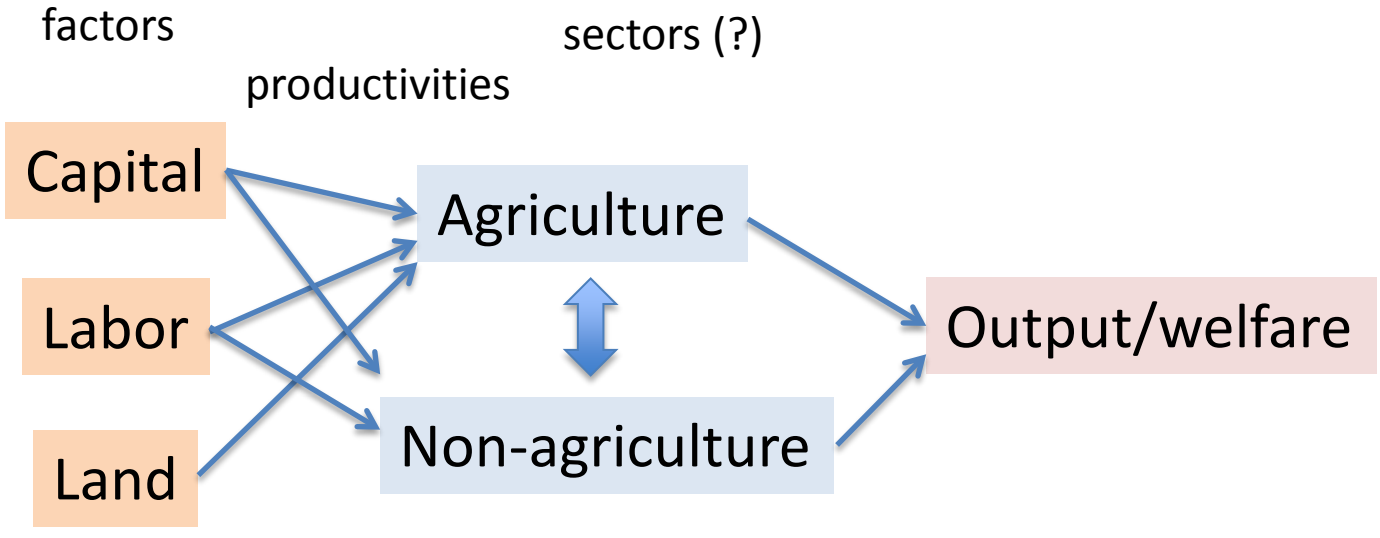
Empirical contributions to the modeling of climate impacts

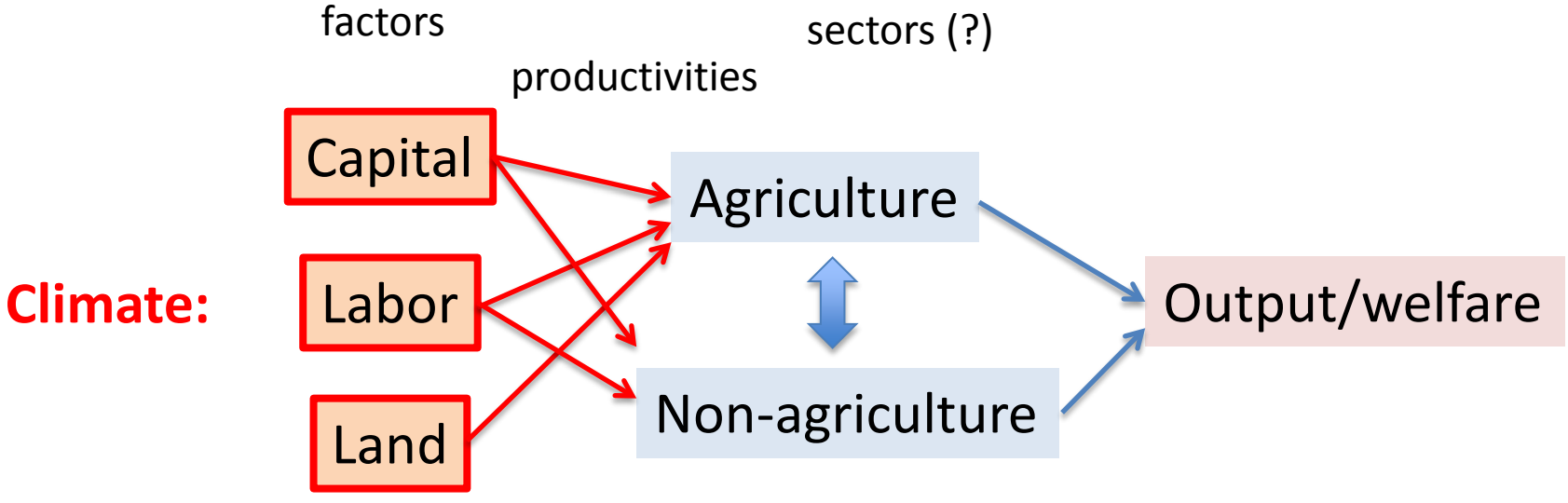
Marshall Burke
Stanford University

June 22, 2016 | Potsdam ISI-MIP Workshop

A simple-minded empiricist's view of impact models

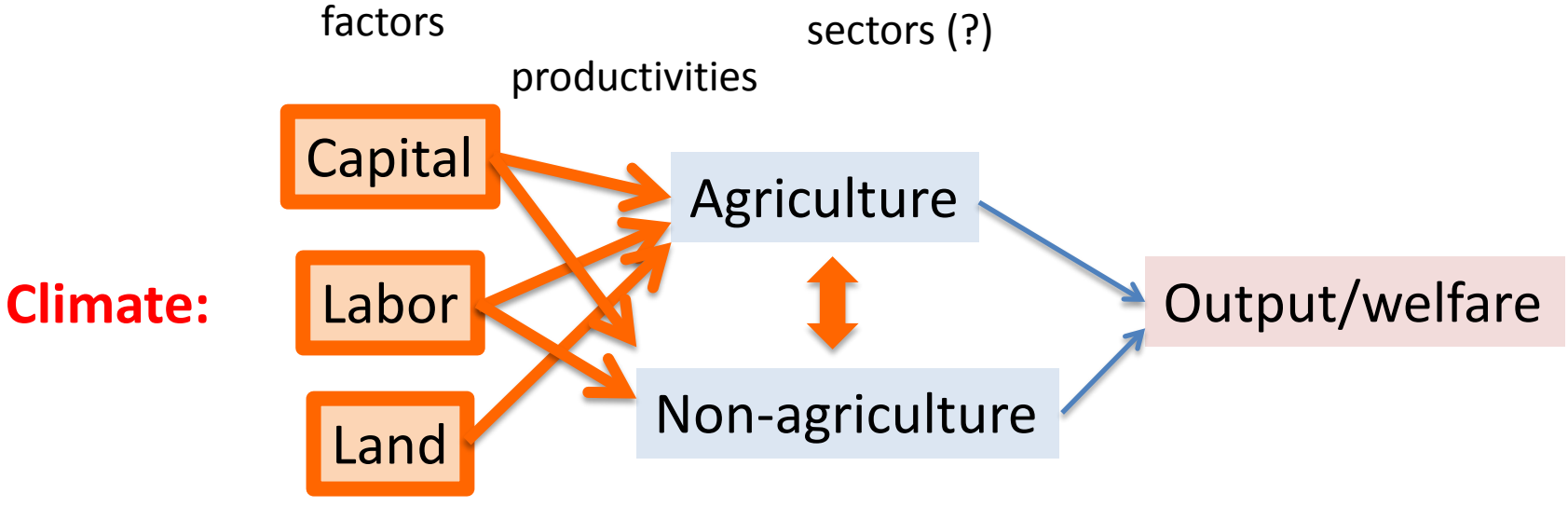


A simple-minded empiricist's view of impact models



Where empiricists might be able to help:

