Nowcasting using International Futures

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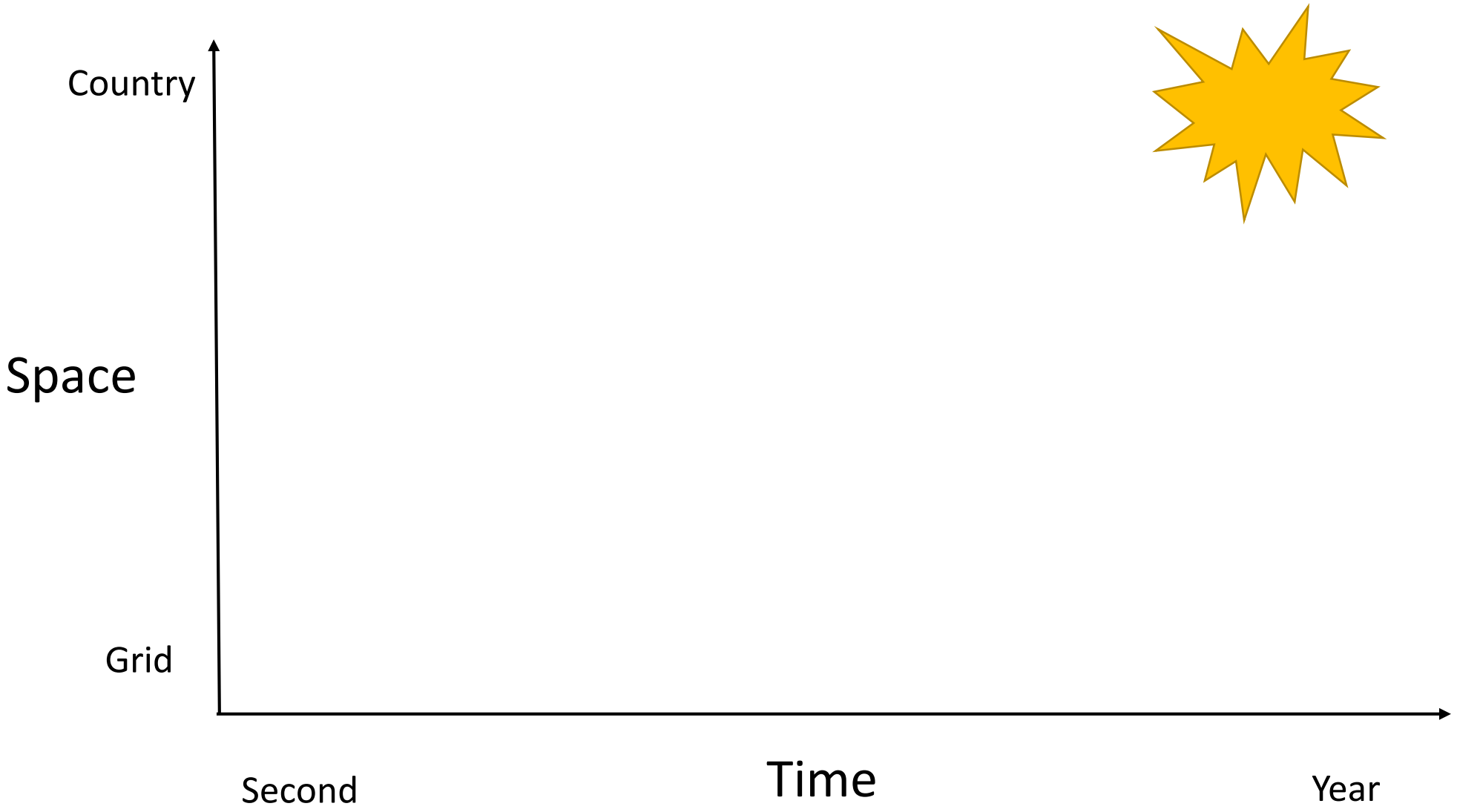
Outline

- Nowcasting and integrated assessment models
- International Futures
- Discussion

Integrated Assessment Models

- Explore the interaction across development systems, traditionally focused on questions related to environmental policy
- But other tools exist that more broadly represent development from an integrated perspective

Space-Time



International Futures

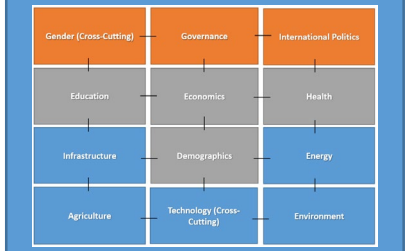
- Model forecasting hundreds of integrated variables for 186 countries to 2100
- Country level, sub-national, and bilateral models
- Structural model characterized by various quantitative methods connected in algorithmic frameworks
- Barry Hughes is founder—over 40 years of development

Data:

WDI, WTO, IMF, etc

Data Pre-Processor:

International Futures (forecasts from 20??-2100)



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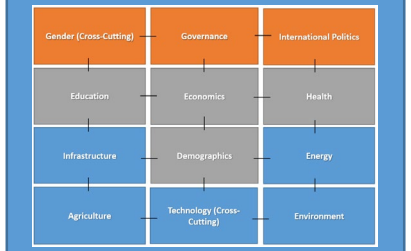

Historical Data

Now

Projection

Data:

WDI, WTO, IMF, etc

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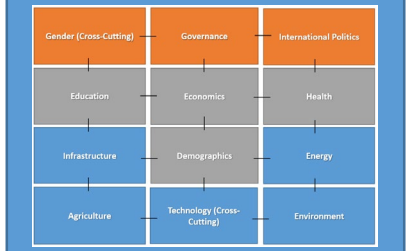

Historical Data

Last Year of Data

Nowcast

Projection

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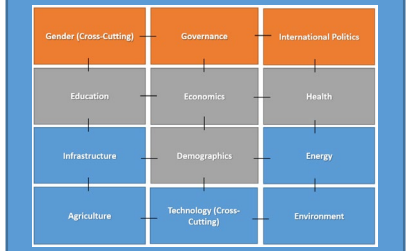


