Scientific Computing and Economics

@Computation Institute

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CI Deep Dive:
Computational Challenges in Quantitative Economic Analysis

CI (Computation Institute):
established in 2000 as a joint initiative between The University of Chicago and Argonne National Laboratory to advance science through innovative computational approaches

over 100 researchers and staff

high-profile, high-impact projects (2015):

Globus
the Center for Robust Decision Making on Climate and Energy Policy
the Knowledge Lab
the Urban Center for Computation and Data

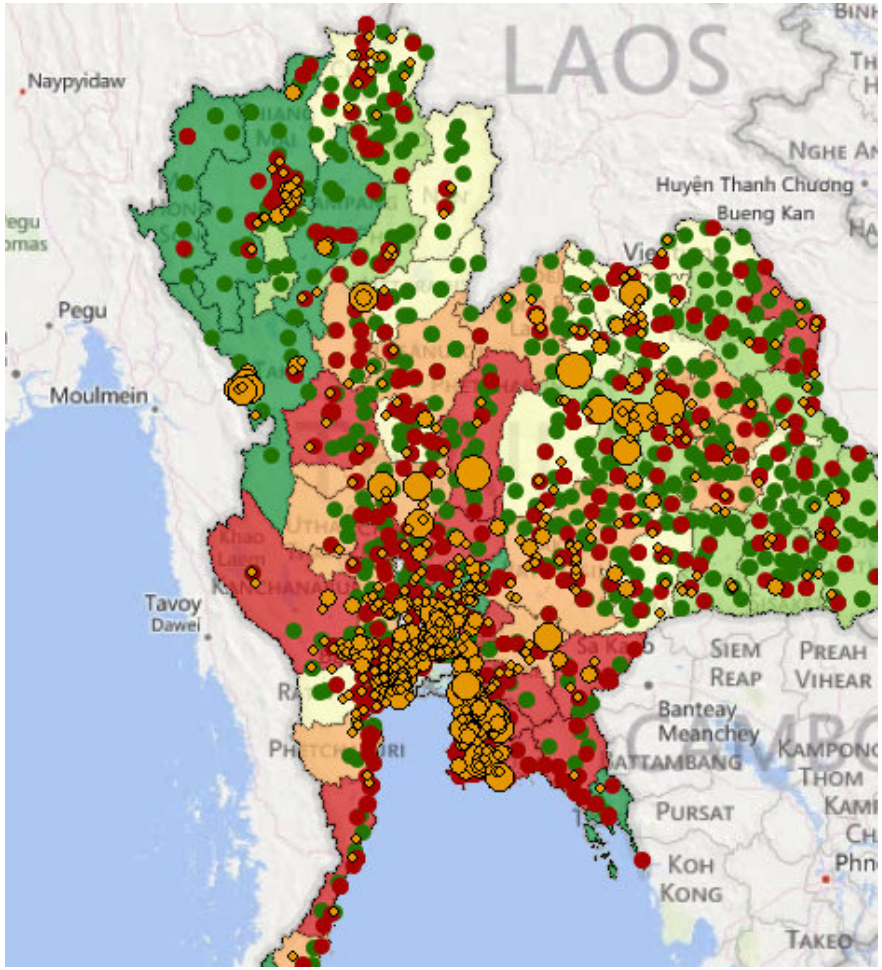
CI Fellows Meeting (2006):

Dynamic incentive problems (Rob Townsend)

Large scale estimation models with life-cycle modeling of individuals (James Heckman)

Partial differential equations in economics (Lars Hansen)

The Townsend Thai Project: from data to structural models



Kaboski and Townsend (2011), Frisch medal for the first study to use a structural model to understand, predict, and evaluate the impact of an exogenous microcredit intervention program

A panel database derived from micro surveys designed from a theoretical perspective to facilitate the integration of theory with measurement.

Data Visualization Tool that uses a web-based interface and geographic information system to map, graph, and analyze socioeconomic data from Thailand.