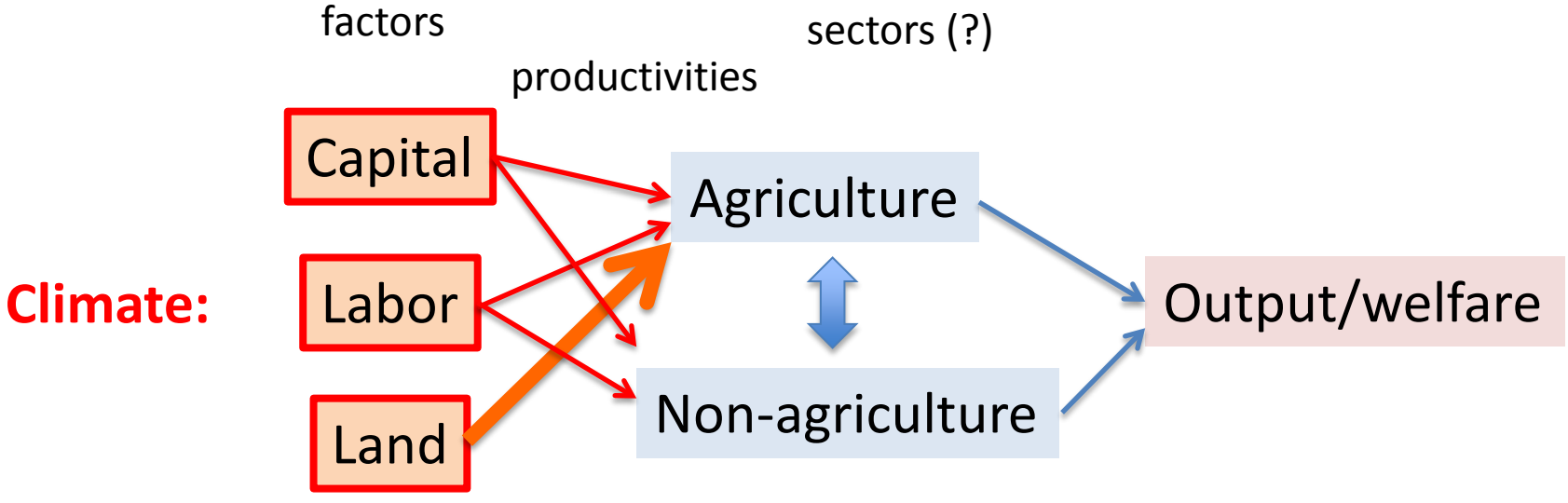
1. Getting at economic primitives in model that could drive impacts



Claim: empirical approaches are only way to get at magnitudes of climate effects for many of these

Where empiricists might be able to help:

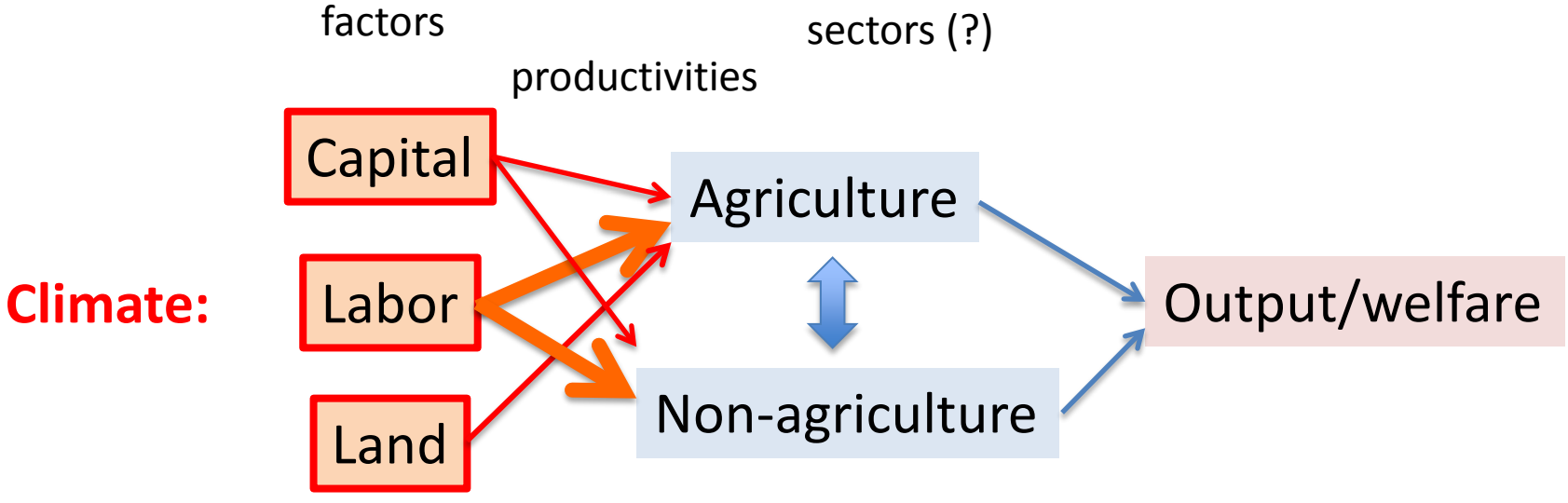
1. Getting at economic primitives in model that could drive impacts



Yield: one (the only?) productivity that we can currently get from process models. (Empirical estimates == AgMIP ensemble mean)

Where empiricists might be able to help:

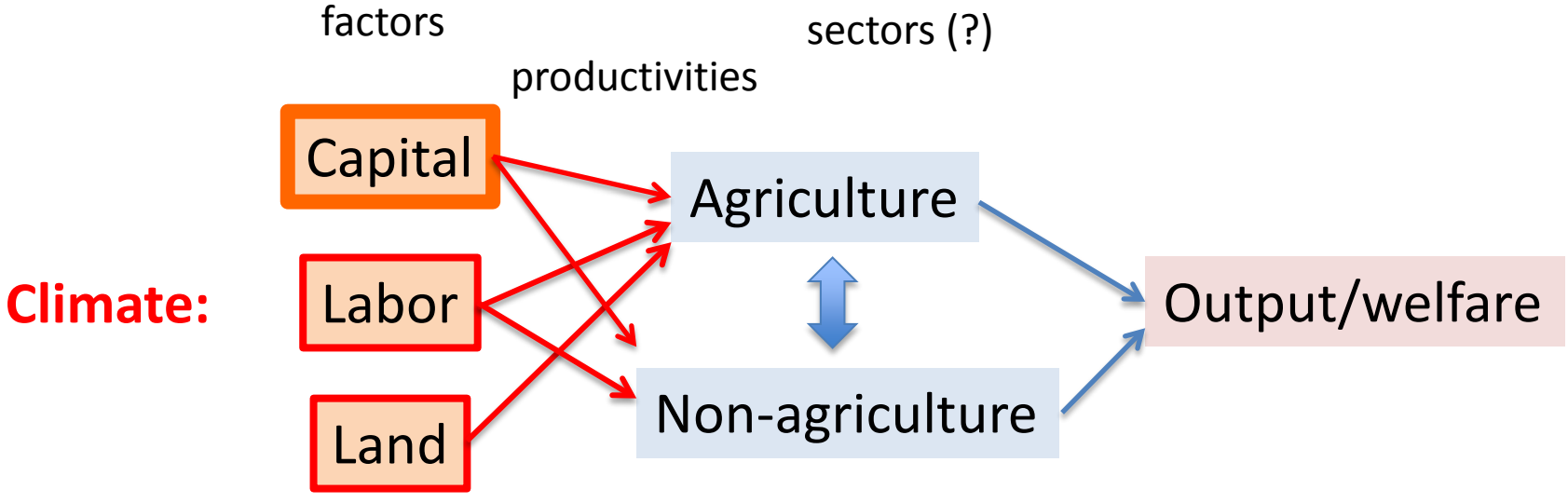
1. Getting at economic primitives in model that could drive impacts



