Kirabaeva) 2024

Abstract: Developing countries face substantial investment needs to maintain agricultural productivity in confronting challenges posed by climate change. This paper studies an Integrated Assessment Model for a small open economy. The country has an agricultural and nonagricultural sector and trades with the rest of the world. The fiscally constrained government can make public investments in standard capital that increases output and in adaptation capital that reduces the climate damage in the agricultural sector. The purpose of the model is to provide adaptation investment guidance. In applications to Egypt and Ghana, we find that the optimal investment strategy maintains a steady level of agricultural consumption. Furthermore, the ideal adaptation investment strikes a balance not only in consumption and total investment but also between standard and adaptation-oriented investments. The optimal investment mix is also influenced by various factors, including the expected impacts of climate change and the degree of trade openness.

Small (not Big) Data: A Machine Learning Approach for Structural Dynamic Economies (with Zachary Stangebye, Work in Progress) 2024

Abstract: We study Gaussian Process Regressions (GDP) in providing global solutions to non-linear dynamic structural models. GPR is relatively easy to implement, can handle a large number of state variables, and approximates the high-dimensional, irregularly spaced value and policy functions with precision and efficiency. We address various practical challenges practitioners may face during GPR implementation, such as overfitting, sample selection, and handling of highly non-linear functions. We demonstrate our approach with applications to the economics of climate change and sovereign default.

TEACHING EXPERIENCE

University of Notre Dame Notre Dame, IN
Teaching Assistant Instructor, Economics Fall 2021

- Hosted independent tutor sessions for *Statistics for Economics*

RESEARCH EXPERIENCE

The University of Texas at Austin Austin, TX
Research Assistant to Dr. Olivier Coibion Fall 2017

University of Notre Dame Notre Dame, IN
Research Assistant to Dr. Robert Johnson Fall 2023-Spring 2024

International Monetary Fund Washington, DC
Fund Intern Program Summer 2023

LANGUAGES: Chinese (native), English (fluent)
PROGRAMMING LANGUAGES: MATLAB, Julia, Python, R, Stata, Pandas, Latex