Climate Change and Developing Country Growth: The Cases of Malawi, Mozambique, and Zambia

Presented by Channing Arndt

Joint work with Paul Chinowsky, Charles Fant, Yohannes Gebretsadik, James Neumann, Sergey Paltsev, C. Adam Schlosser, Kenneth Strzepek, Finn Tarp, and James Thurlow


ANGOLA
(Cabinda)
Luanda
Mbuji-Mayi
Lake Tanganyika
TANZANIA
Zanzibar
Dar es Salaam
SEYCHELLES
Lake Nyasa
COMOROS
Moroni
Glorioso Islands
(FRANCE)
Lubumbashi
MALAWI
ANGOLA
Kitwe
Lilongwe
Mayotte
(admin. by France,
claimed by Comoros)
Cidade de Nacala
Lubango
ZAMBIA
Namibe
Lusaka
Blantyre
Tromelin Island
(FRANCE)
Juan de Nova Island
(FRANCE)
Mahajanga
Zambezi
Toamasina
Harare
MOZAMBIQUE
ZIMBABWE
Beira
Mozambique Channel
Antananarivo
Port Louis
MAURITIUS
NAMIB DESERT
Windhoek
BOTSWANA
Bassas da India
(FRANCE)
St. Denis
Reunion
(FRANCE)
Walvis Bay
KALAHARI DESERT
NAMIBIA
Europa Island
(FRANCE)
MADAGASCAR
Gaborone
Pretoria
Maputo
Johannesburg
Mbabane
SOUTH
SWAZILAND
Maseru
Orange
Durban
AFRICA
LESOTHO
Cape Town
Port Elizabeth
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Questions

- What are the implications of climate change for growth and development prospects to about 2050?
- What are the more important impact channels?
- What adaptation options are available that might reduce impacts?

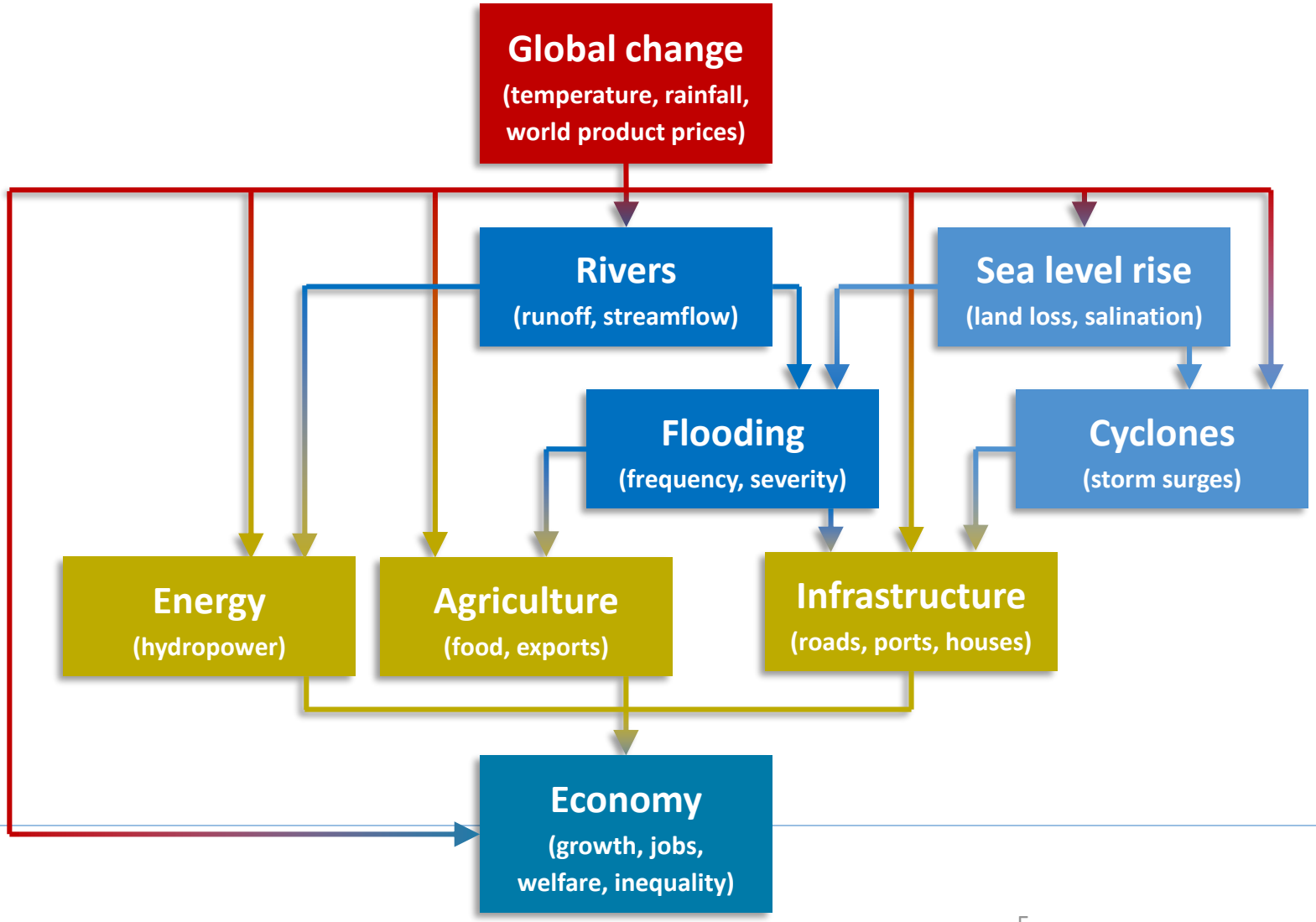
Special issue: Climate Change Impacts and Adaptations: Lessons Learned from the Greater Zambezi River Valley and Beyond. *Climatic Change*. 130(1)(2015).