Last Year of Data

Nowcast

Historical Data

Projection

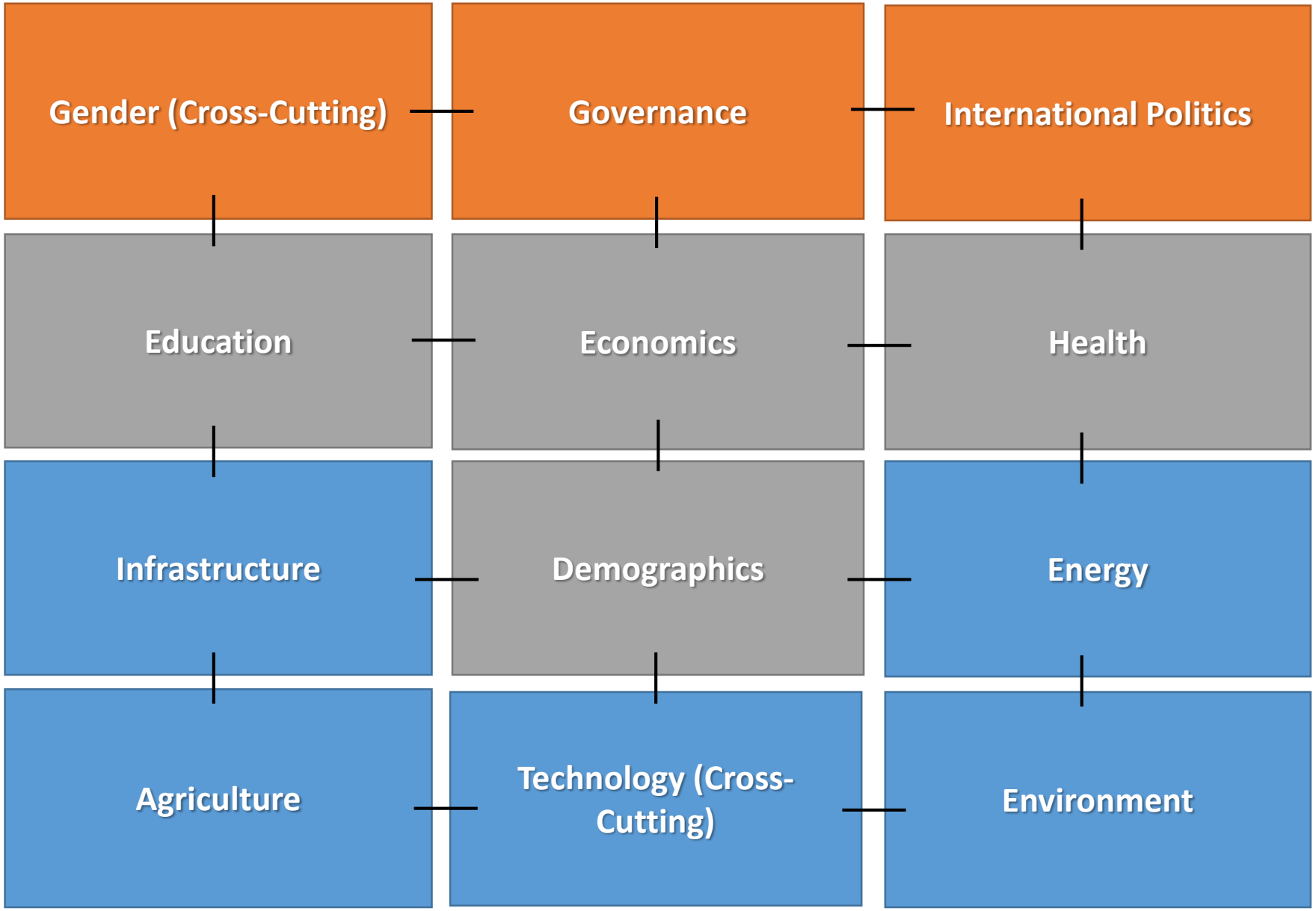
Pre-processor

- How do you initialize a model with 500 variables across multiple issue areas where data converge is inconsistent?
  - Seeding holes where possible
  - Estimating holes where necessary (cross-sectionally)
  - Balancing global sums (sometimes with iteration/optimization)
  - Using flows to calculate and estimate stocks
  - Extrapolation
- See documentation and model code

The IFs Model

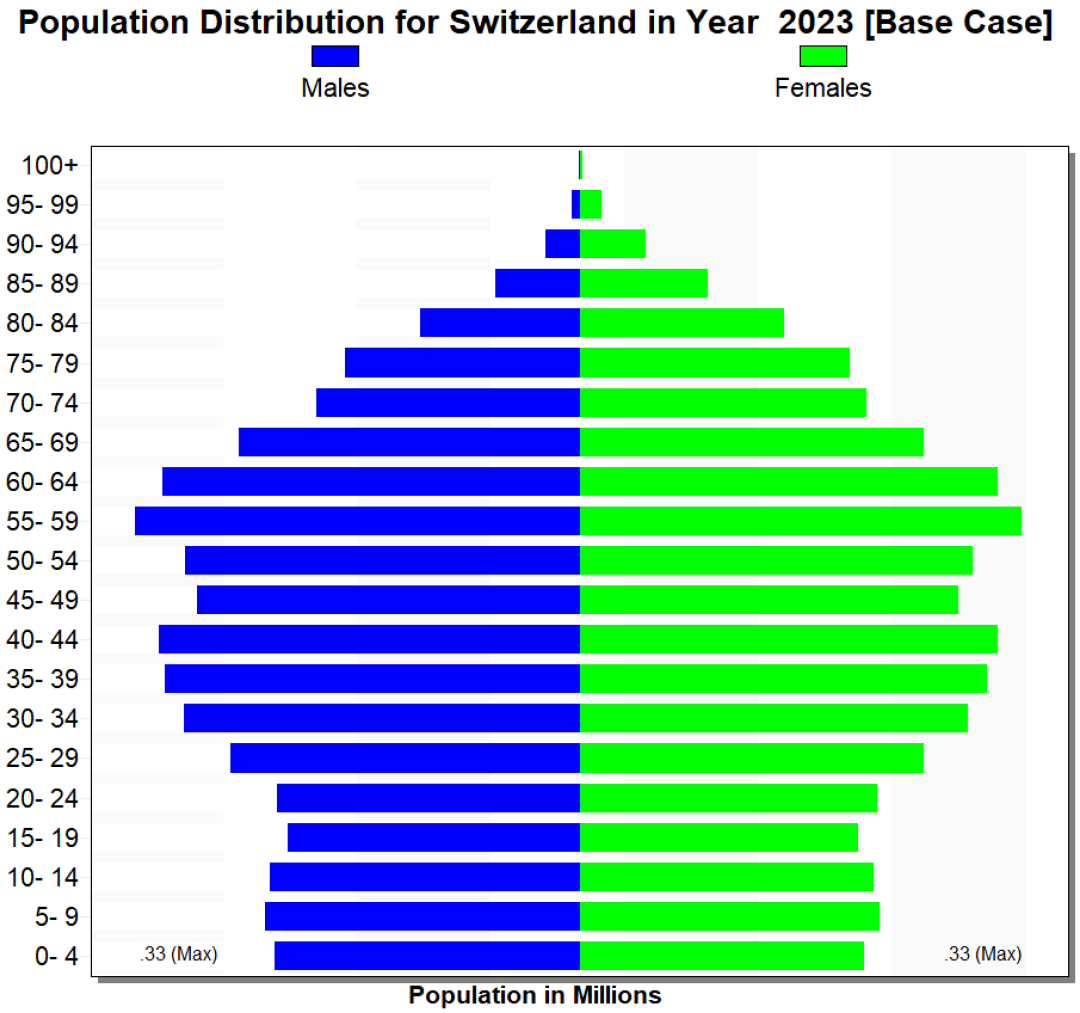
pardee.du.edu

International Futures (IFs)



The IFs Model: Demographics

- Standard age-sex cohort component model
- Endogenous fertility, mortality, migration



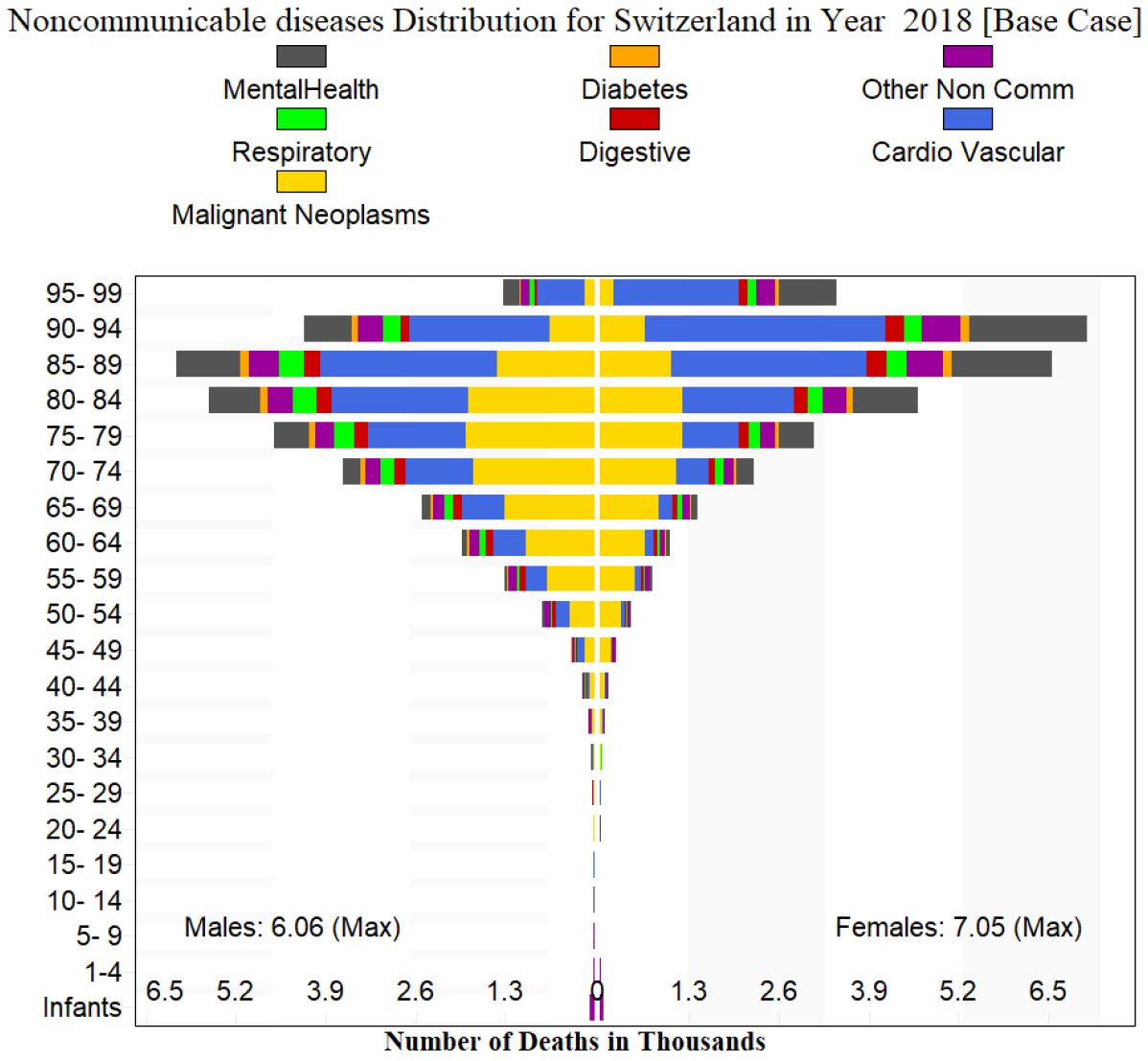
The IFs Model: Economics

- Input-output table embedded in social accounting matrix, endogenized productivity across four broad categories
- Bilateral trade by sector, tariffs by sector