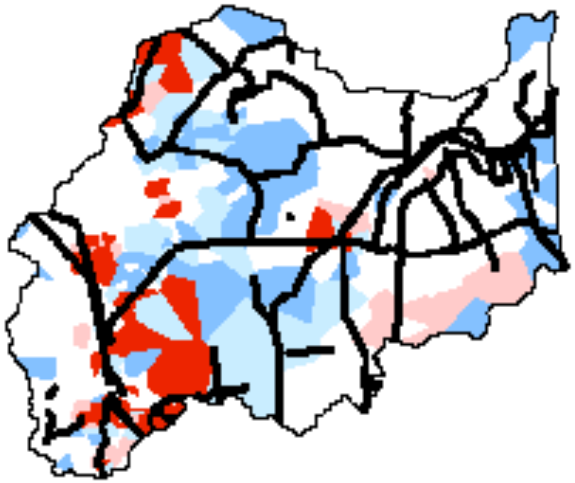
"Townsend That Data is arguably one the most remarkable, unique, and extensive datasets in the world. It represents more than 15 years of annual data for 985 households and monthly data on 680 households running for more than 150 continuous months." from "Chronicles from the field: The Townsend Thai Project", MIT Press, 2013.

"Project evaluation using RCT is unlikely to discover the elusive keys to development, nor to be the basis for a cumulative research program that might progressively lead to a better understanding of development", Angus Deaton

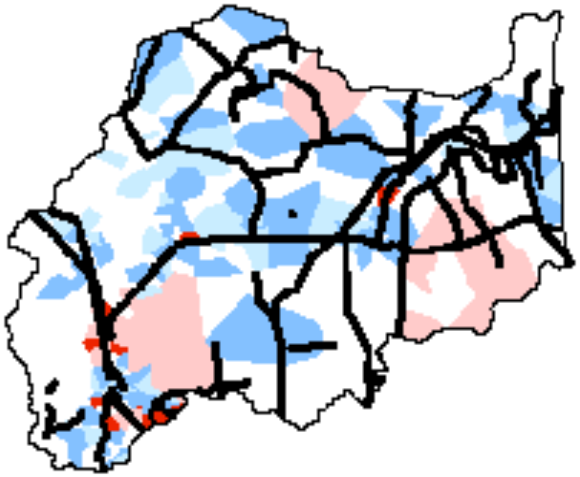
Occupation Choice and Credit:

centers of growth in Lop Buri province (Thailand)

model predictions for 1986-1996



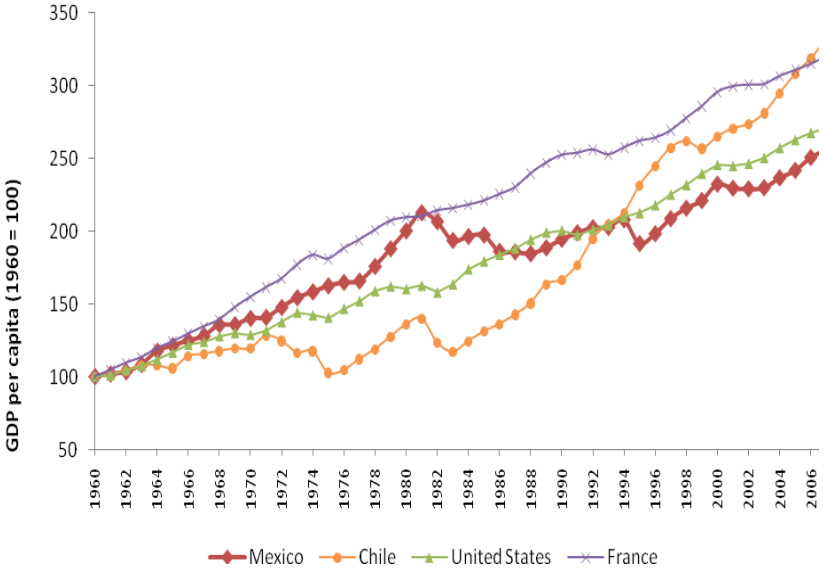
Credit expansion on
(model)