- **What are the implications of effective global mitigation for the case economies by 2050?**

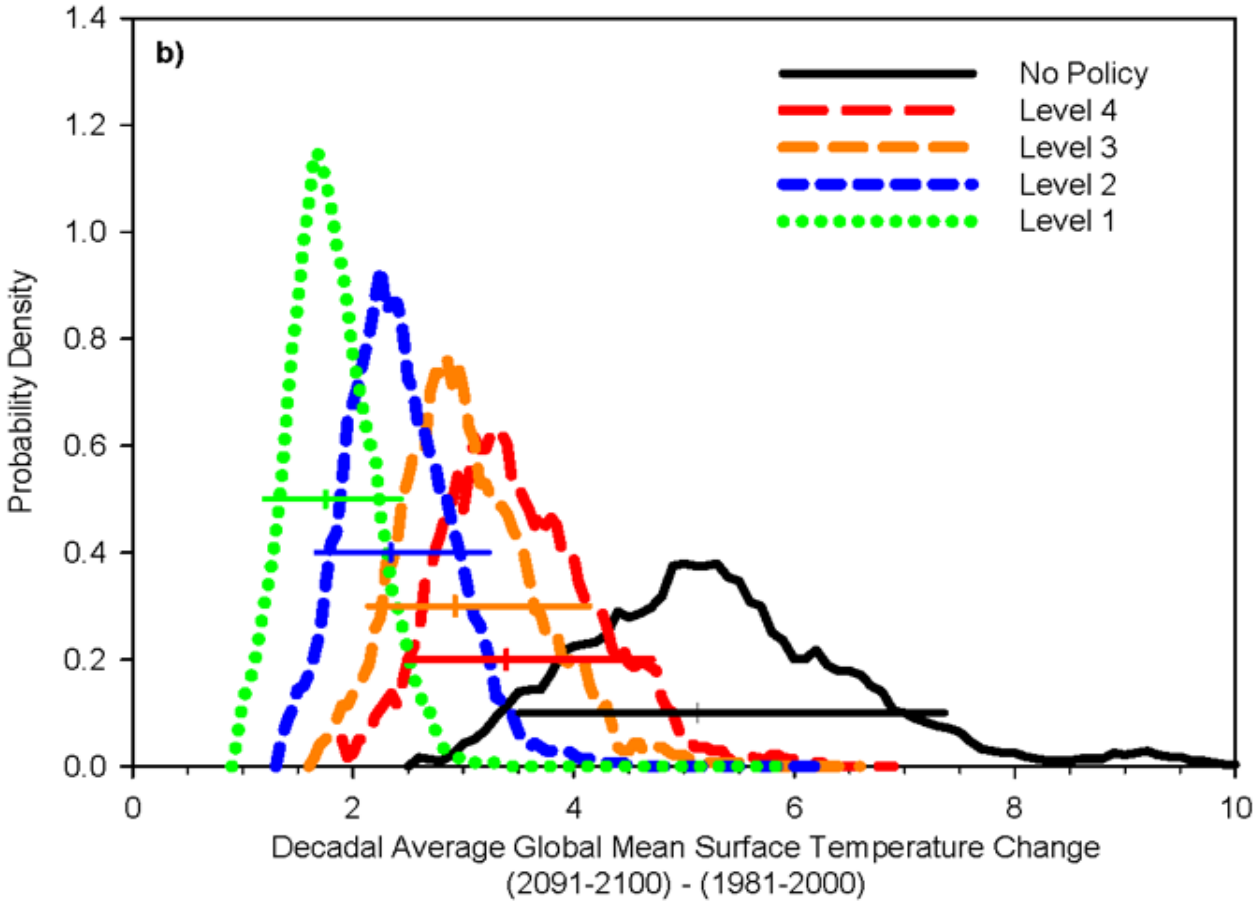
Conclusions

- Effective global mitigation generates two sources of benefit.
- First, less distorted climate outcomes result in typically more favorable and less uncertain economic outcomes even by 2050.
- Second, successful global mitigation results in reduced global fuel producer prices, relative to unconstrained emissions, providing a substantial terms of trade boost to structural fuel importers.