Labor productivity: estimates almost surely have to come from empirical studies (of which there are an increasing amount)

Where empiricists might be able to help:

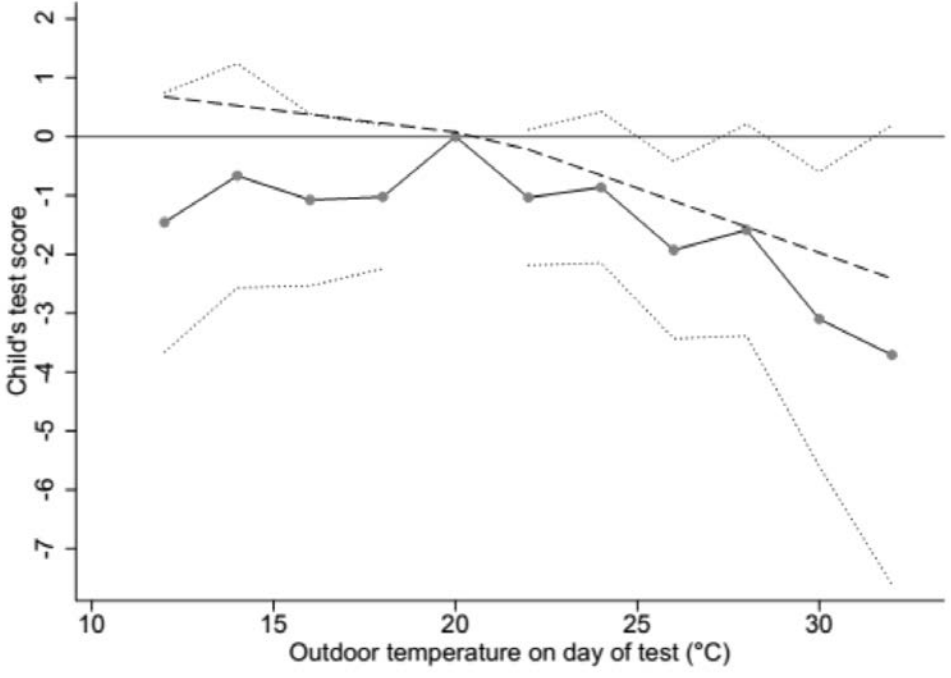
1. Getting at economic primitives in model that could drive impacts



Potential subtle effects on human capital accumulation.

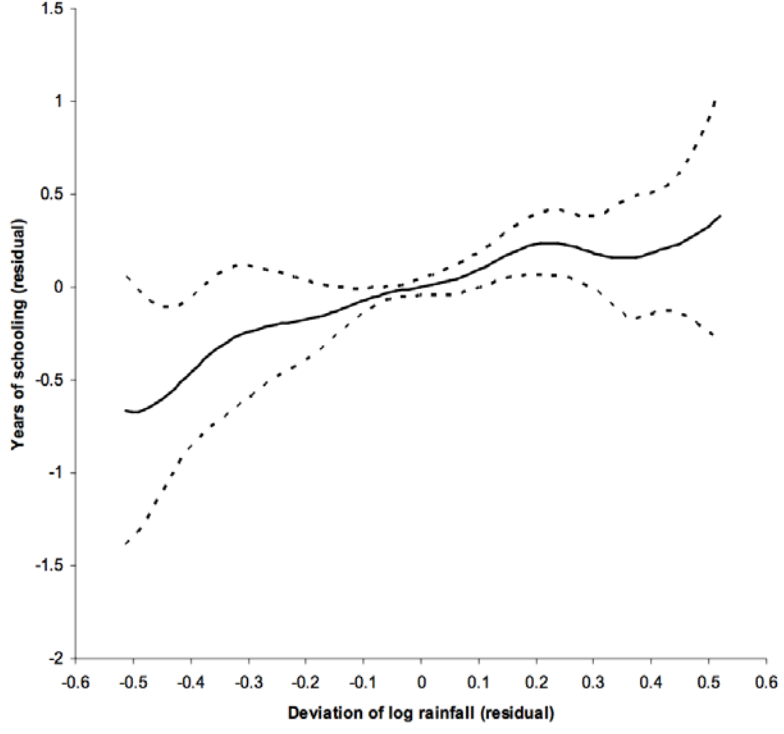
Climate and human capital

Temperature and cognitive performance (US)



Graff Zivin et al 2015

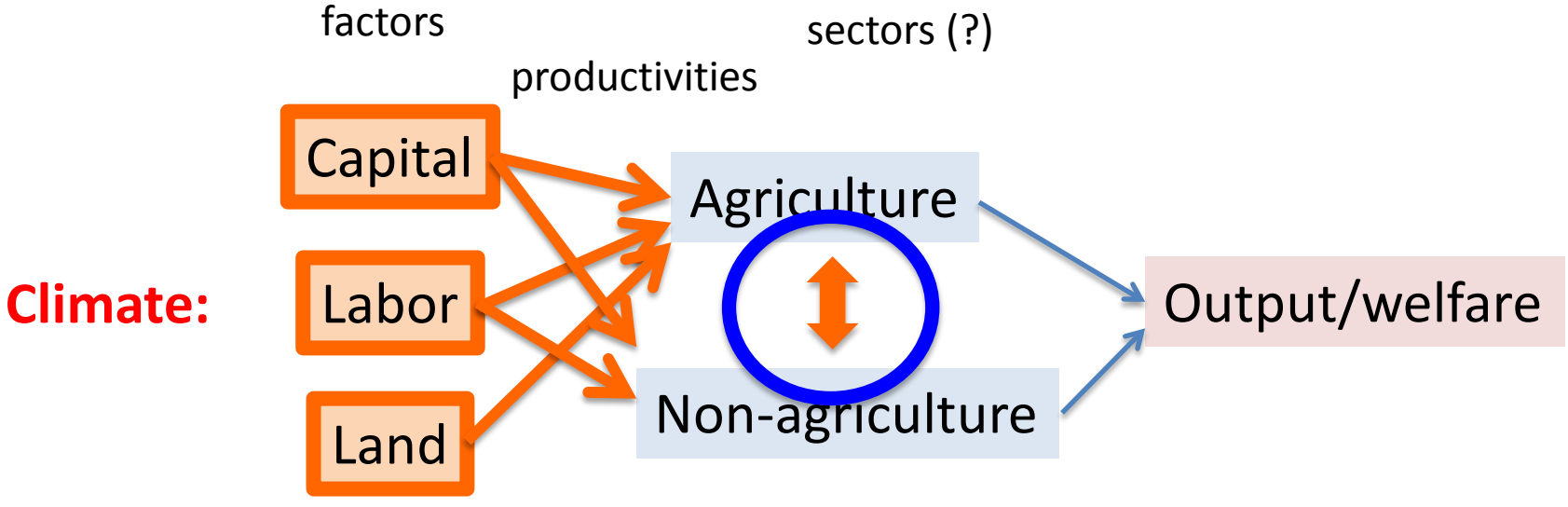
Birth-year rainfall and later years of schooling (Indonesia)



Maccini & Yang 2009

Where empiricists might be able to help:

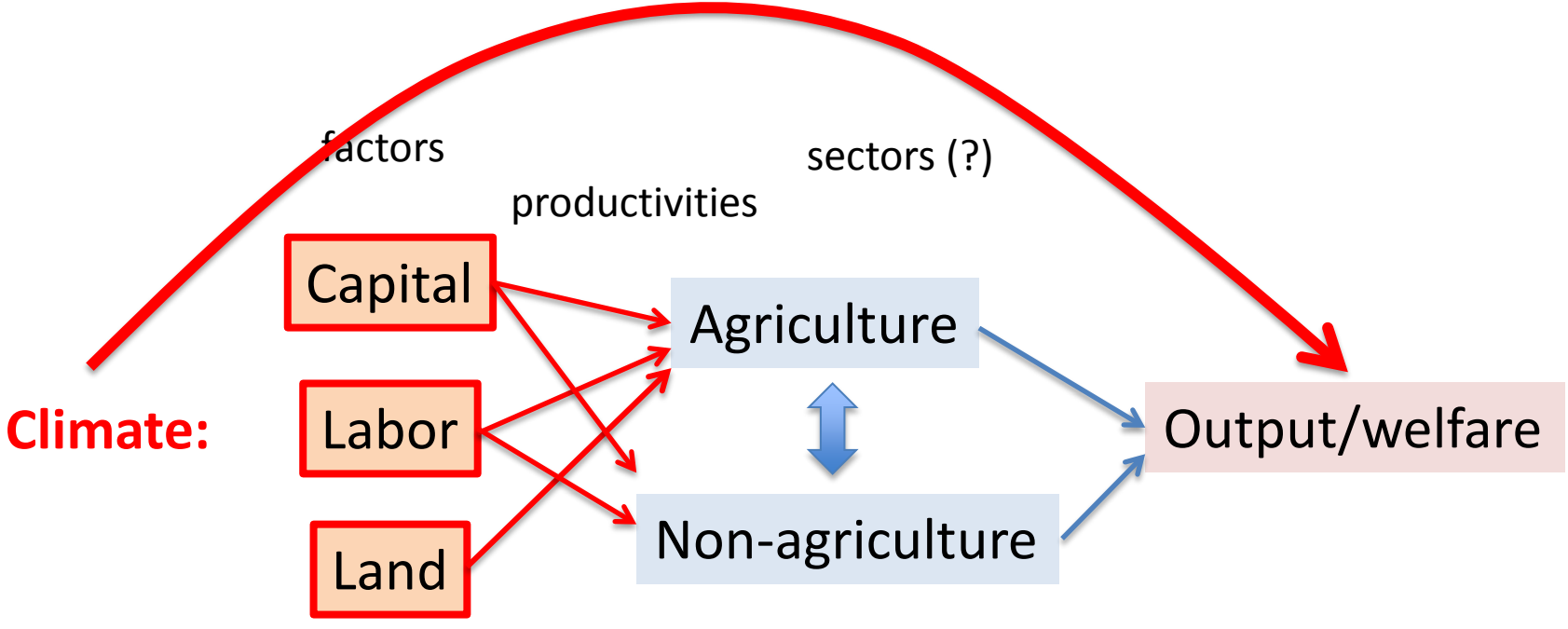
1. Getting at economic primitives in model that could drive impacts



Very active empirical literature on **sectoral re-allocation.**

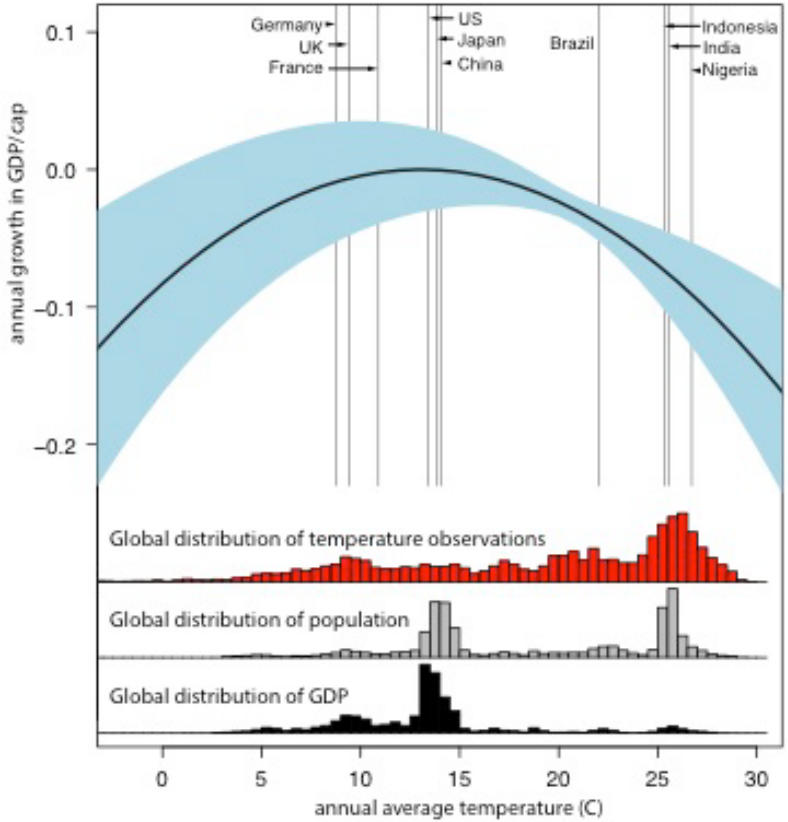
Where empiricists might be able to help:

2. Helping validate models of aggregation

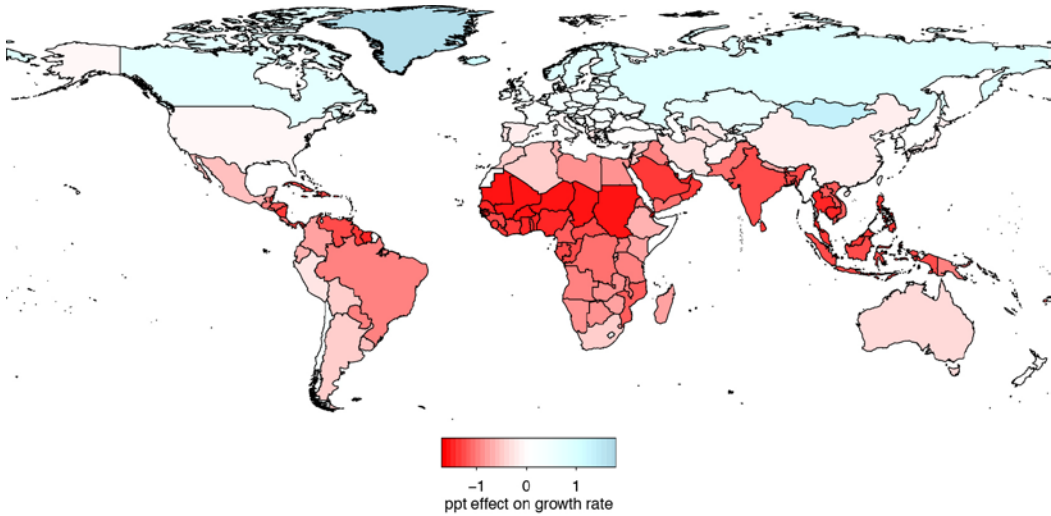


Burke, Hsiang, Miguel *Nature* (2015)

Analyzed temperature impacts on GDP growth, using ~50yrs of data for all countries in the world