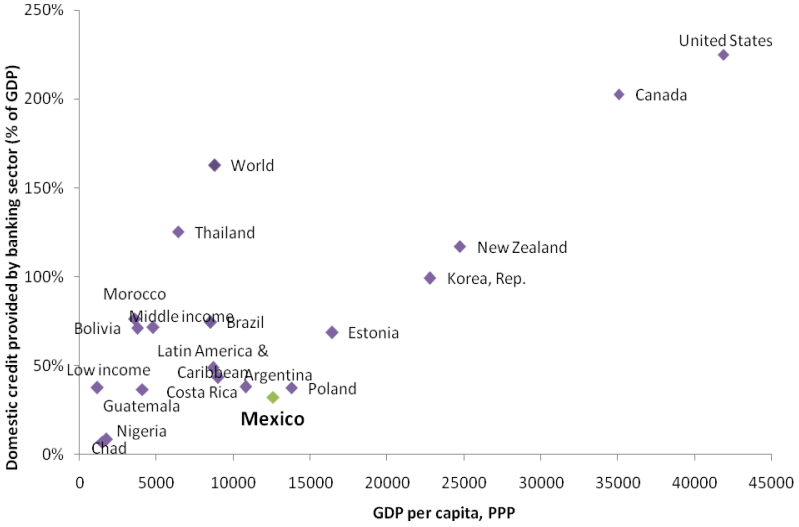


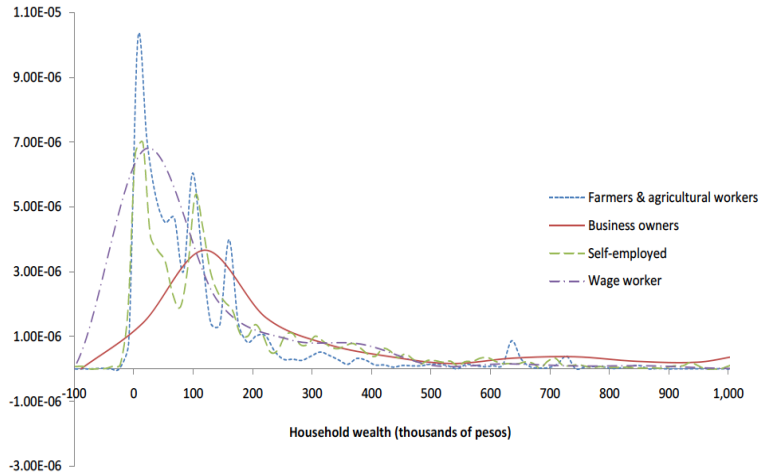
Credit expansion frozen
(model)

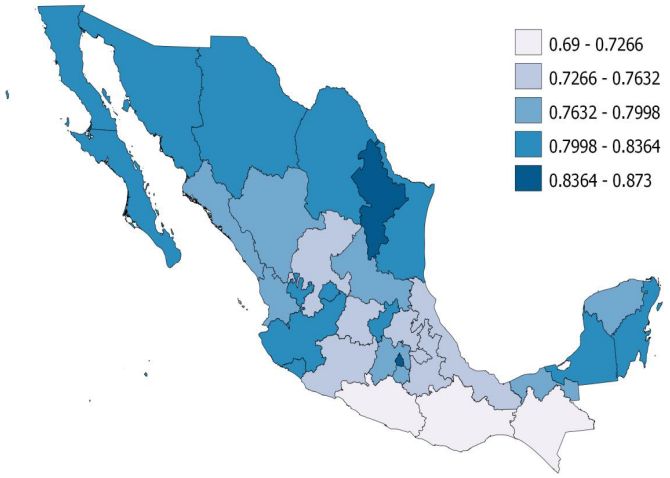
"The Geographic Concentration of Enterprise in Developing Countries" by John Felkner and Robert M. Townsend. Quarterly Journal of Economics, 2011.

Financial Intermediation, Entrepreneurship, and Economic Growth in Mexico









Through the lens of the model: Mexico vs. Thailand

- From 2000 to 2008, wealth inequality increased significantly between those having access to credit markets compared to those without access to credit markets