Multi-Sector Modeling Framework

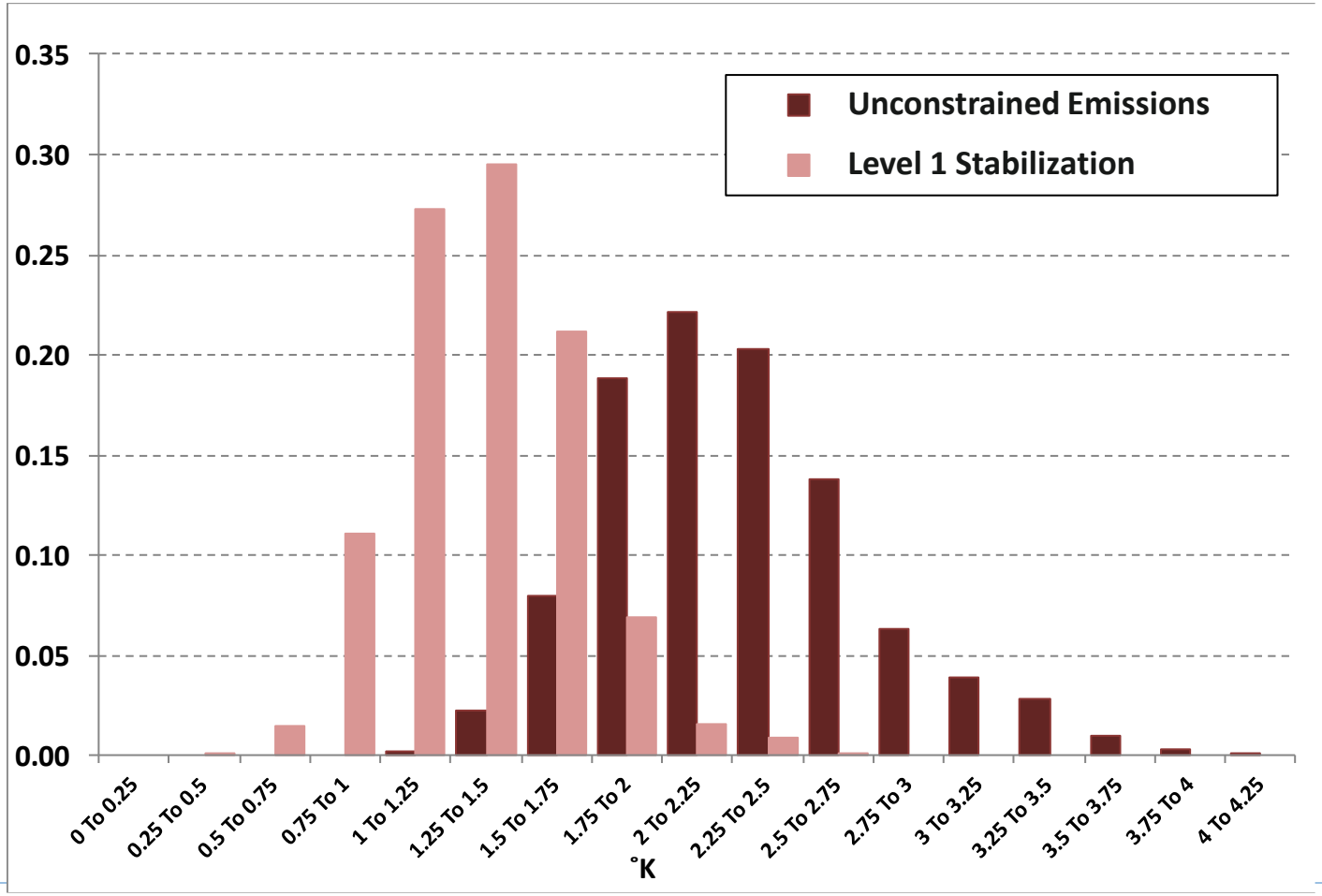


Uncertainty Approach: Ranges of Global Temperature Rise by 2100

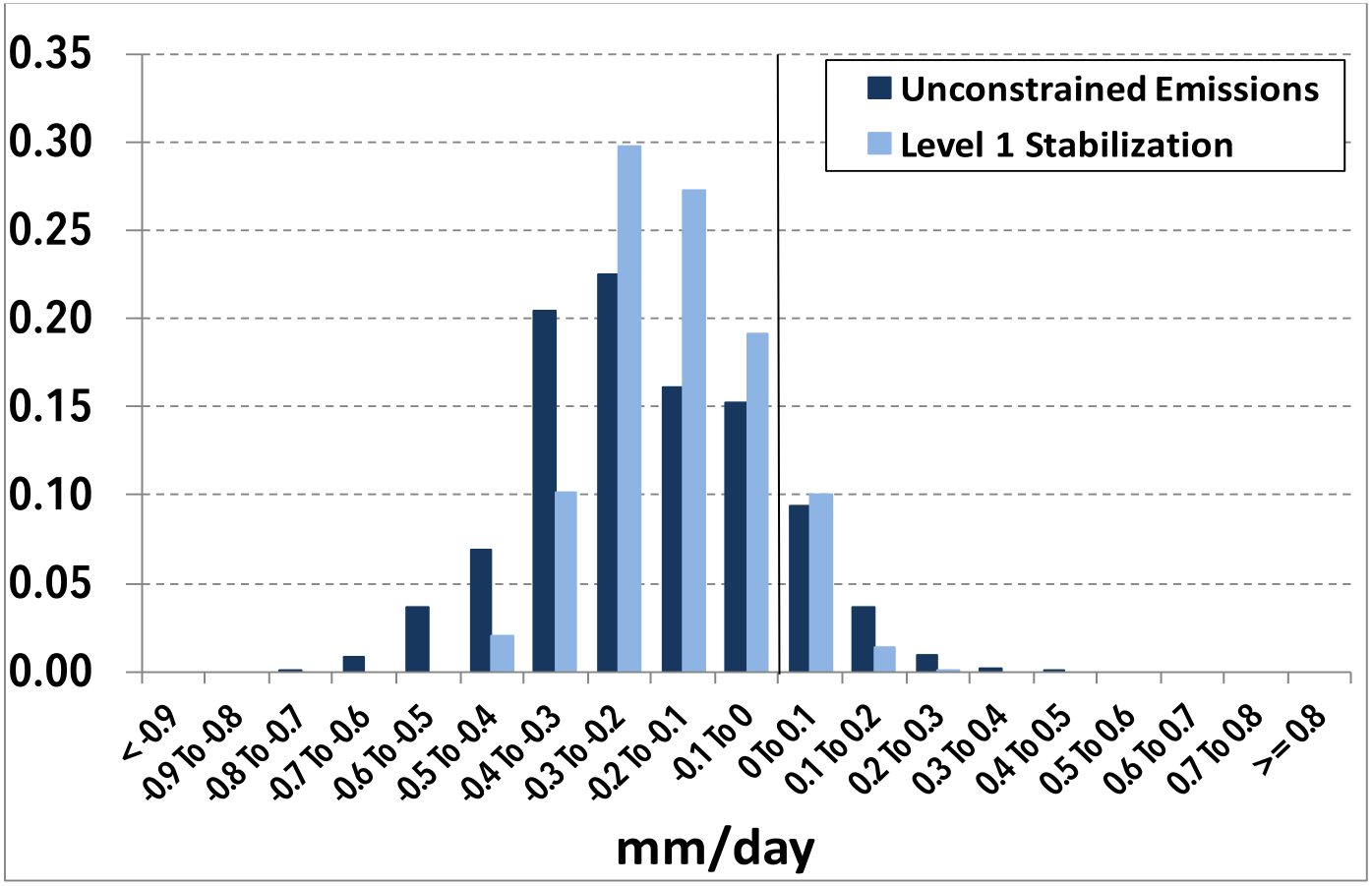


Sources: Sokolov et al., 2009, and Webster et al., 2009

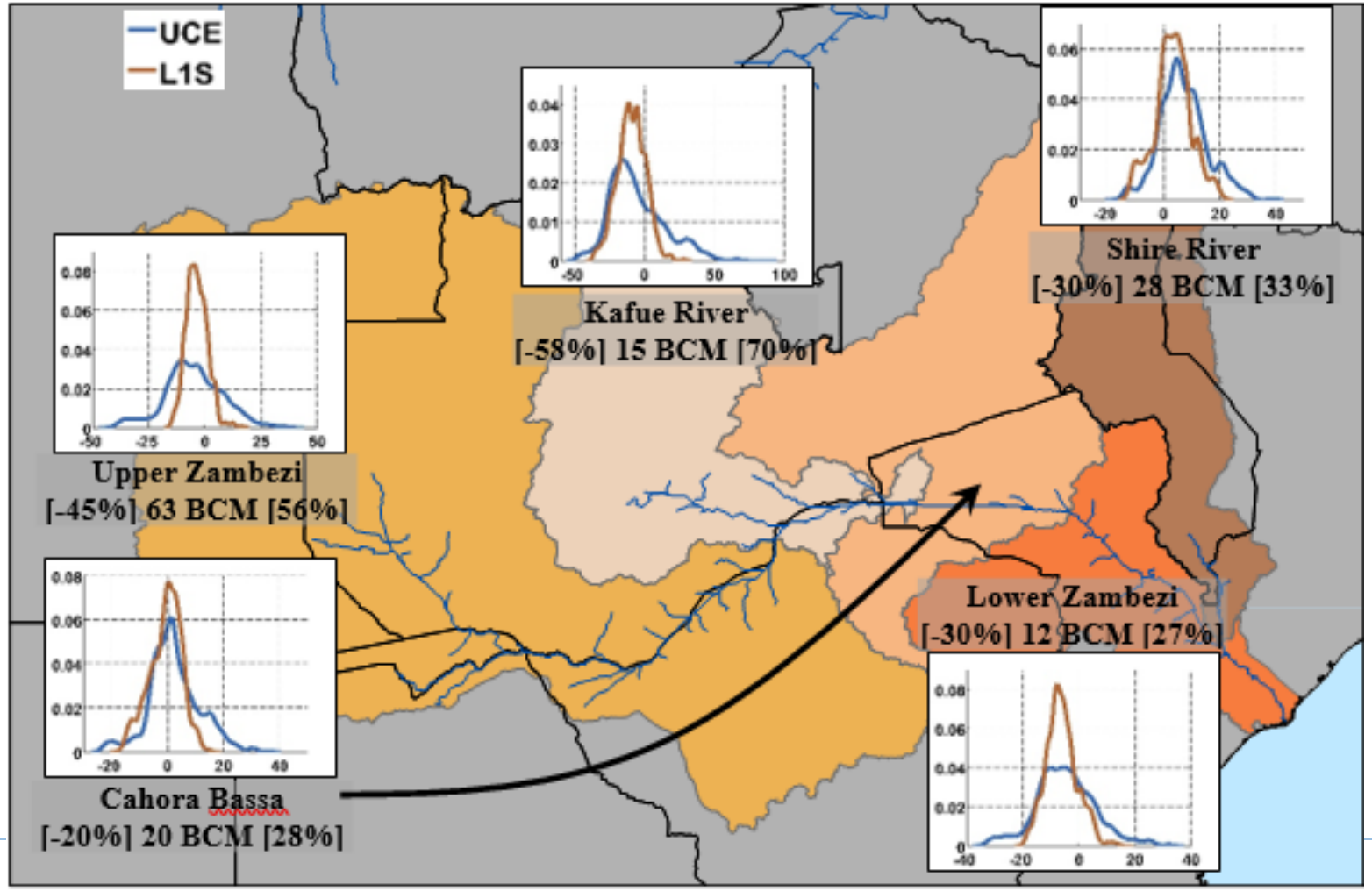
Zambezi River Valley: Temperature Anomalies by 2050 (Summer)