SAM	Working File	Sectors						Households			Firms		
Switzerland	2018	Agriculture	Energy	Materials	Manufacture	Services	ICTech	Unskilled	Skilled	Total	Firms	FDI Outflow	E O
Sectors	Agriculture	11.21239	0.00081	0.03461	2.30314	4.05694	0.02753	10.5907	13.1428	-0.9359			
	Energy	0.3006	0.0428	0.61132	8.31259	2.45464	0.18813	0.7005	0.8693	-8.1214			
	Materials	0.60331	0.00574	12.1039	22.52321	2.10199	1.32287	0	0	-5.4016			
	Manufactures	1.76082	0.04664	2.15845	47.78333	27.71385	2.85239	10.8297	13.4394	4.4873			
	Services	3.17901	0.02825	2.15403	19.06065	63.66908	5.03946	131.4138	163.0813	7.6962			
	ICTech	0.08469	0.00257	0.12176	1.80394	5.17458	7.50719	28.1633	34.95	2.275			
Households	Unskilled	3.5687	0.2964	4.2202	67.7643	102.1881	11.452				3.9939		
	Skilled	2.053	0.4002	4.1416	46.9383	182.6533	15.6438				35.9448		
	Total										39.9387		
Firms	FDI Inflow												
	Equity Inflow												
	Value Added	4.4543	0.552	6.6254	90.8837	225.6918	21.4691						
Capital	Capital							32.0631	69.729	0	133.5785		
Government	Income Tx							29.2601	38.8864	68.1464			
	Soc Sec Tx							21.5726	28.6698	50.2425	39.8092		
	Corp/Bus Tax										16.5705		
	Indirect Tax										76.7307		
	Aid Receipts												
	World Bank												
	IMF Credits												
ROW	ROW	17.9686	4.9946	8.055	262.1537	107.2161	22.4132					55.3878	

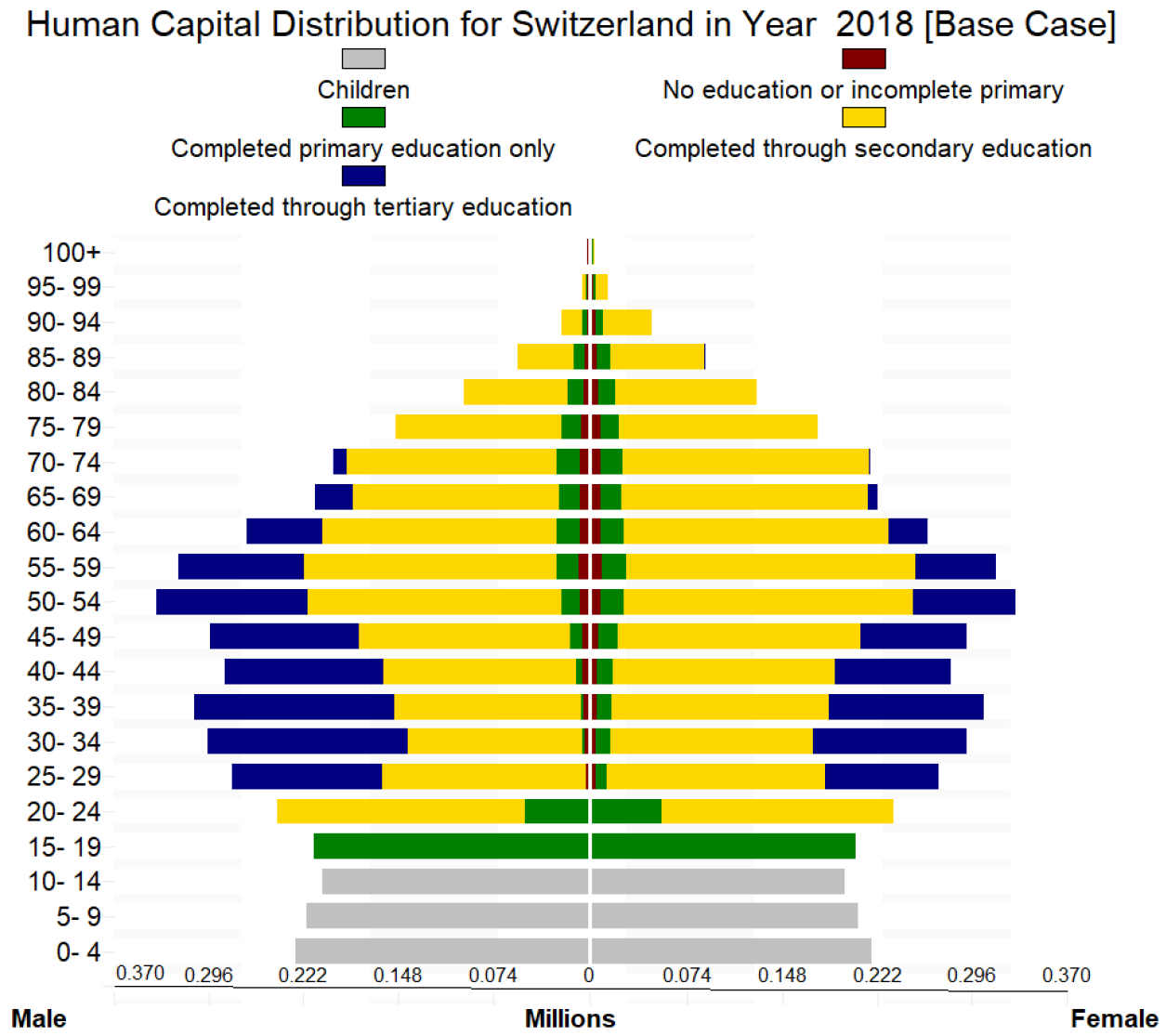
The IFs Model: Health

- Mortality and morbidity by age/sex
- Relative risk tables across 21 categories
- Undernutrition, stunting, obesity, smoking, urban air pollution, cookstoves, water and sanitation



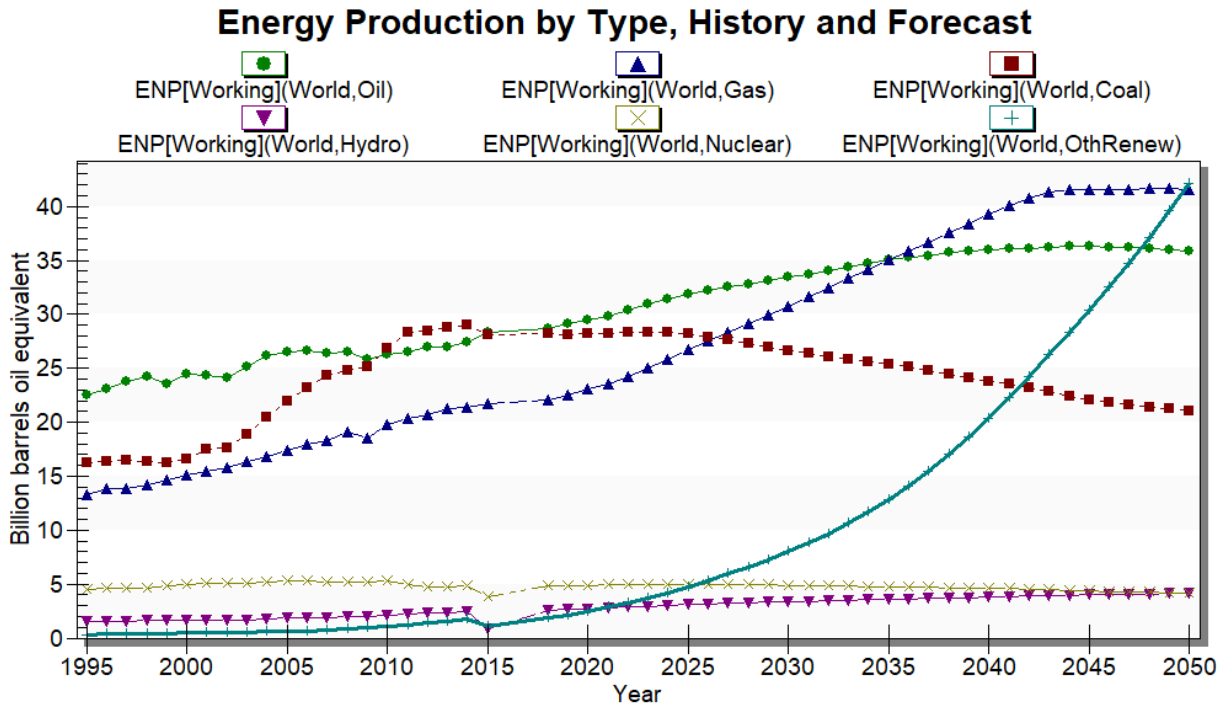
The IFs Model: Education

- Enrollment by level by sex
- Quality by level by sex by reading/math
- Connected to government finance