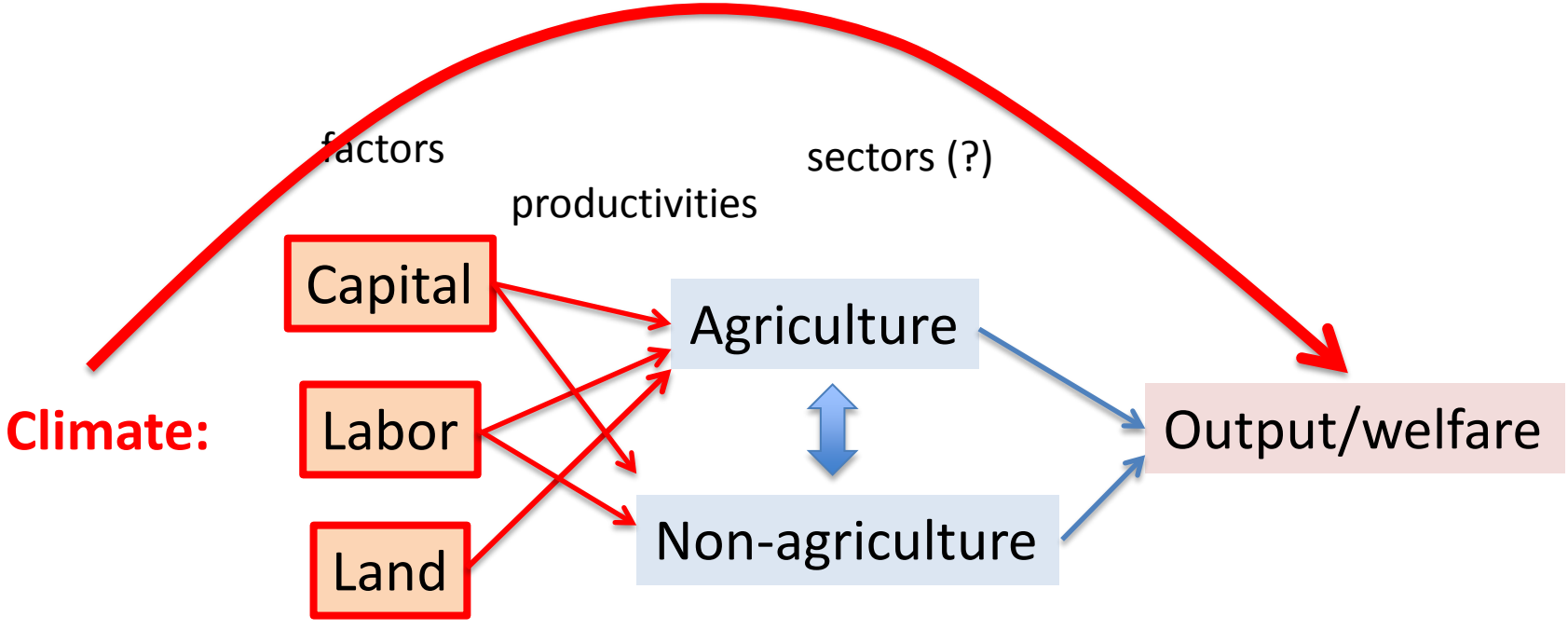


Marginal effect of +1C in each country



Where empiricists might be able to help:

2. Helping validate models of aggregation



As in AgMIP: compare model estimates to aggregate empirical estimates, and iterate if disagreement?

Where empiricists might be able to help:

3. Understanding how effects on primatives/outcomes change over space or time

By 2030, rapid, inclusive, and climate-informed development can prevent most (but not all) climate change impacts on poverty

Just how large might these impacts be on poverty by 2030 and how much can devel-

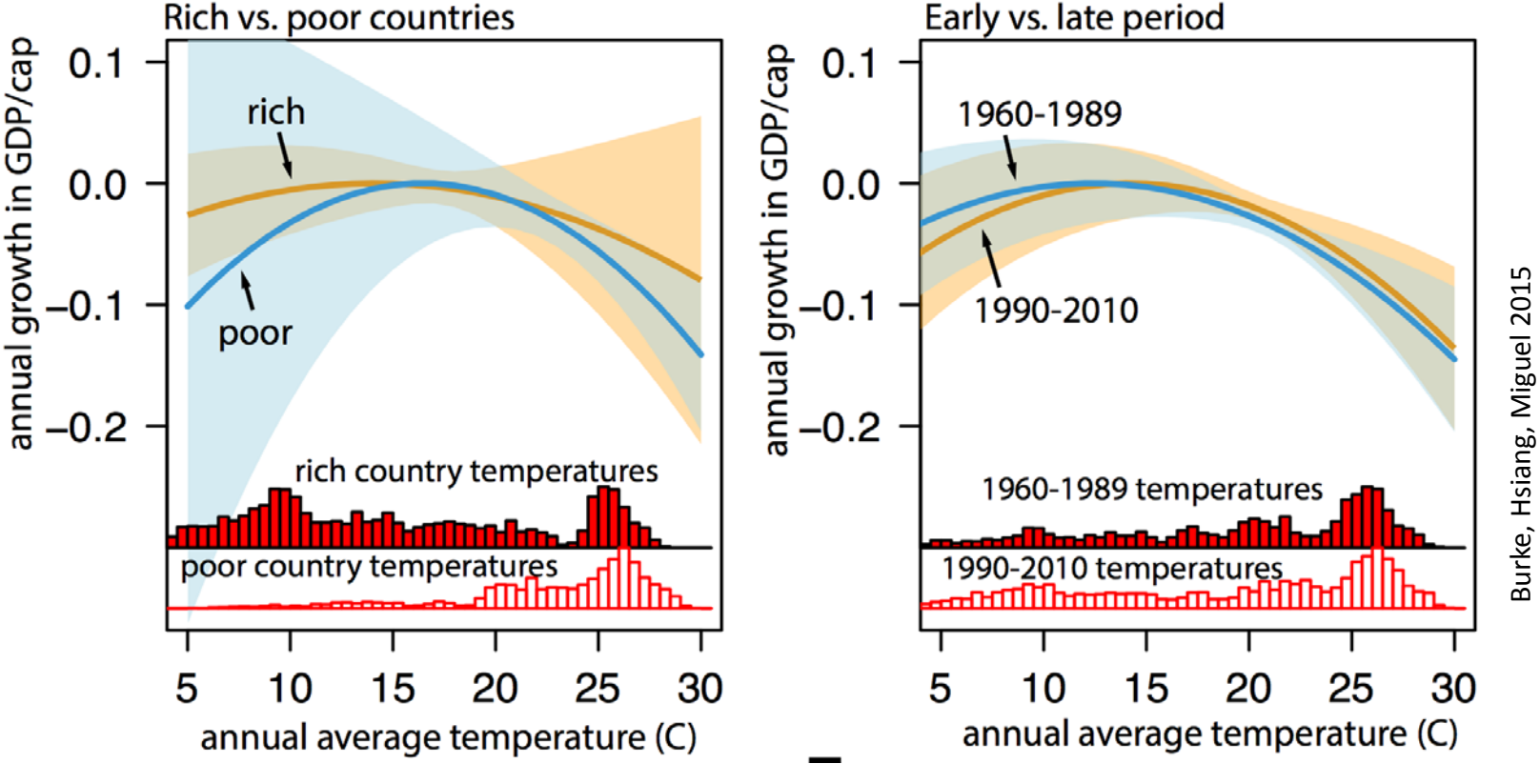
report. But we do so with t
impact scenarios—a *low-i*
impact scenario—given tha
biological impacts will be
dependent on (i) how ecos
physical systems (like gla
zones) respond and (ii) how
ously adapt (like adopting
practices or improved hygi

We do not attribute pro

World Bank *Shock Waves* Report, 2016

Where empiricists might be able to help:

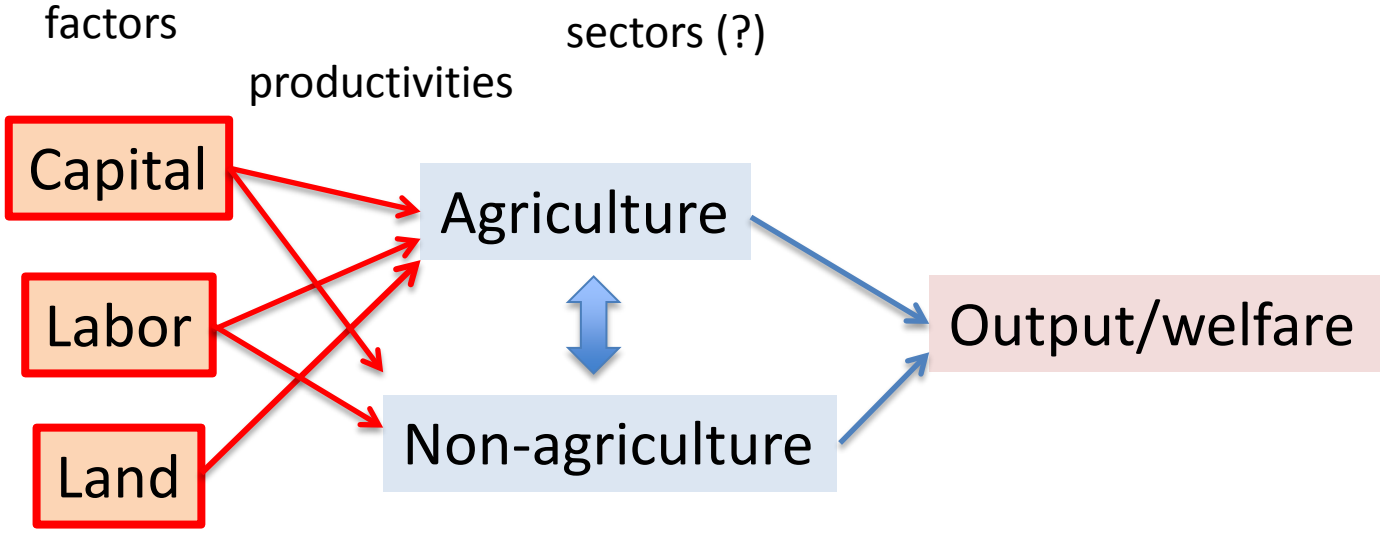
3. Understanding how effects on primatives/outcomes change over space or time