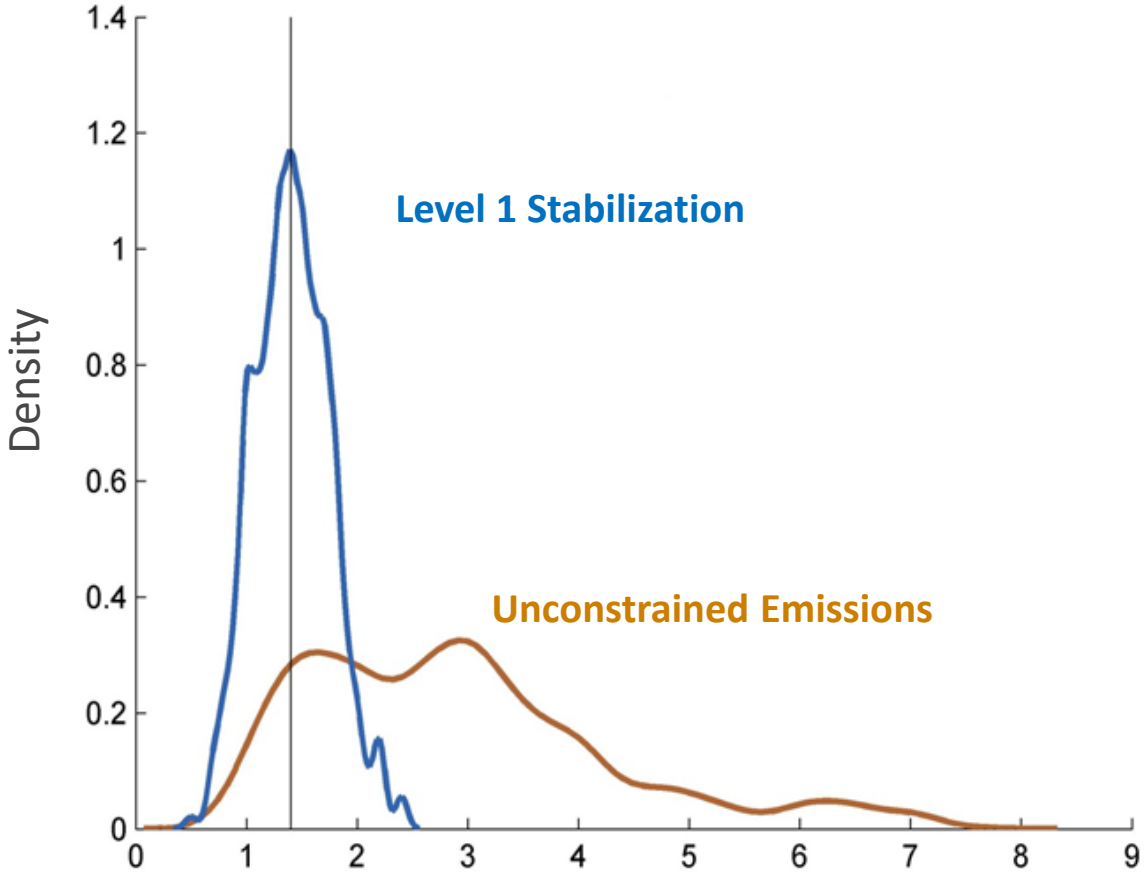
Zambezi River Valley: Precipitation Anomalies by 2050 (Spring)