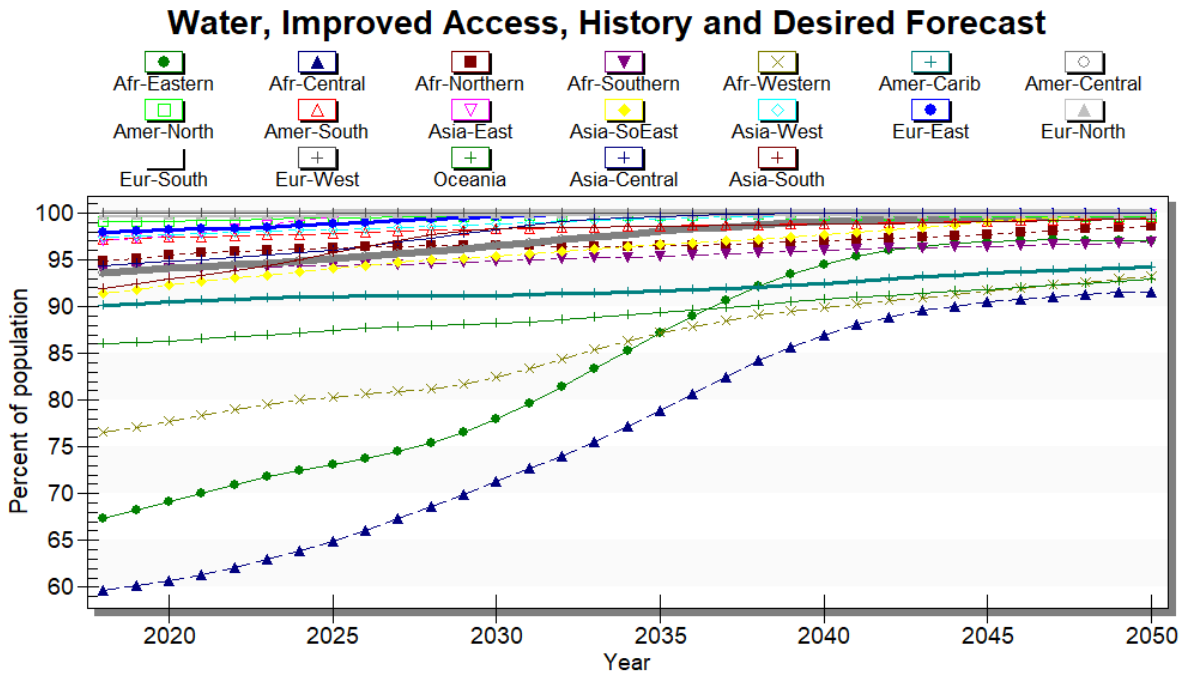
The IFs Model: Energy

- Production/consumption by oil, gas, coal, hydro, nuclear, renewable



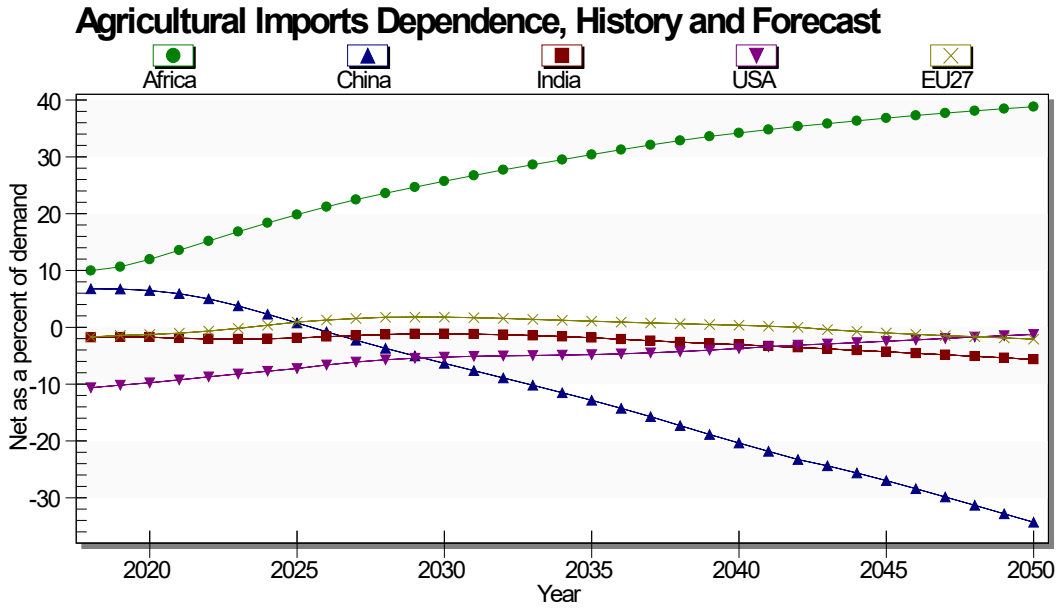
The IFs Model: Infrastructure

- Supply/demand for electricity production, access, roads (paved/unpaved), water and sanitation, and ICT
- Connected to public/private finance



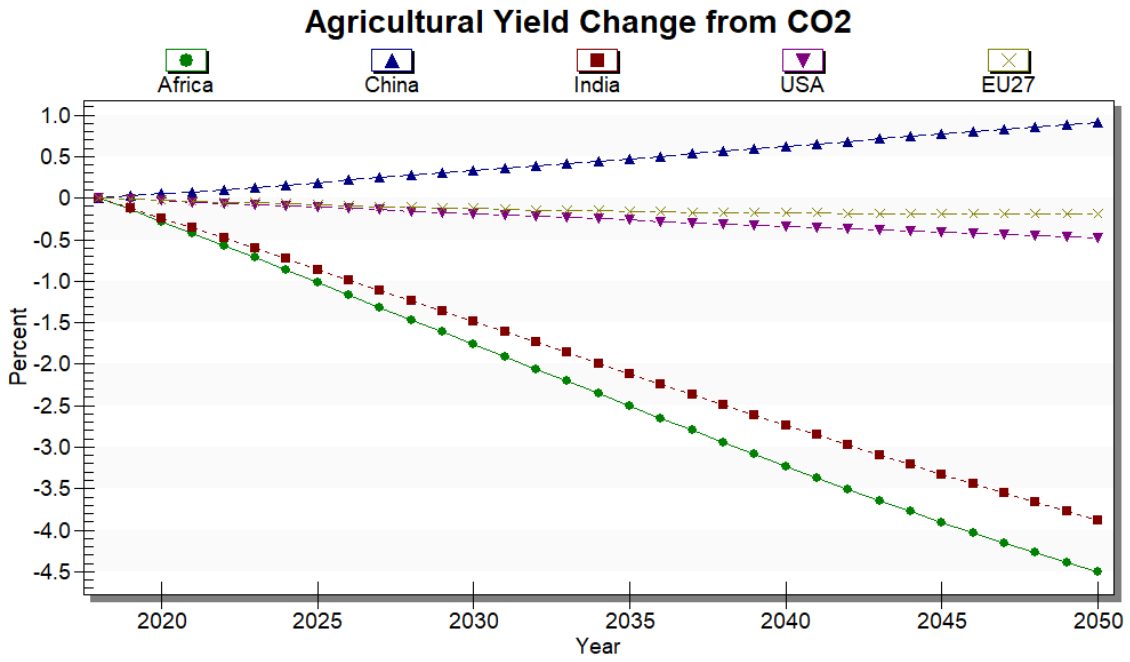
The IFs Model: Agriculture

- Land use, production (fish, meat, crop), loss, trade
- Connected to food security issues (imports, calories available)