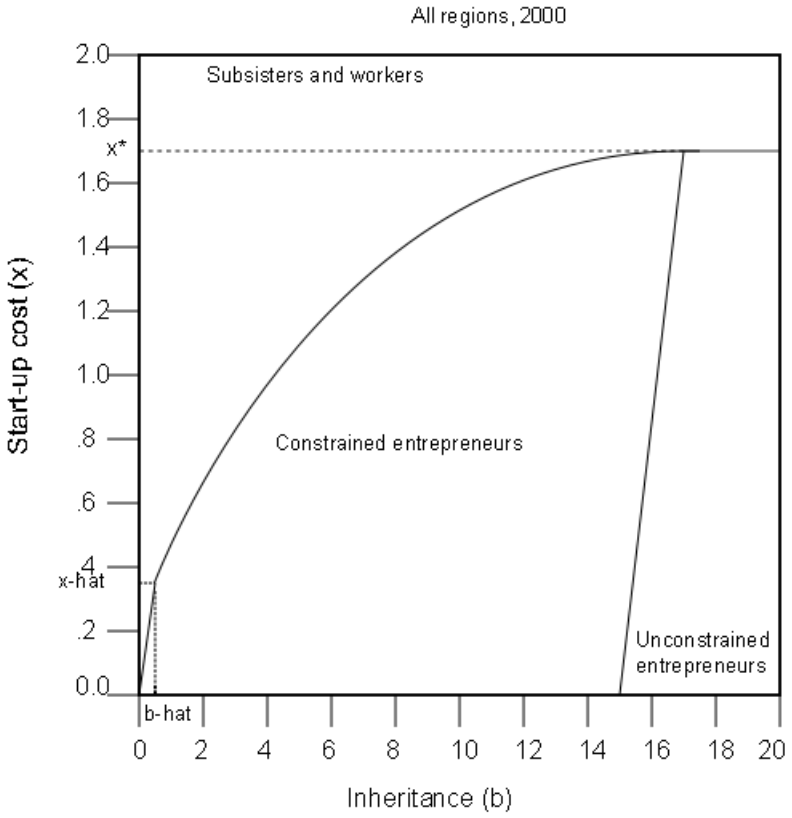
- A very small number of households have much higher incomes than the rest. A significant gap between credit-enabled and non-credit enabled households is present from the beginning

- The South performed the worst in terms of income growth, while the Valley of Mexico performed best. This is puzzling, since the latter is also the region with the lowest levels of entrepreneurship. Urban areas in and around the Valley of Mexico have lower rates of entrepreneurship than predicted by the model

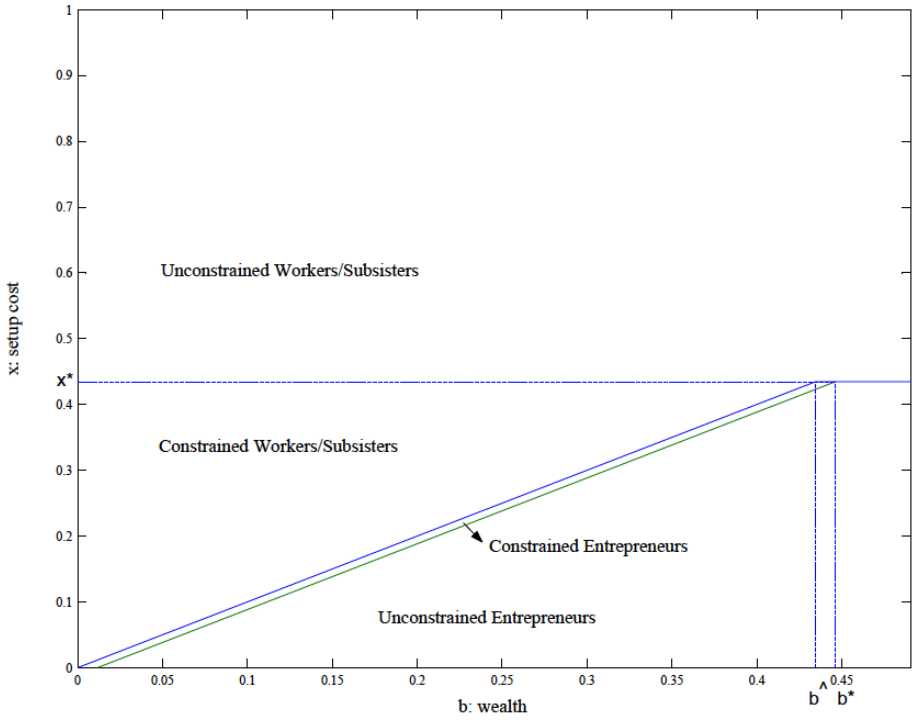
- The North has the highest levels of income overall, while the South has the lowest. The wealth gap among regions closes considerably, as the South experiences the most growth in wealth, and the North the least growth