Where empiricists might be able to help:

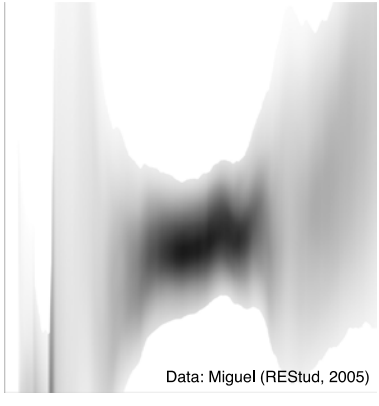
4. Helping deal with things that don't fit well in this framework

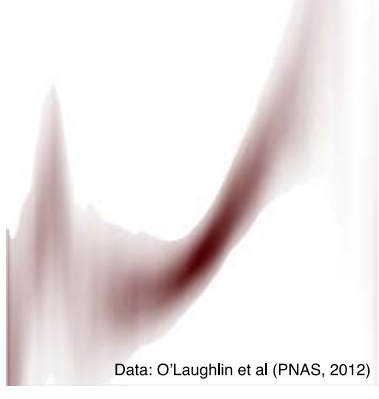
Example 1: conflict

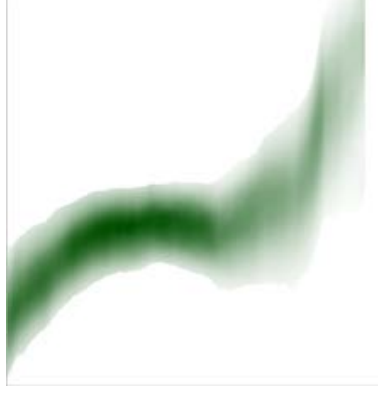


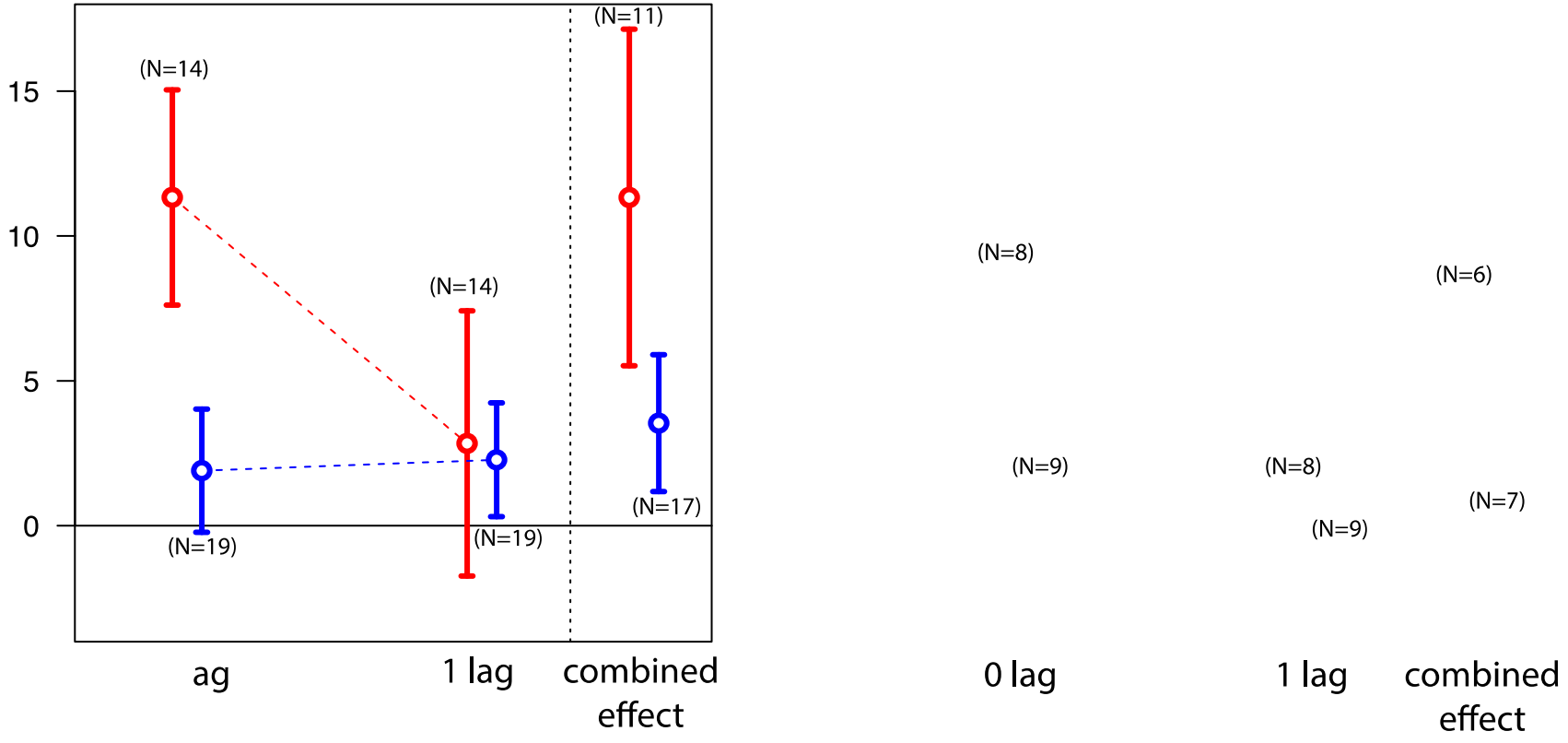
Climate and conflict:

Hsiang, Burke, Miguel 2013









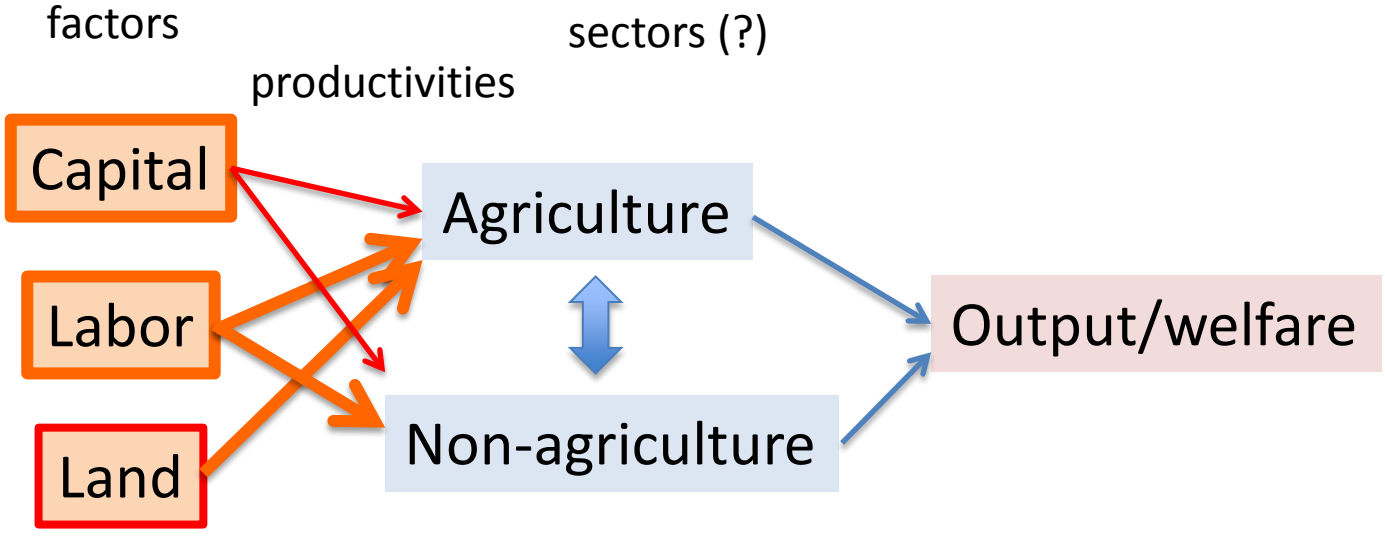
~20% increase in intergroup conflict per +1C