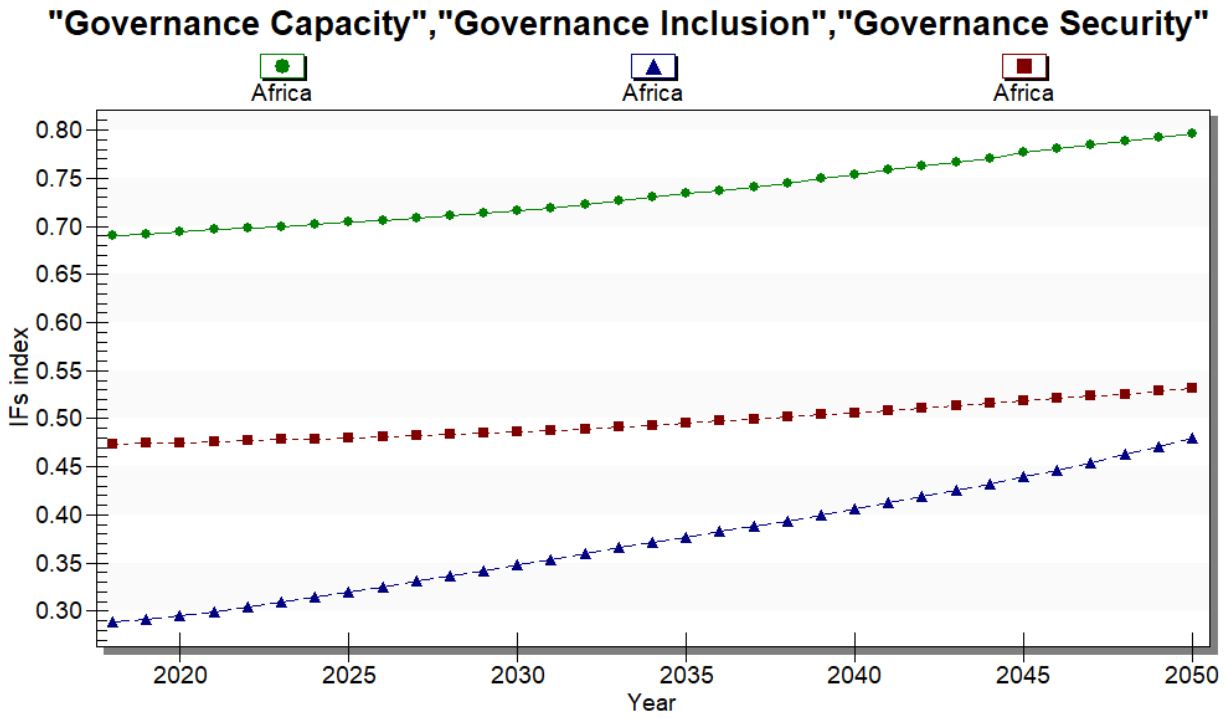
The IFs Model: Environment

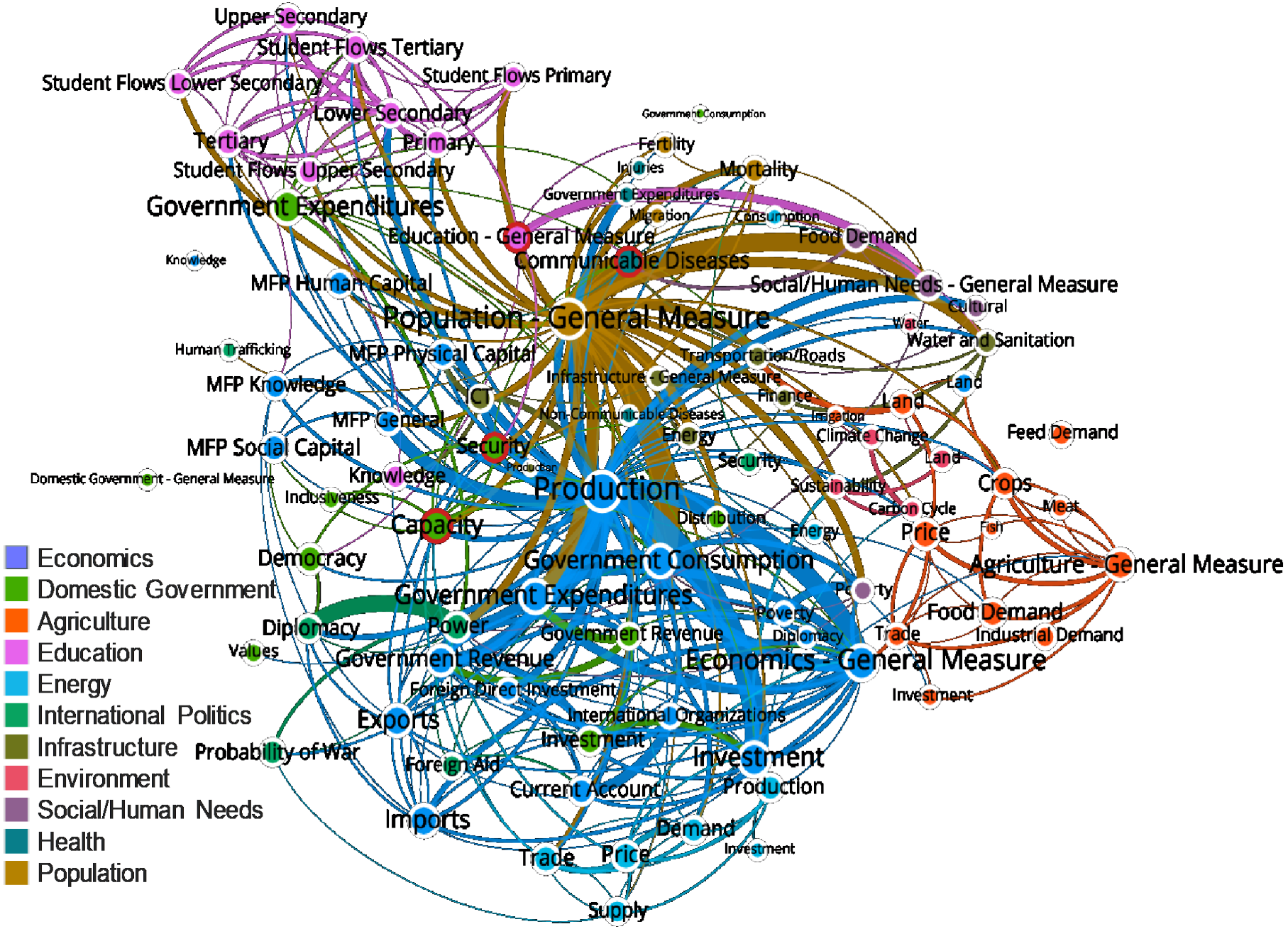
- Carbon cycle
- Impacts productivity and agriculture production
- Multiple measures of adaptive capacity to climate change



The IFs Model: Governance

- Conflict (international and domestic)
- Capacity (government revenue, corruption, effectiveness)
- Inclusion (gender, democracy)




