

Macroeconomic and Distributional Implications of Shocks and Policies Affecting the Provision of Environmental Goods and Services: A Modeling Approach.

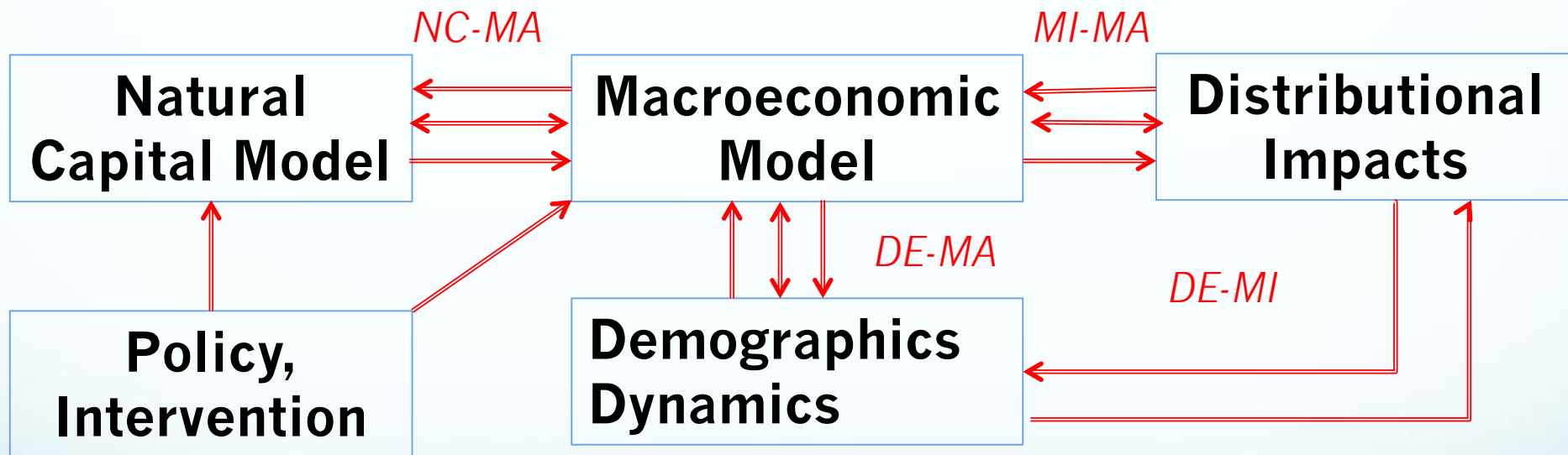
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*Prepared for Workshop on Green Growth Modeling,
Advanced Systems Analysis (ASA) and Risk and Resilience (RISK),
International Institute for Applied System Analysis (IIASA).
Schloss Laxenburg, Austria. July 18th, 2017*

Agenda

- Conceptualization
- Ecological Models
- Macroeconomic Models
- Micro, Distributional Impacts Models
- Demographics
- Model Examples