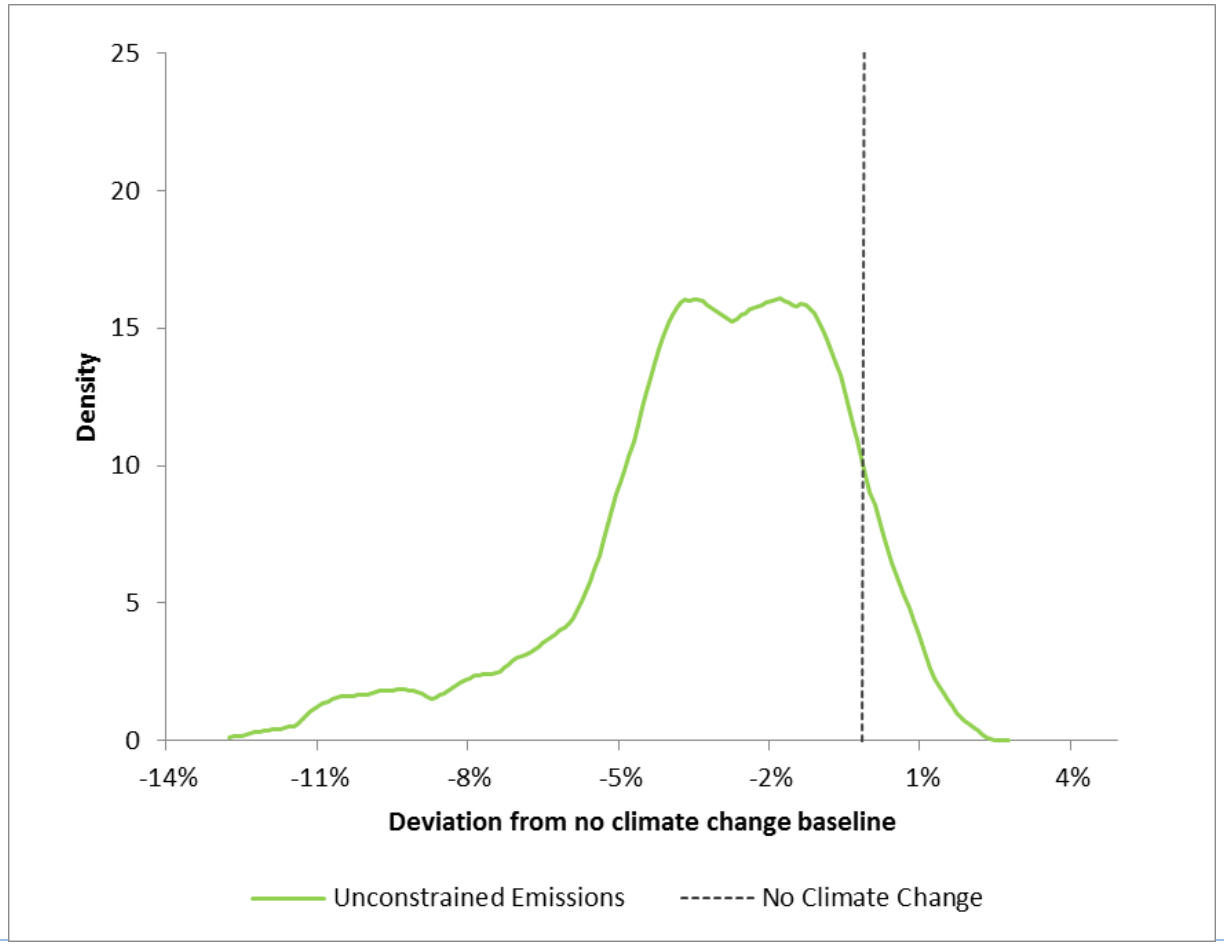
Runoff Anomalies



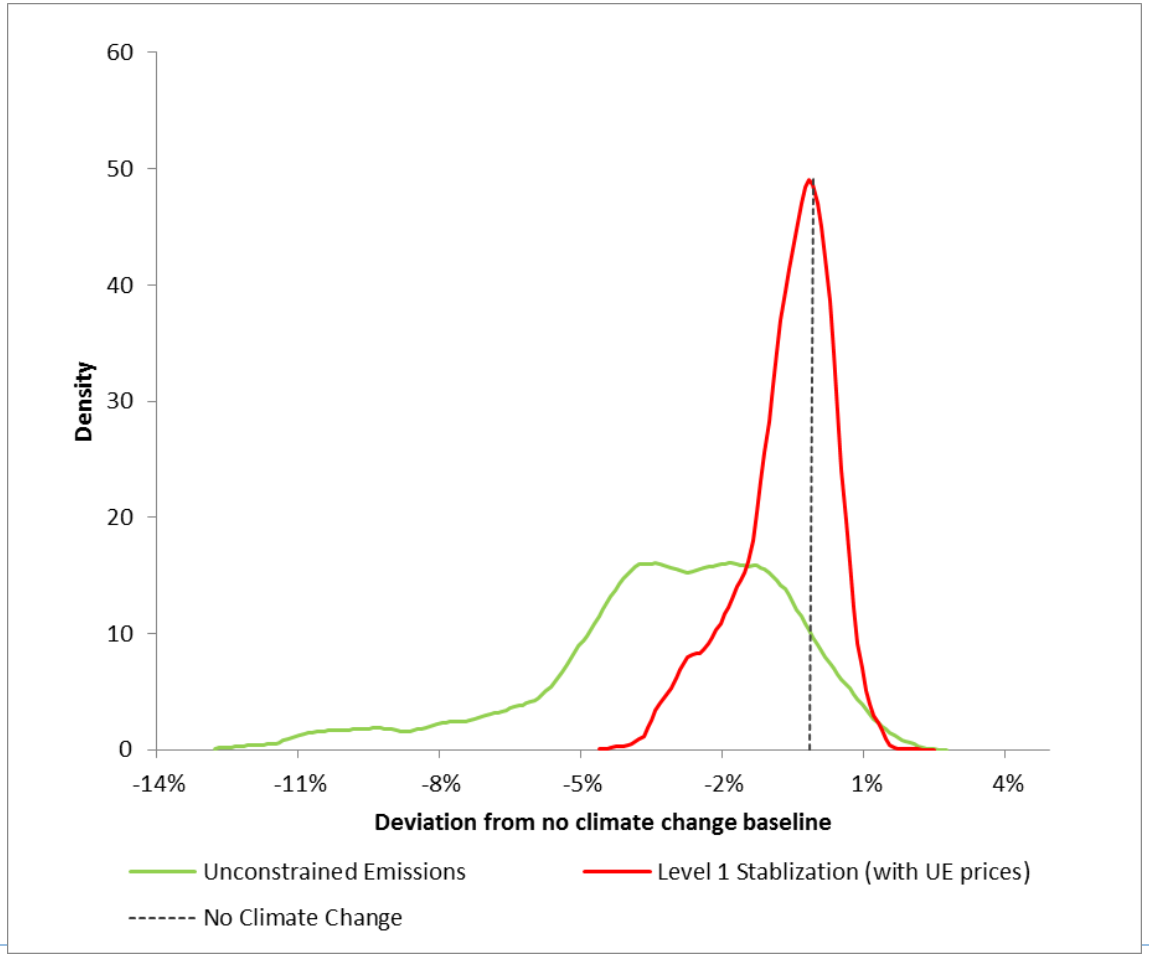
Mozambique: Flooding Projections



Mozambique: Implications for GDP in 2050 (1)