Upper Secondary
Student Flows Tertiary
Student Flows Lower Secondary
Student Flows Primary
Lower Secondary
Tertiary
Primary
Student Flows Upper Secondary
Government Expenditures
Education - General Measure
Knowledge
MFP Human Capital
Population - General Measure
Human Trafficking
MFP Physical Capital
MFP Knowledge
ICT
MFP General
MFP Social Capital
Security
Domestic Government - General Measure
Knowledge
Inclusiveness
Production
Capacity
Democracy
Diplomacy
Values
Government Expenditures
Power
Government Revenue
Probability of War
Foreign Aid
Exports
Imports
Current Account
Trade
Price
Supply
Demand
Investment
Production
Foreign Direct Investment
International Organizations
Investment
Government Consumption
Fertility
Injuries
Mortality
Government Expenditures
Migration
Consumption
Food Demand
Communicable Diseases
Social/Human Needs - General Measure
Cultural
Water
Water and Sanitation
Transportation/Roads
Infrastructure - General Measure
Finance
Land
Irrigation
Non-Communicable Diseases
Energy
Climate Change
Feed Demand
Security
Land
Sustainability
Crops
Carbon Cycle
Meat
Distribution
Energy
Price
Fish
Government Consumption
Agriculture - General Measure
Poverty
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Poverty
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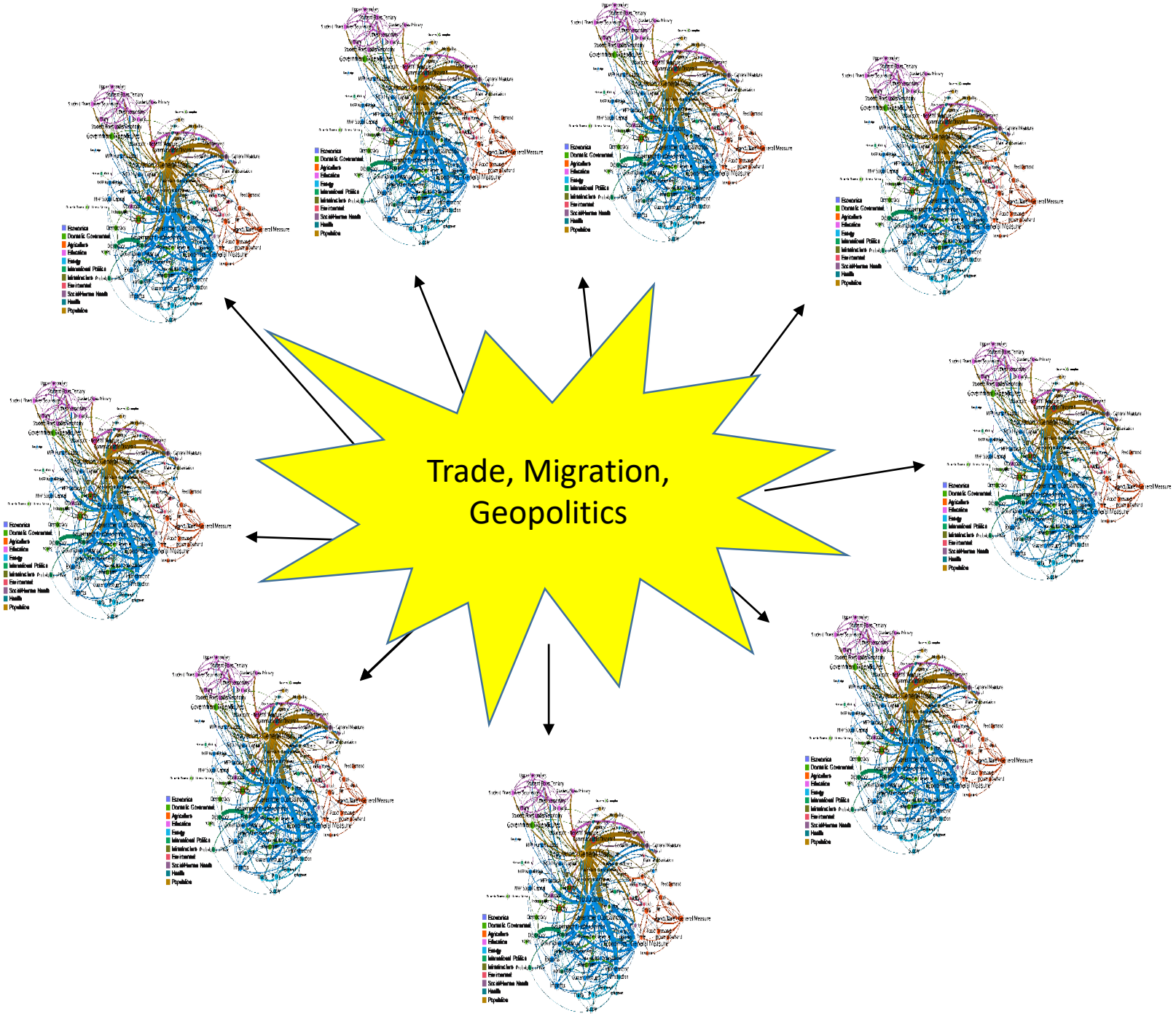
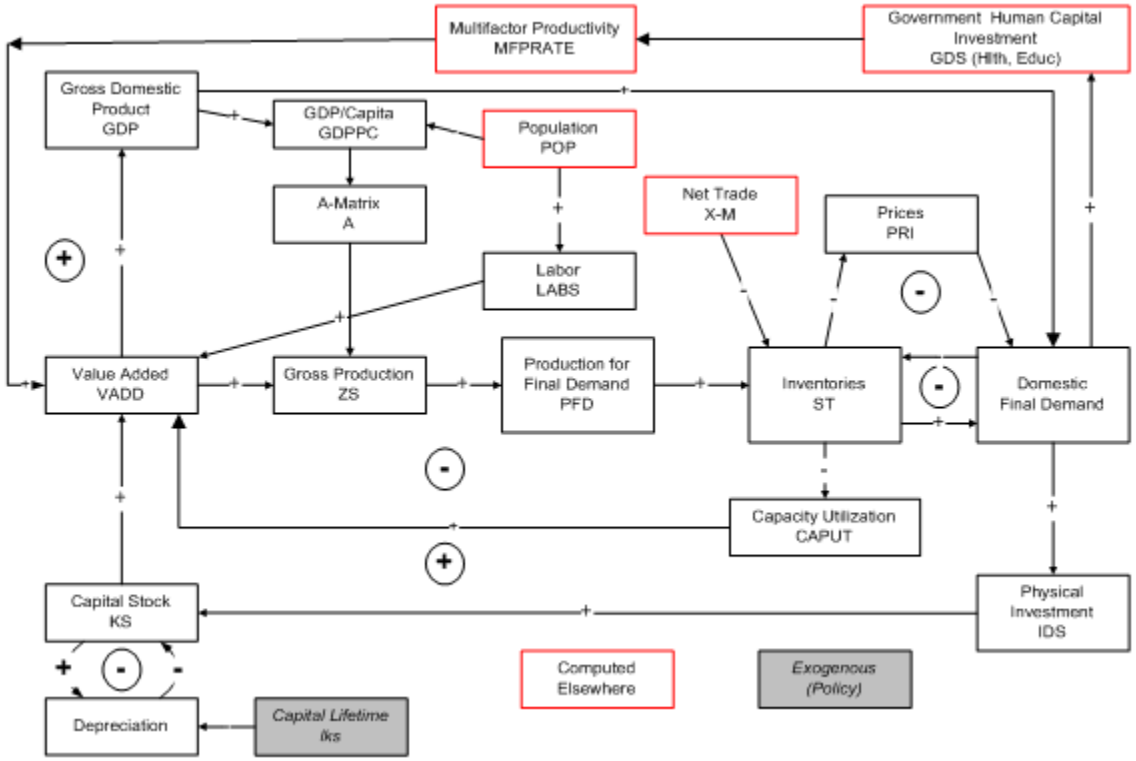

Trade, Migration,
Geopolitics

The IFs Model

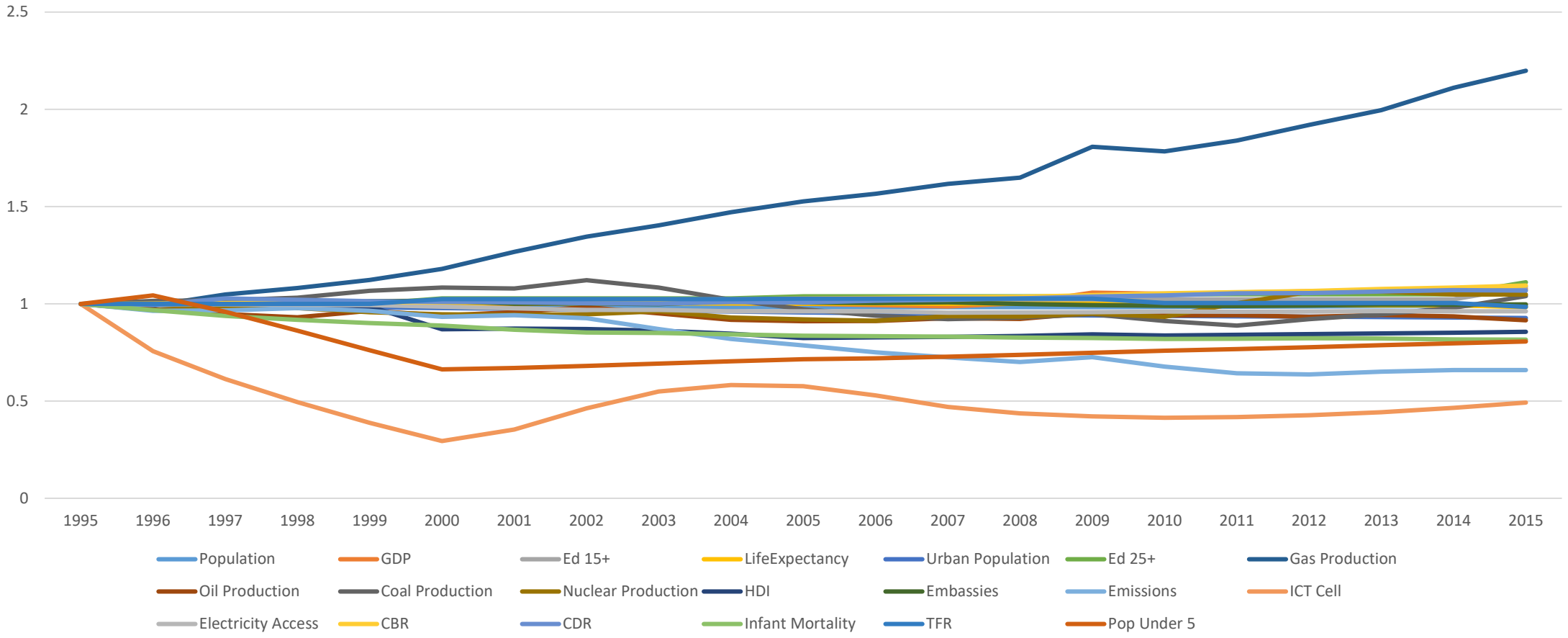
- Documentation:
  - Wiki: pardee.du.edu/wiki



$$VADDP_{r,s} = CDA_{r,s,t=1} * TEFF_{r,s} * CAPUT_{r,s} * KS_{r,s}^{CDALFS_{r,s}} * LABS_{r,s}^{(1-CDALFS_{r,s})}$$