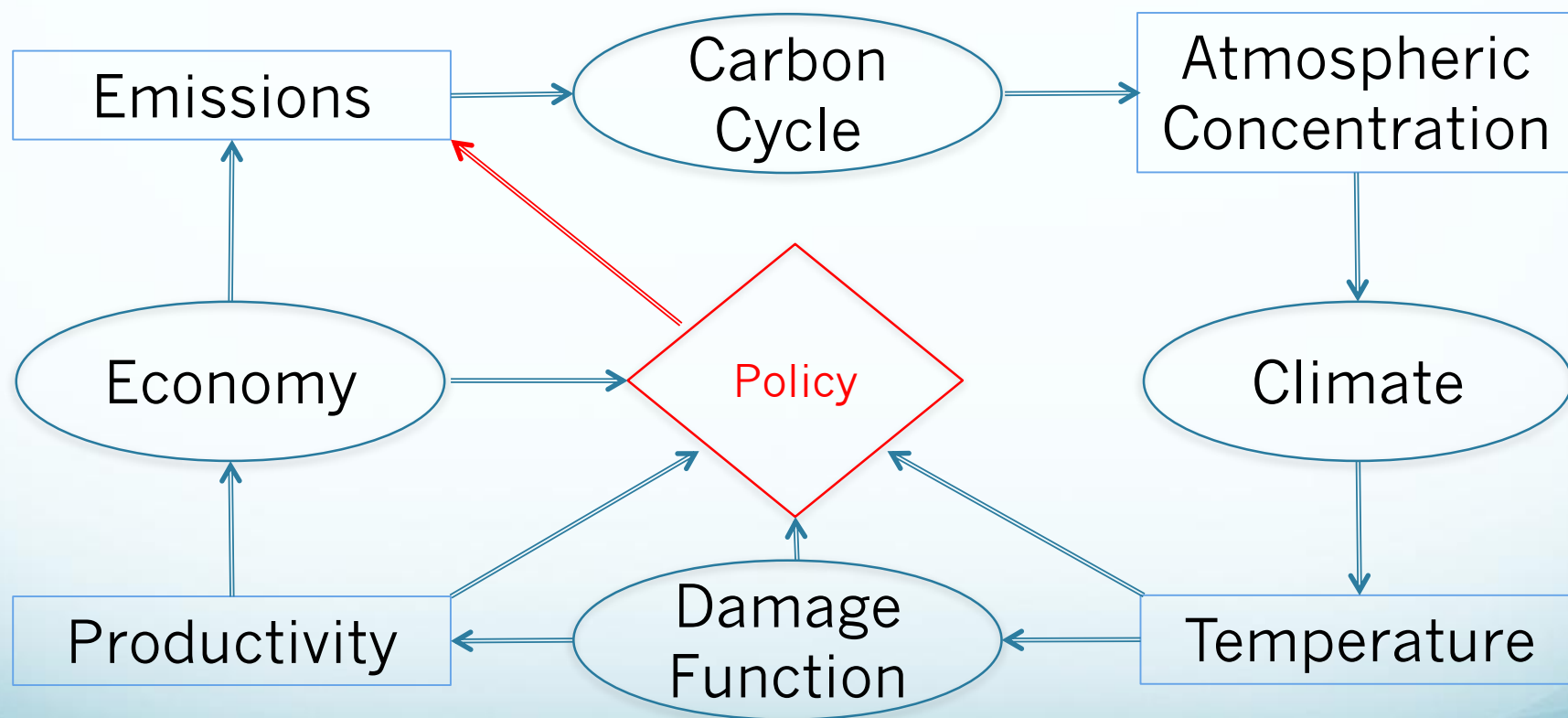
Thinking About Models for Linking Natural Capital and the Socio-Economic