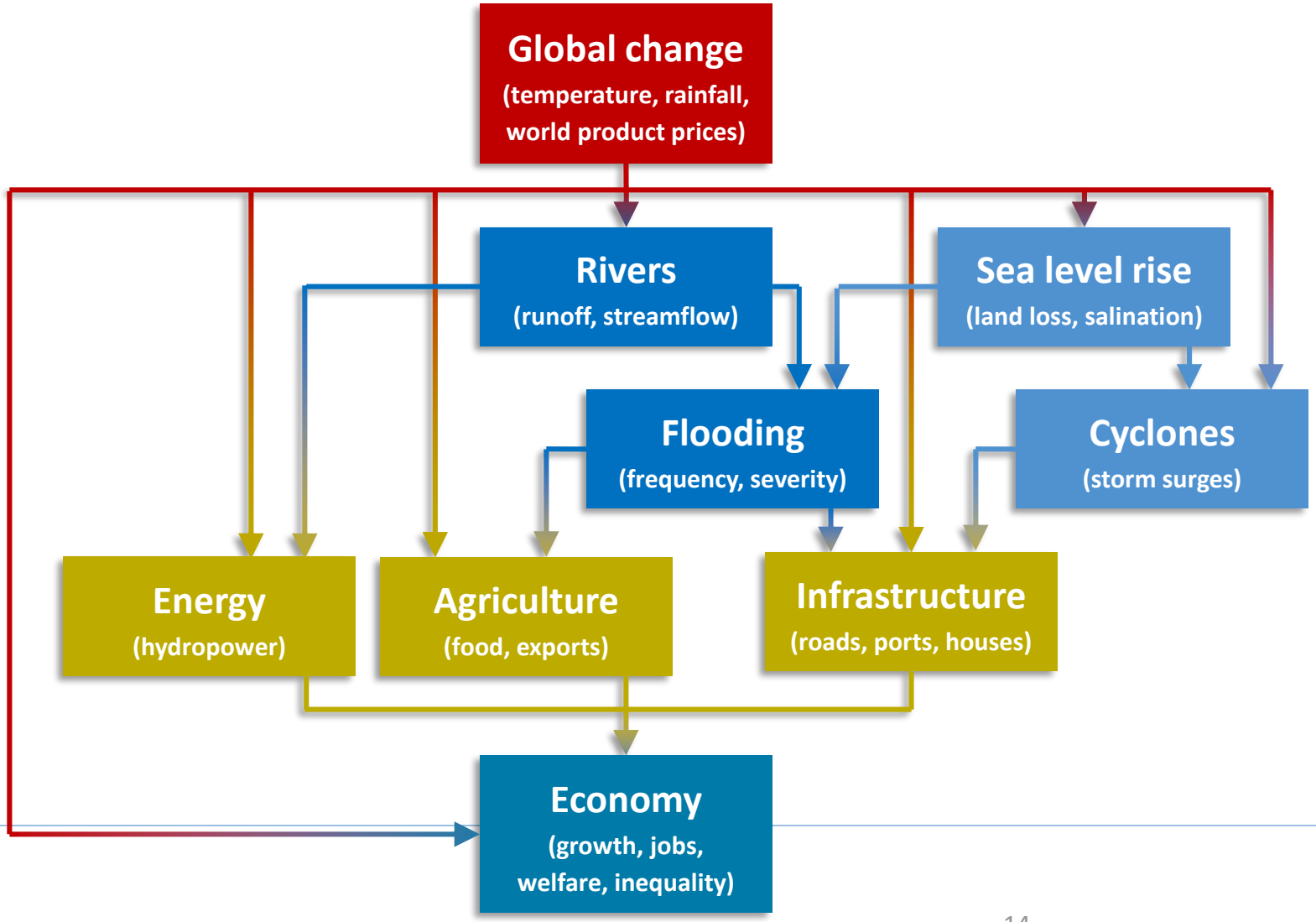
Mozambique: Implications for GDP in 2050 (2)



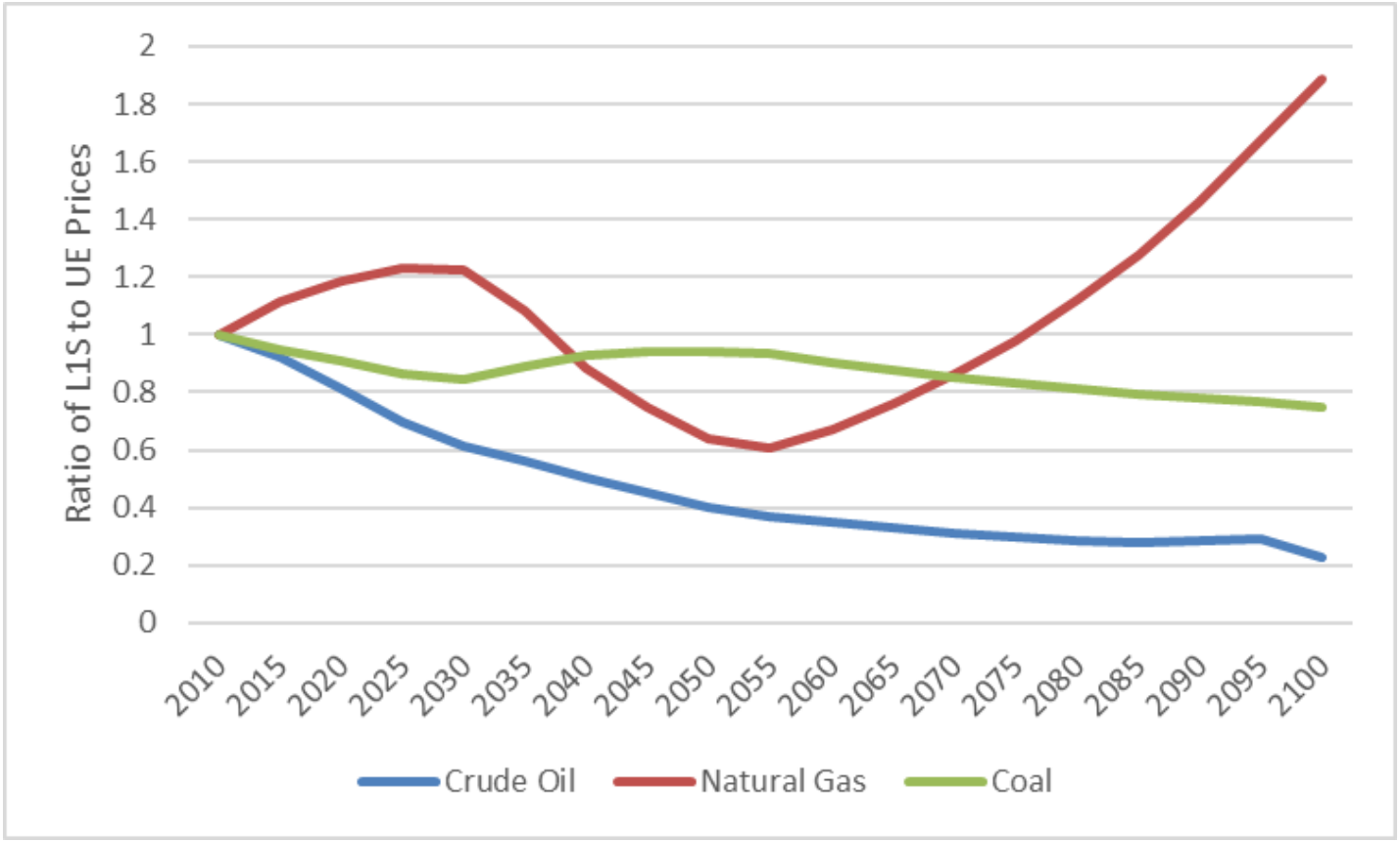
World Price Effects – Fossil Fuels

- The carbon budget that limits global temperature rises to two degrees Centigrade above pre-industrial levels corresponds to burning between 1/5th and 1/3rd of the world's proven reserves of oil, gas and coal (IPCC 2014)
- "If that estimate is even approximately correct, it would render the vast majority of reserves 'stranded' – oil, gas and coal that will be literally unburnable without expensive carbon capture technology, which itself alters fossil fuel economics" (Carney 2015).