- The model shows average income in the credit sector being much higher than income in the non-credit sector. The gap in income is increasing over time

Entrepreneurship and Financial Constraints: Mexico vs. Thailand



Thailand

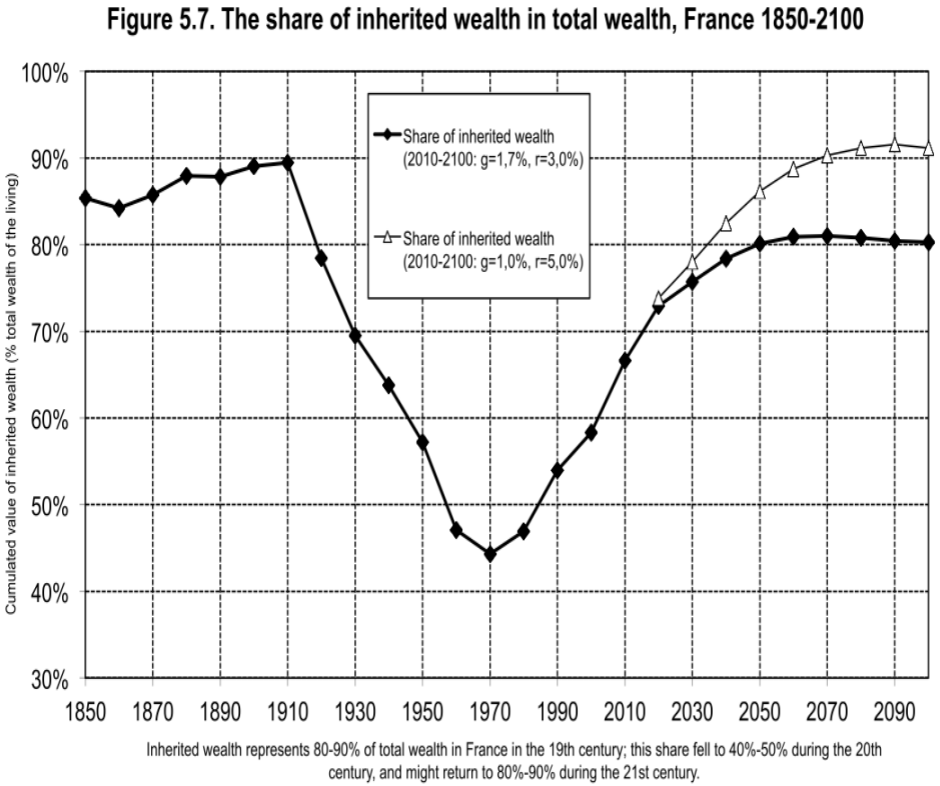


Mexico

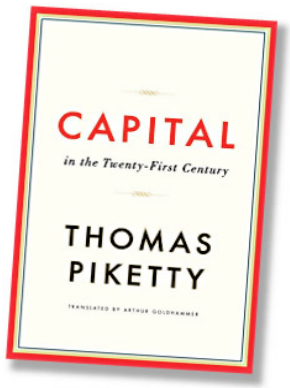
New models and research algorithms

- Algorithms for computing competitive equilibrium with heterogeneous agents in hierarchical multiscale settings
- Dynamic models with endogenously incomplete financial regimes
- "Economic development and the equilibrium interaction of financial frictions" (with Ben Moll and Rob Townsend) - our point: we should use micro data to choose between myriad of alternative forms of introducing a financial friction into our models
- "Imperfect competition among financial service providers: a framework connecting contract theory, industrial organization, and development economics" (with Rob Townsend)
- HJB PDE for Robust Economic-Climate Models
- Tensor-based Computing