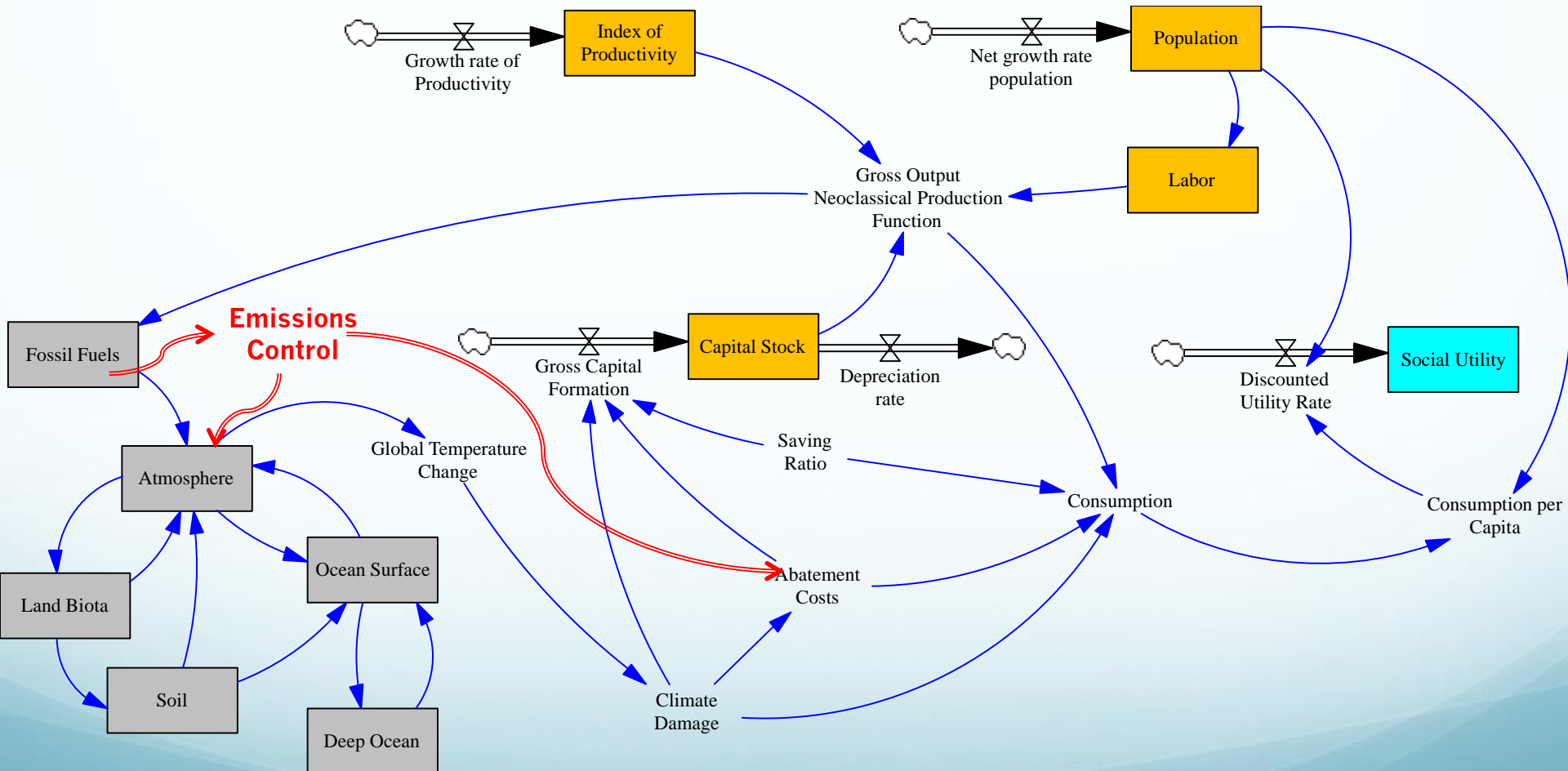
Linking Natural Capital and the Macro Economy

- **NatCap → Macro** : Impacts of Natural Capital Depletion, Pollution, Emissions on Factor Productivity, Input and factor supply (e.g. Jorgeson IGEM)
- **Macro → NatCap** : Impacts of Economic Activity on Pollution, Emissions, Natural Capital Depletion
- **NatCap → Macro**: Integrated Assessment Methods (e.g. Nordhaus DICE, RICE Models; World Bank's ENVISAGE)