Multi-Sector Modeling Framework



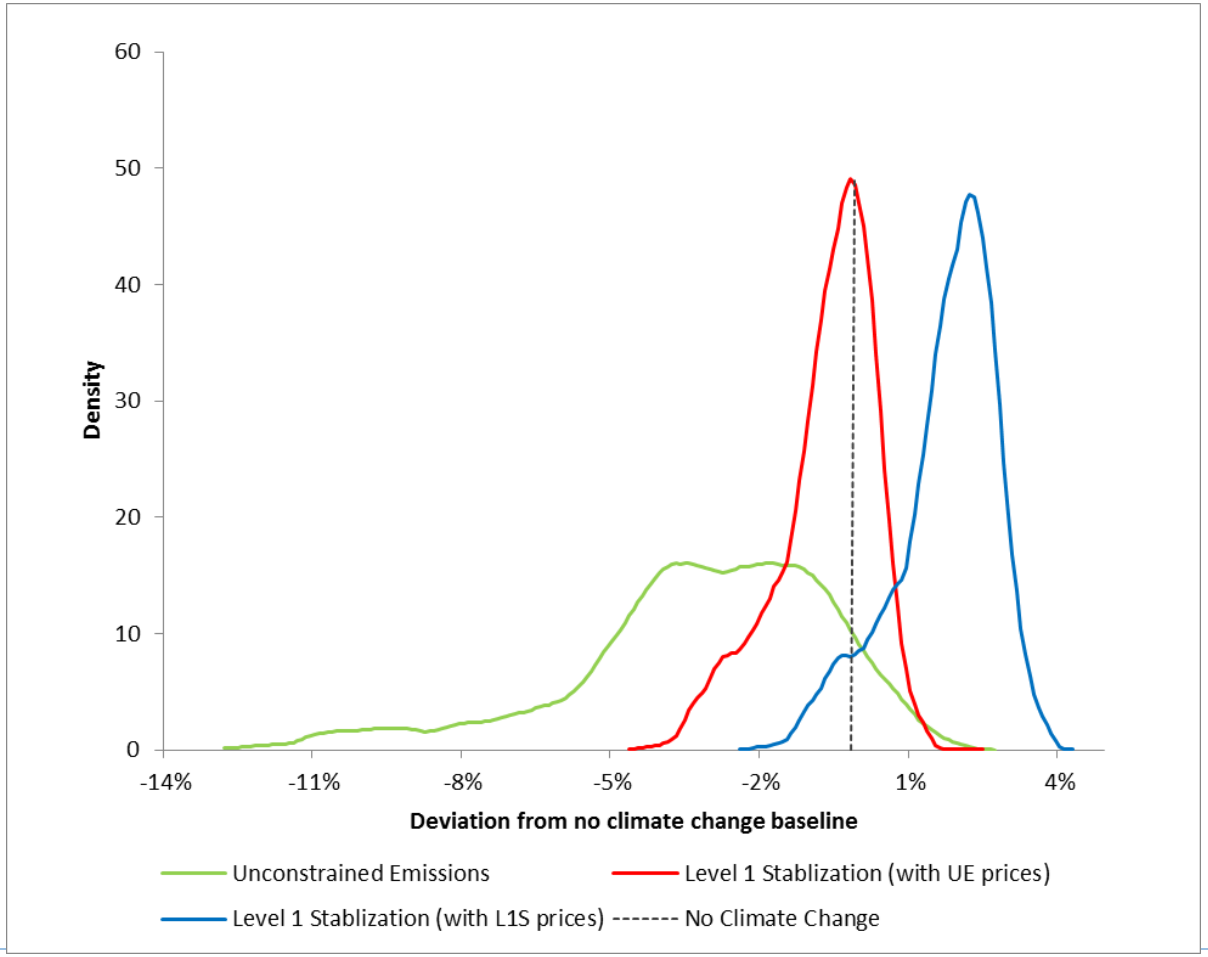
Fossil Fuel Producer Prices



Special and Differential Treatment

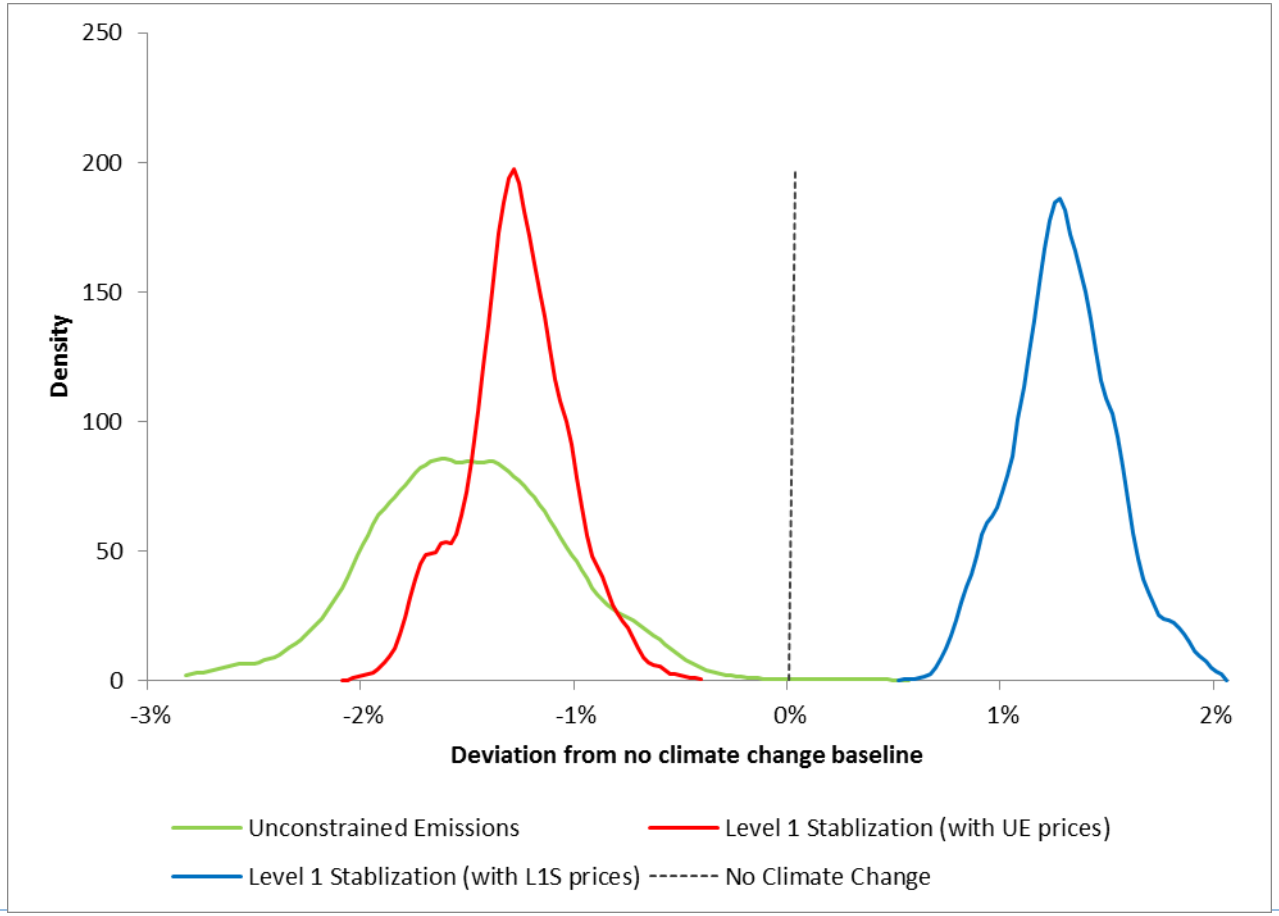
- The world successfully mitigates
- Our case economies are exempted from global mitigation policies
- We also abstract from recent natural gas and coal findings in Mozambique in all scenarios