$s = 3, 4...nsectr$ or $s = 1, 2...nsectr$

Validation from 95-15



Example 1: Severe Acute Malnutrition

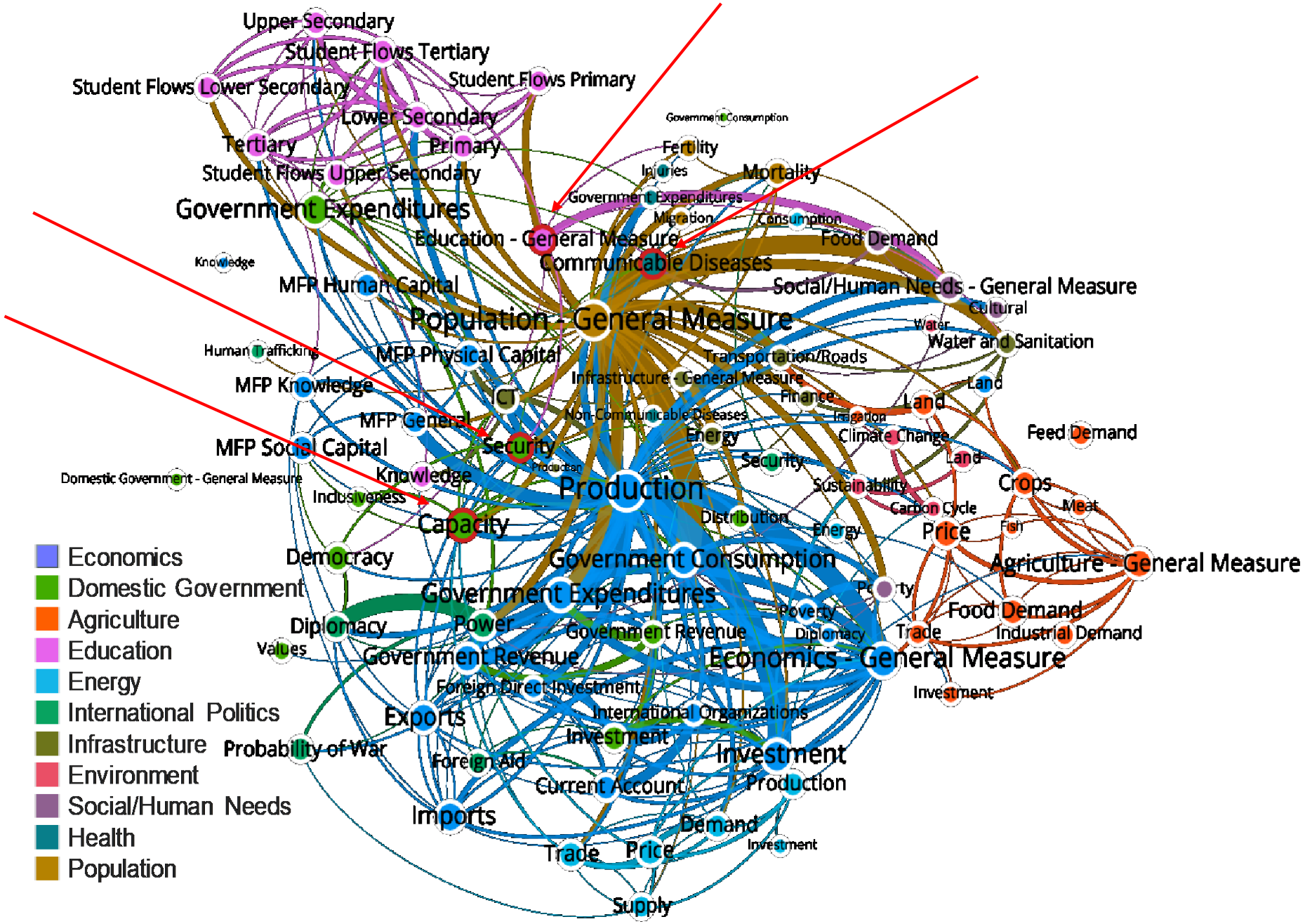
- Data exist across multiple sources
- Many nulls
- Temporal coverage varies significantly

Estimate drivers

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Education	-0.155**	-0.177***	-0.176**	-0.187***	-0.168***	-0.0983*	-0.103**
	(0.004)	(0.000)	(0.003)	(0.000)	(0.000)	(0.010)	(0.005)
GDP Per Capita	-0.0318						
	(0.468)						
Poverty	-0.00195						
	(0.727)						
Sanitation			0.000408				
			(0.936)				
Safe Water				0.00343			
				(0.635)			
Calories Per Capita					-0.000108		
					(0.715)		
Gender Gap						-0.0940	
						(0.325)	
Transparency						-0.290*	-0.306**
						(0.012)	(0.007)
Conflict						0.121**	0.114**
						(0.003)	(0.004)
Constant	-2.518***	-2.608***	-2.653***	-2.841***	-2.395**	-2.592***	-2.455***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Observations	98	98	88	88	88	107	107
AIC	-451.7	-455.1	-404.4	-404.7	-404.6	-584.8	-585.8
BIC	-441.4	-449.9	-397.0 1	-397.2	-397.1	-571.5	-575.1
R^2	0.623	0.621	0.621	0.622	0.621	0.714	0.711
ll	229.8	229.5	205.2	205.3	205.3	297.4	296.9
dev	-459.7	-459.1	-410.4	-410.7	-410.6	-594.8	-593.8

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$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Non-Communicable Diseases
Irrigation
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Energy
Climate Change
Feed Demand
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Security
Land
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Knowledge
Production
Sustainability
Crops
Inclusiveness
Carbon Cycle
Meat
Capacity
Distribution
Energy
Price
Fish
Democracy
Government Consumption
Agriculture - General Measure
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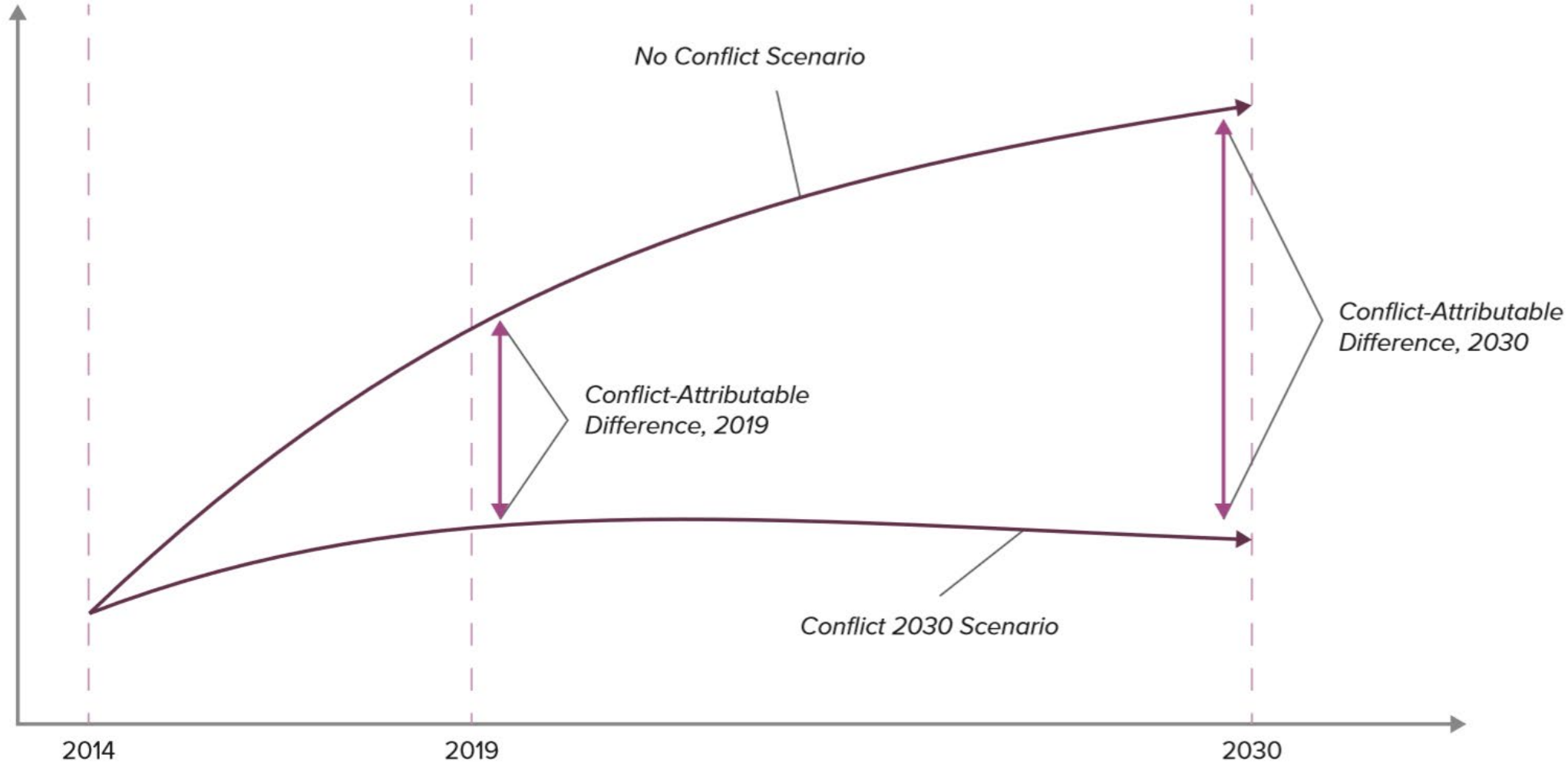
Food Demand
Diplomacy
Power
Government Revenue
Diplomacy
Trade
Industrial Demand
Values
Government Revenue
Economics - General Measure
Foreign Direct Investment
Investment
International Organizations
Exports
Investment
Probability of War
Foreign Aid
Investment
Current Account
Production
Imports
Demand
Trade
Price
Investment
Supply
Economics
Domestic Government
Agriculture
Education
Energy
International Politics
Infrastructure
Environment
Social/Human Needs
Health
Population