Burke, Hsiang, Miguel (2015)

Where empiricists might be able to help:

4. Helping deal with things that don't fit well in this framework

Example 1: conflict

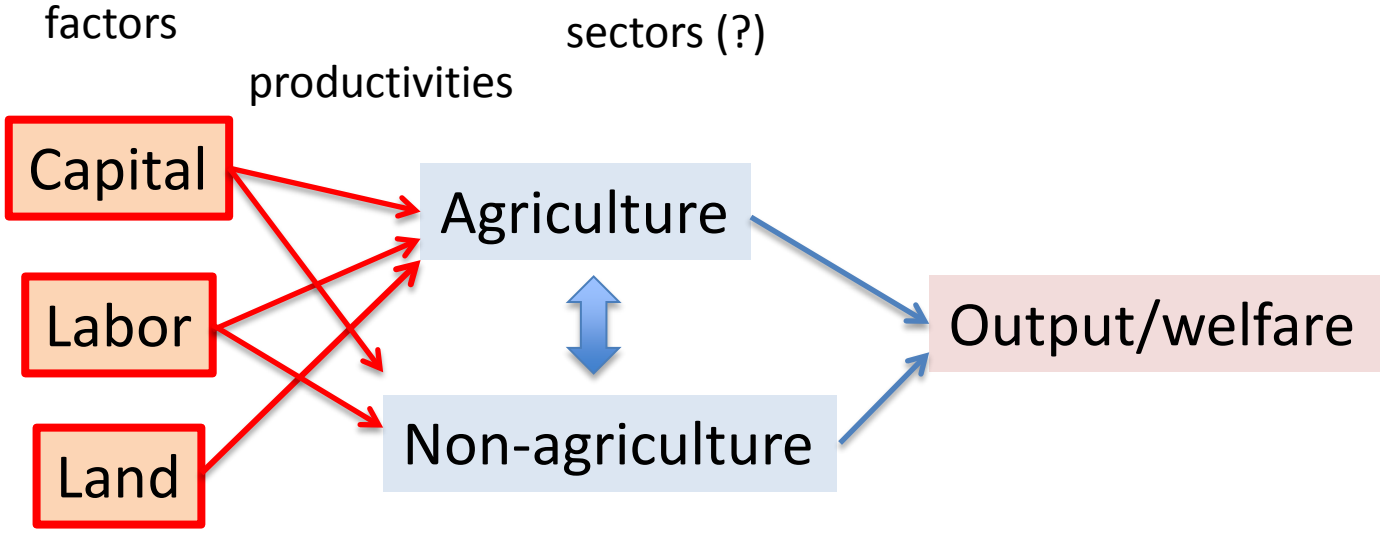


Maybe it can go through existing channels?

Where empiricists might be able to help:

4. Helping deal with things that don't fit well in this framework

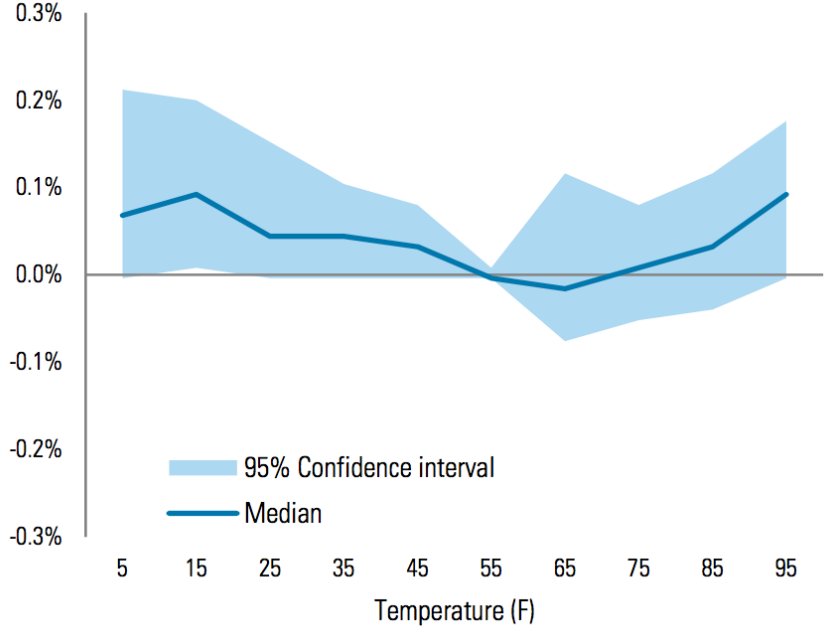
Example 2: mortality



Climate and mortality

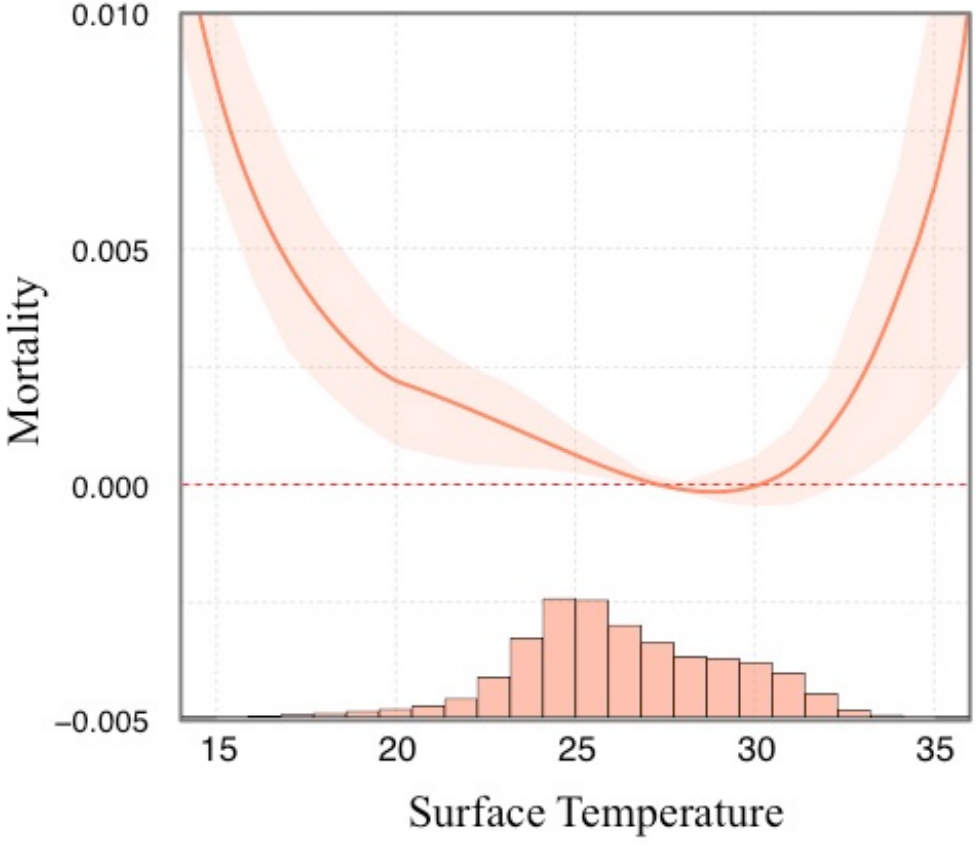
Figure 8.I: Temperature impact on mortality