Mozambique: Implications for GDP in 2050 (3)

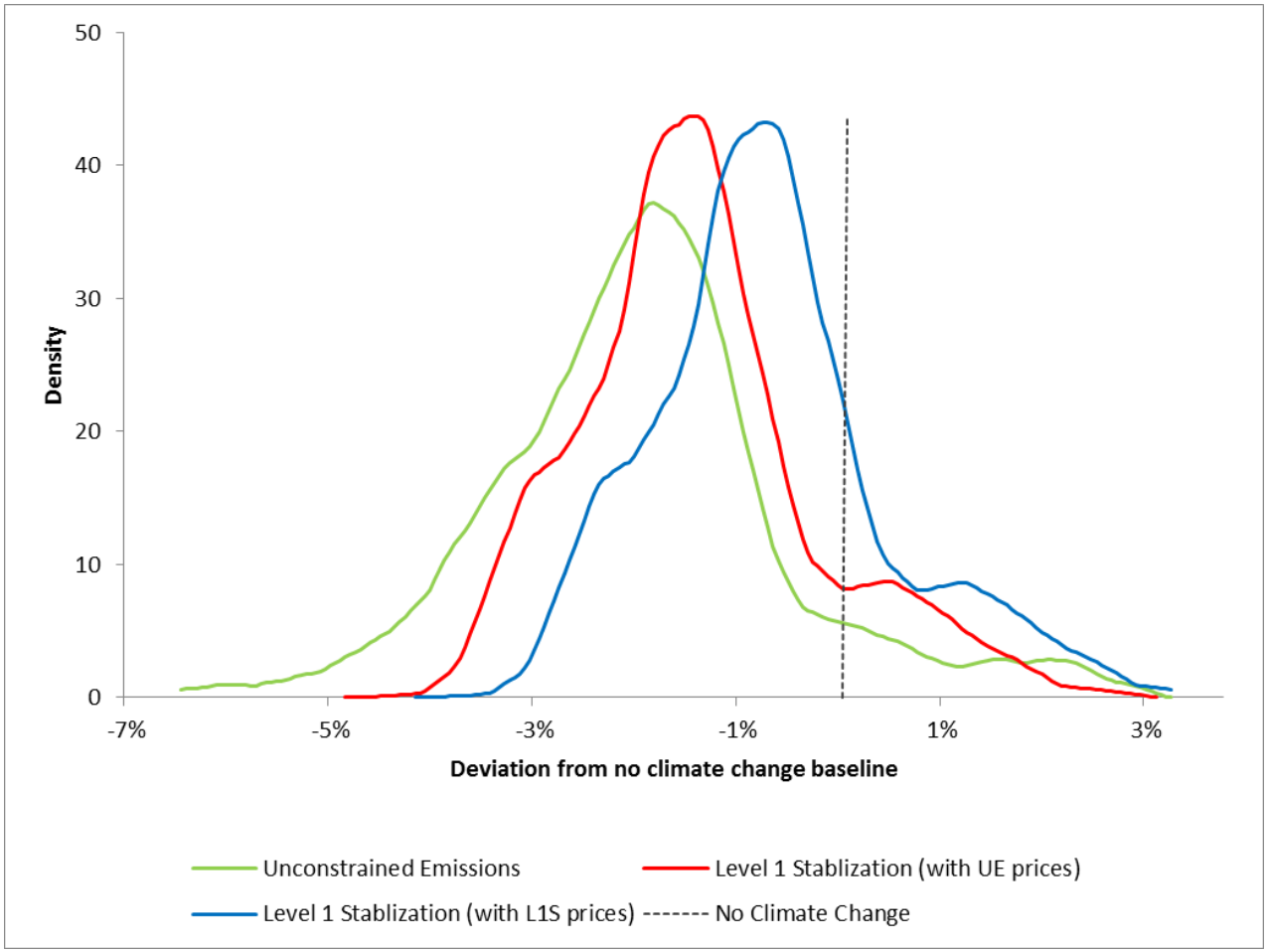


Also see: Arndt, C., M.A. Hussain, E.S. Jones, V. Nhate, F. Tarp, and J. Thurlow. "Explaining the Evolution of Poverty: The Case of Mozambique." *American Journal of Agricultural Economics*. 94(4) (2012): 854-872.

Malawi:
Implications for GDP in 2050



Zambia:
Implications for GDP in 2050



Conclusions

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Existing Literature

- **Hasegawa et al. (2018): "Risk of increased food insecurity under stringent global climate change mitigation policy."**
- **This result driven by:**
  - Relatively mild climate change impacts by 2050.
  - Bioenergy production competing with food production for fixed factors (land and water) and driving up food prices.
  - Emissions based constraints on agriculture "could also exacerbate rural poverty."

Comparison

Hasegawa et al

- Carbon taxes imposed
- Less detailed modeling of CC impacts
- Food price rises decrease food security
- Aggregation dampens fuel price effects

Arndt et al

- Exempted
- More detailed modeling of CC impacts
- Food price rises may improve food security
- Fuel price effects fully captured.