Need to estimate IVs:

- Education: connected to the education pipeline
- Transparency: Simple relationship with GDP per capita
- Conflict: driven by variables identified in the quantitative literature (Goldstone et al 2010)

Example 2: Yemen during conflict

FIGURE 4 | *Illustration of a "conflict-attributable" difference in this analysis. The "conflict-attributable" impact on a particular indicator is the difference between the indicator value in the No Conflict scenario and a scenario that includes conflict.*



2019 IMPACT

If the conflict were to end in 2019, it would account for:

233,000 DEATHS (0.8 per cent of the 2019 population) with 102,000 combat deaths and 131,000 indirect deaths due to lack of food, health services and infrastructure

1 CHILD DEATH every 11 minutes and 54 seconds in 2019

140,000 deaths of children under the age of five

13.4M YEARS years of the population living with malnutrition (17 per cent of the total population in 2019)

44M YEARS of people living in extreme poverty (40 per cent of the 2019 population)

1.6M YEARS of children living with malnutrition (14 per cent of the 2019 child population)

10.3M YEARS of children without access to schools (36 per cent of school-aged children in 2019)

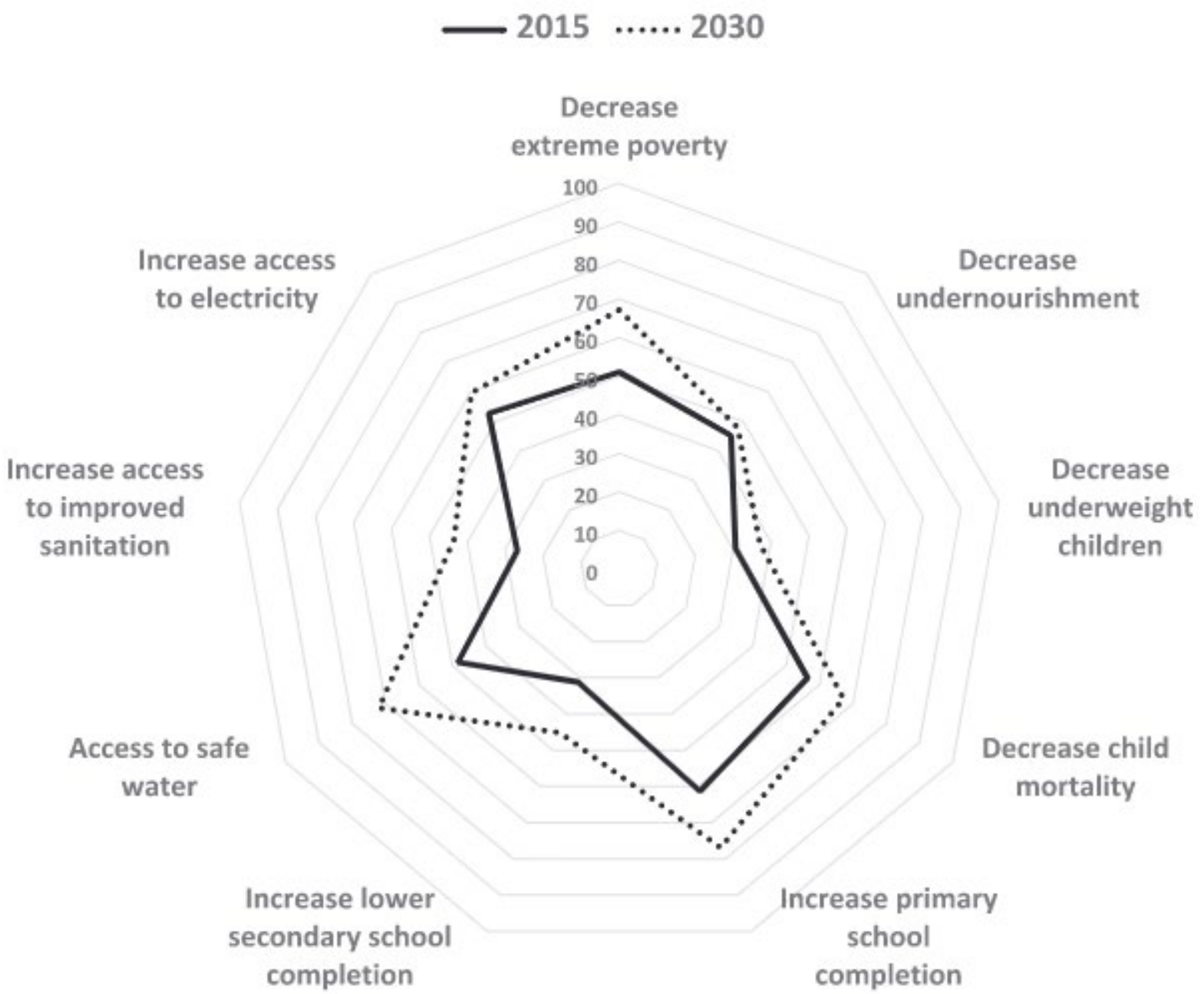
US $89B loss in economic output

&

US $2,000 reduction in Gross Domestic Product (GDP) per capita (at Purchasing Power Parity (PPP))

Example 3: SDGs

Results:

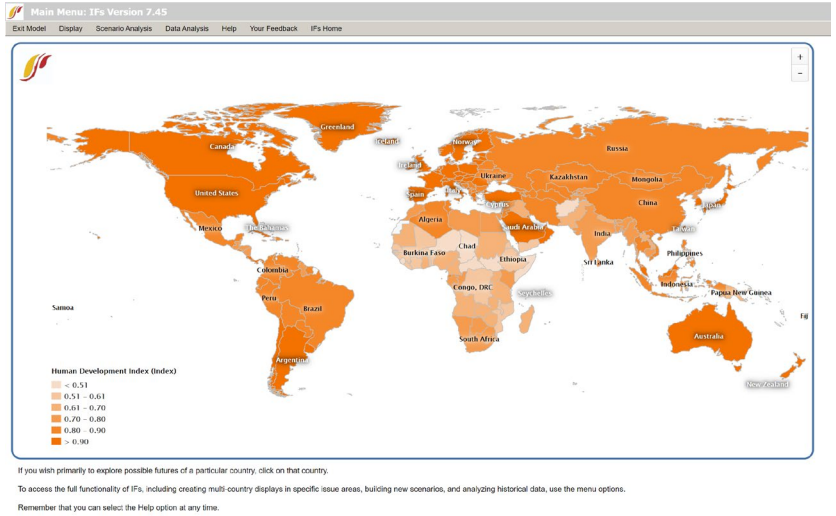

2015
2030
Decrease extreme poverty
Decrease undernourishment
Decrease underweight children
Decrease child mortality
Increase primary school completion
Increase lower secondary school completion
Access to safe water
Increase access to improved sanitation
Increase access to electricity
100
90
80
70
60
50
40
30
20
10
0

Discussion

Uncertainty and epistemological limits:

“…all models are wrong but some are useful”
-Someone Smart

Conclusion



- Open and transparent tool: pardee.du.edu
- Academic research center
- Collaborations with lots of international organizations, UN and AU
- Lots of data and model-based resources to share
- Next model steps focus on forecasting networks and sub-national analysis

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