Percentage change in mortality rate (deaths/100,000) vs. daily maximum temperature (F)



Risky Business report, 2015

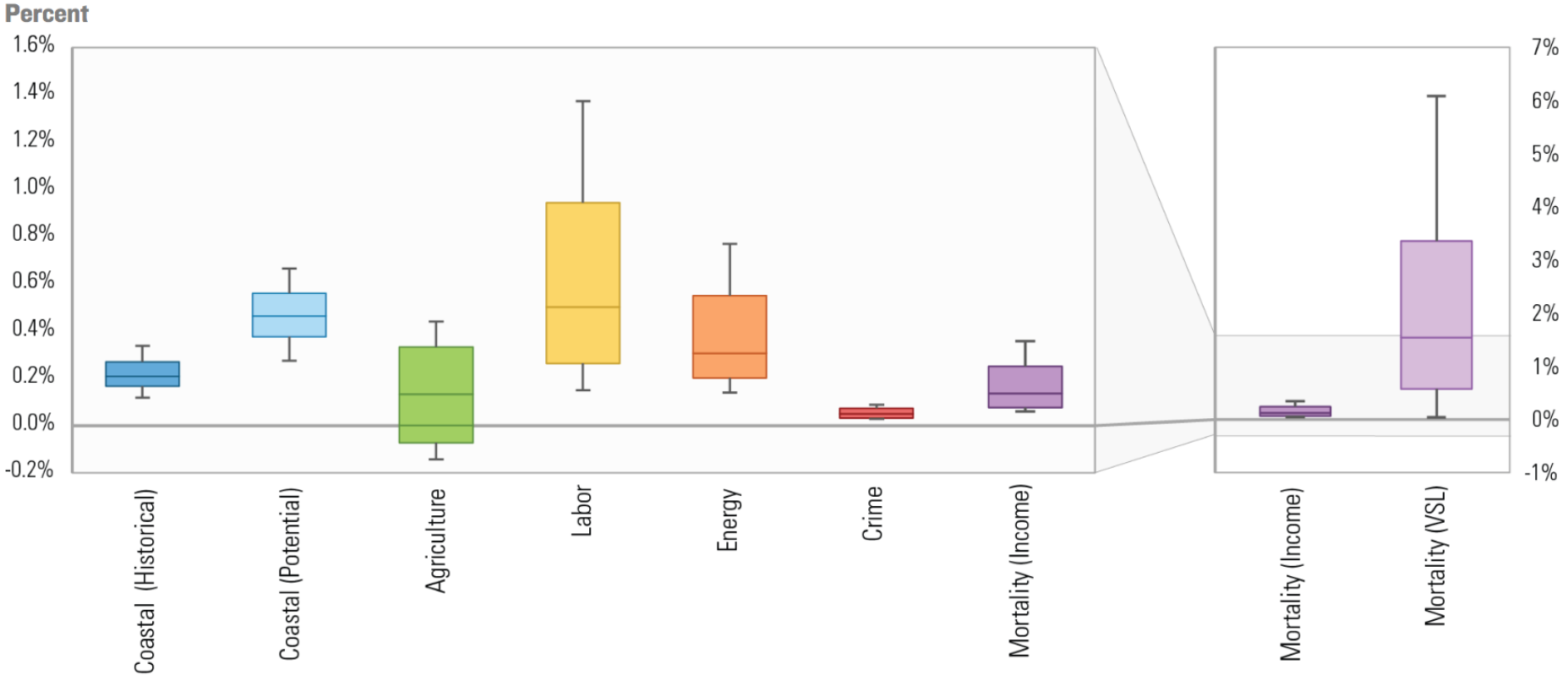
Temperature and child mortality in Africa



Heft-Neal and Burke, in prep

Value of mortality impact dominates other direct impacts (US)

Figure I3.23: Direct costs and benefits under RCP 8.5 as a share of GDP, 2080-2099

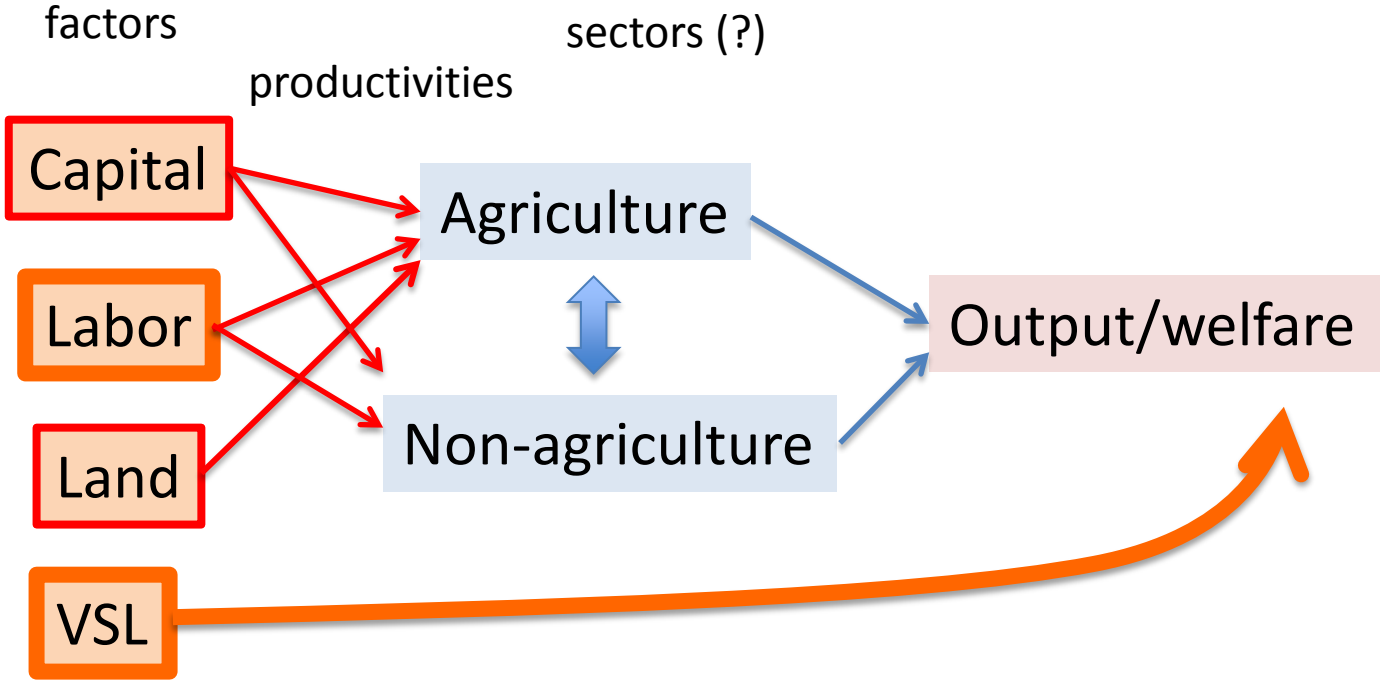


Risky Business Report (2015)

Where you need empiricists' help:

4. Helping deal with things that don't fit well in this framework

Example 2: mortality



Conclusion

My (biased!) view is that empirical estimates are central to the enterprise of climate impact modeling.

1. Get at model primitives
2. Understand how these primitives change over space or time
3. Help validate model aggregation
4. Help account for important un-model-ables.

But we empiricists need guidance from you:

- What are key, uncertain parameters we could help with?