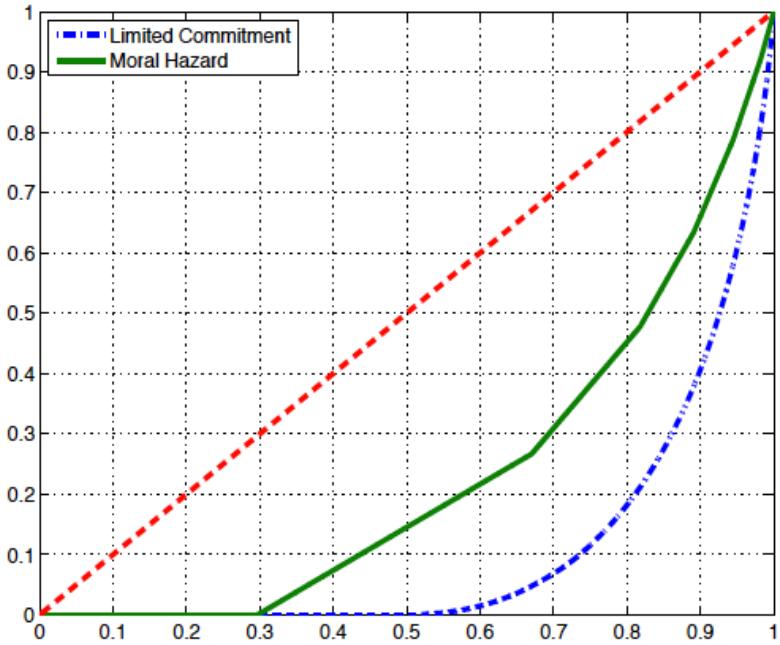
The Fundamental Force for Divergence: r > g?



Piketty and Zucman (2014)



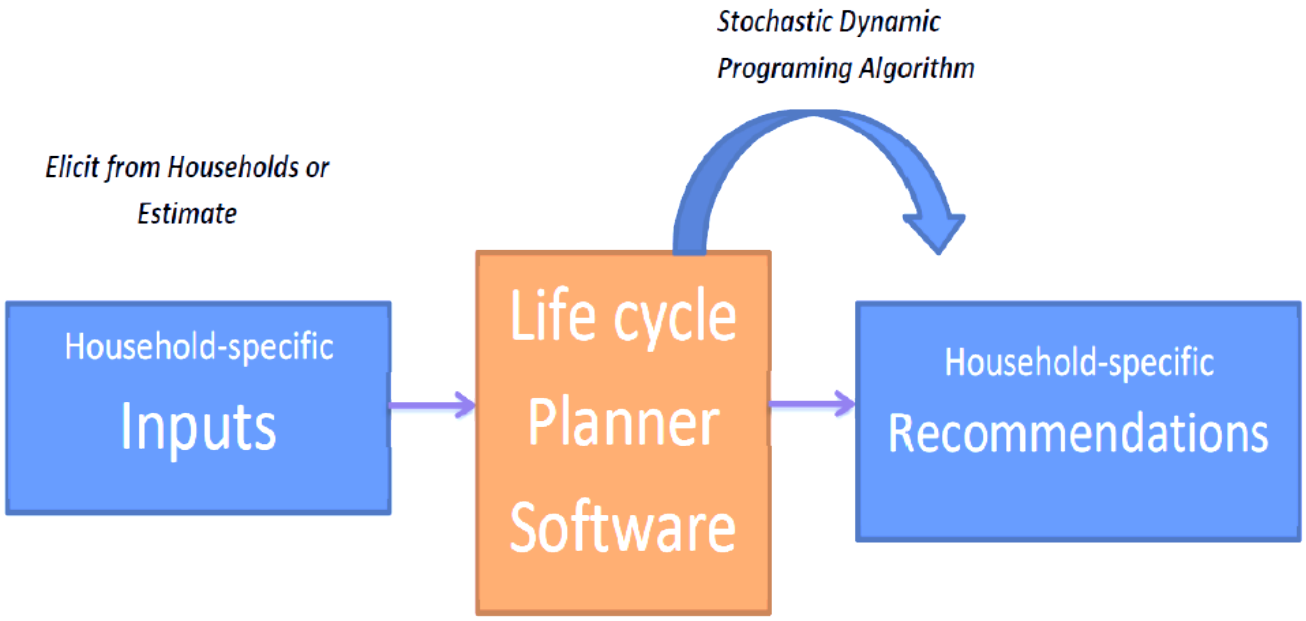
Wealth Lorenz Curves



"Economic development and the equilibrium interaction of financial frictions" with B. Moll and R. Townsend, 2014

Lifecycle Wealth Management Software: from data to model

(with Stefanie Stantcheva and Rob Townsend)



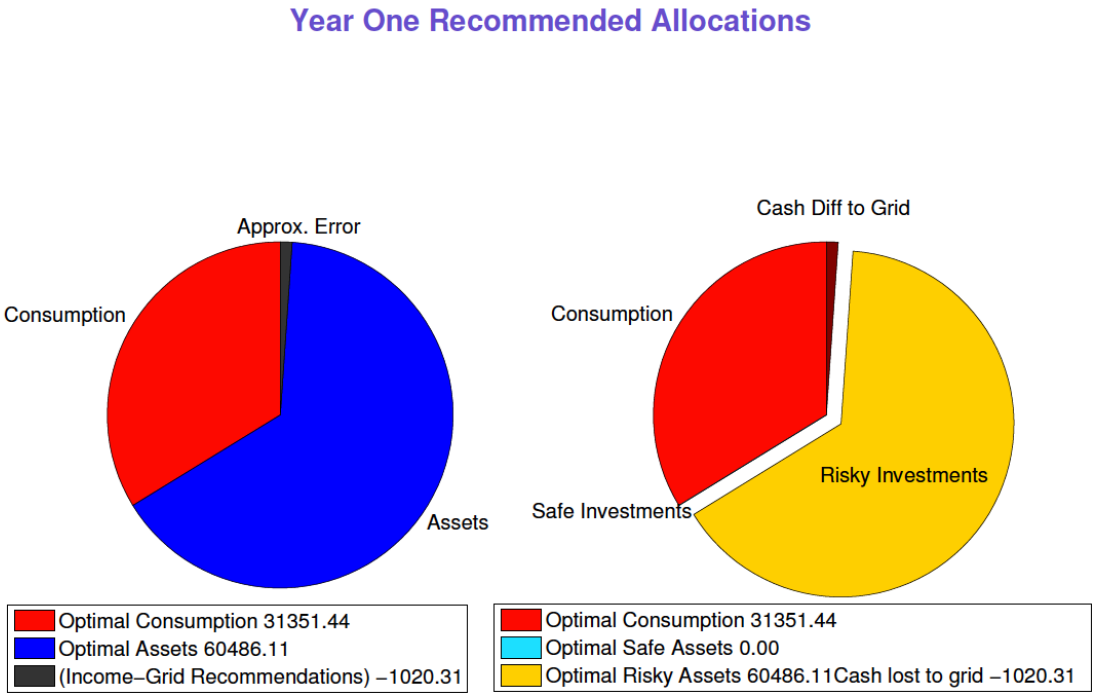
"The main purpose of economics is to understand and to help alleviate poverty"
Gary Becker

From model to field experiments and back to data analysis

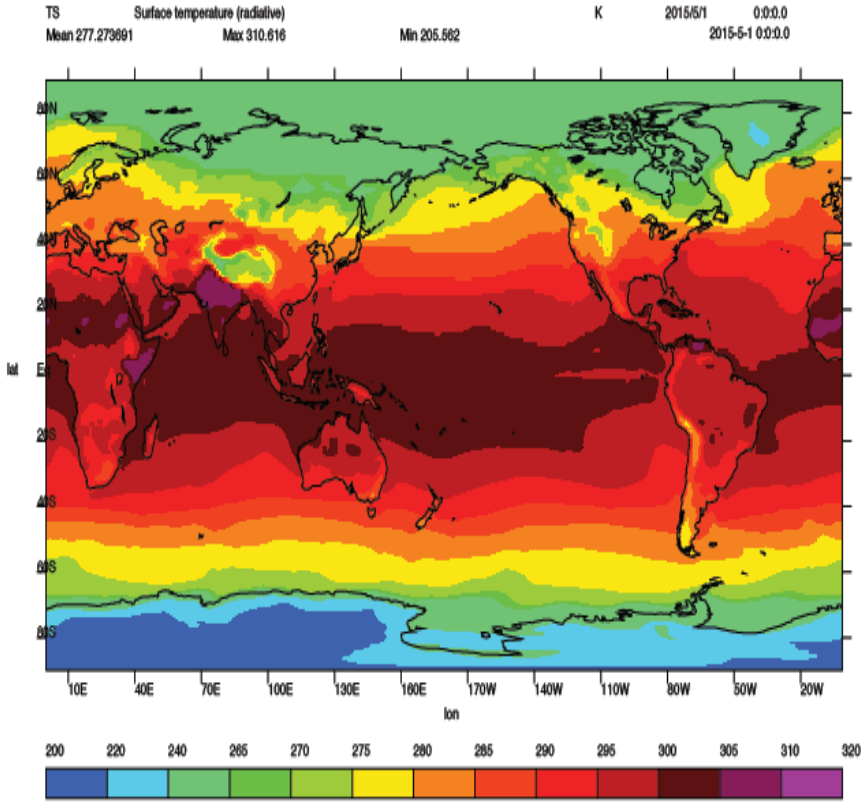
Planner allows to show many possible simulations of households predicted income paths under various real life scenarios with optimal policy applied

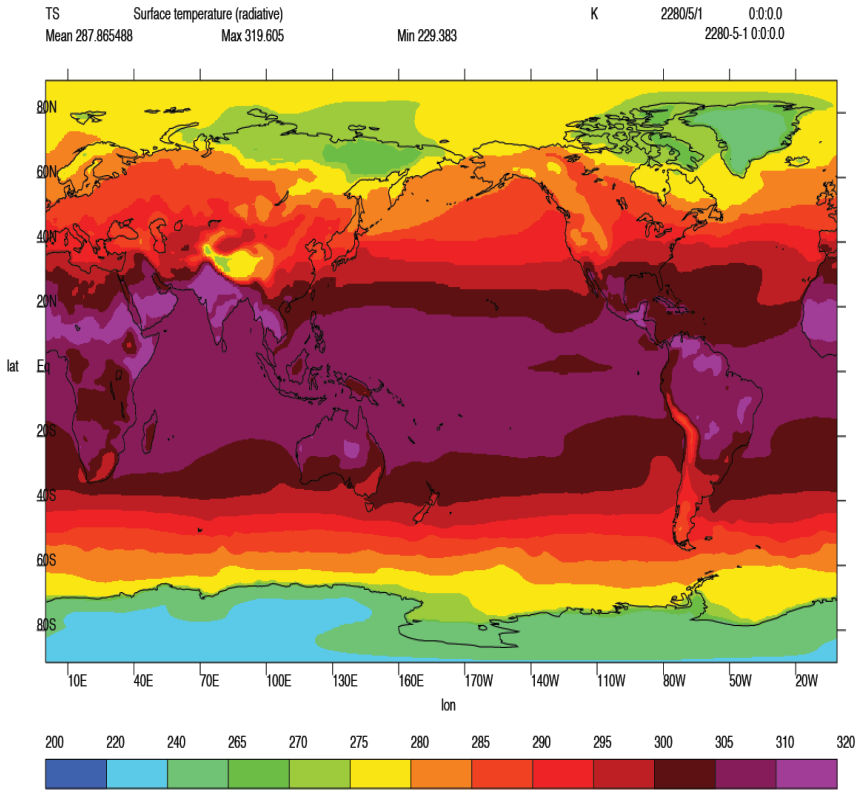
Goal is to help households think through various scenarios and choice options

Intervening across several dimensions: reducing transactions costs, improving learning ability, reducing choice uncertainty, linked to ambiguity aversion – collect: household's current strategies and plans



HJB PDE for Robust Economic-Climate Models





$$G_\lambda^*(K, T, \log A, \log \lambda) = \theta \sigma_\lambda \frac{\partial W(K, T, \log A, \log \lambda)}{\partial \log \lambda}$$

CI Centers and Projects:

from big data analysis to models and back again

rdcep

A Center for Robust Decision Making on Climate and Energy Policy

KNOWLEDGE LAB

CENTER for MULTISCALE THEORY and SIMULATION

NSF CENTER for CHEMICAL INNOVATION

Open Science Grid

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