Feed Backs: Economy and Climate

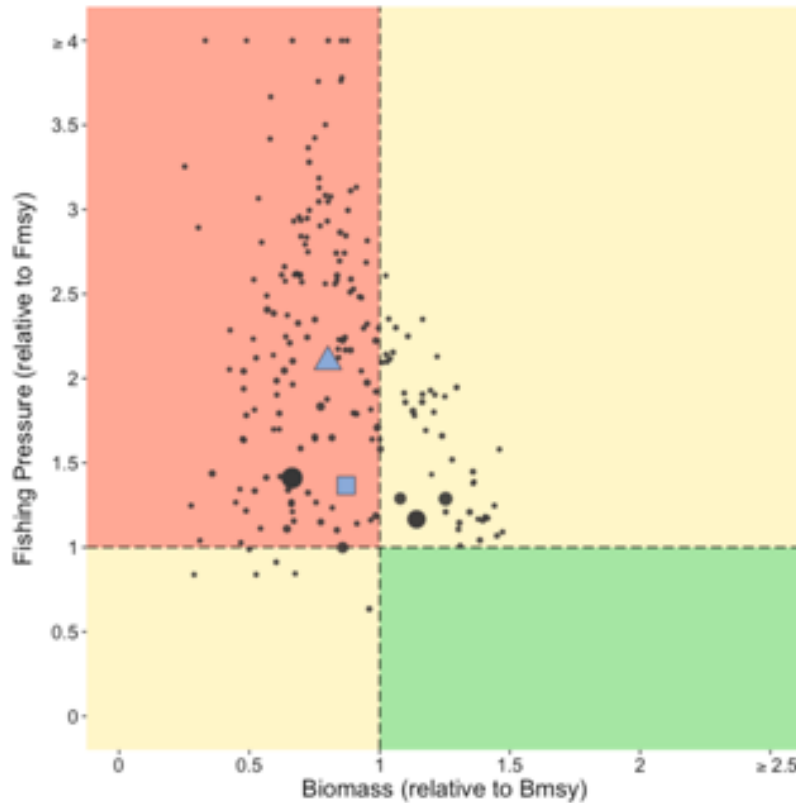


High Schematic Diagram for DICE Model



Ecological Model

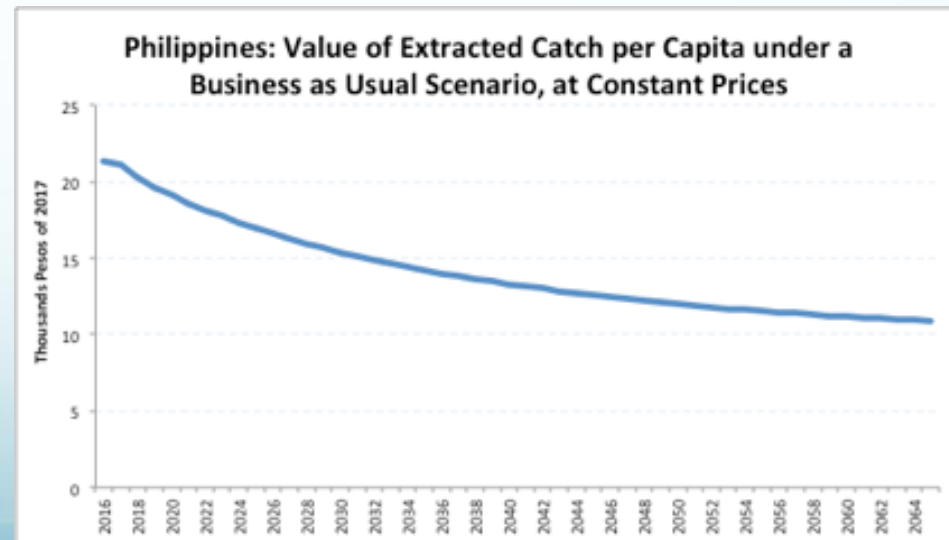
Kobe Process. Philippines, 2014



SUSTAINABLE
FISHERIES GROUP
UC SANTA BARBARA



- Bio-economic modeling framework
- Vibrant Oceans Initiative



<https://www.bloomberg.org/program/environment/vibrant-oceans/>

<https://www.rare.org/our-work#.WWnv-0u5uUc>

Ecological Model

InVEST

integrated valuation of
ecosystem services
and tradeoffs

<https://www.naturalcapitalproject.org/invest/>

- Carbon
- Coastal Vulnerability
- Crop Pollination
- Fisheries
- Habitat Quality
- Habitat Risk Assessment
- Malaria
- Marine Fish Aquaculture
- Marine water quality
- Offshore wind energy
- Water purification

Macro Model

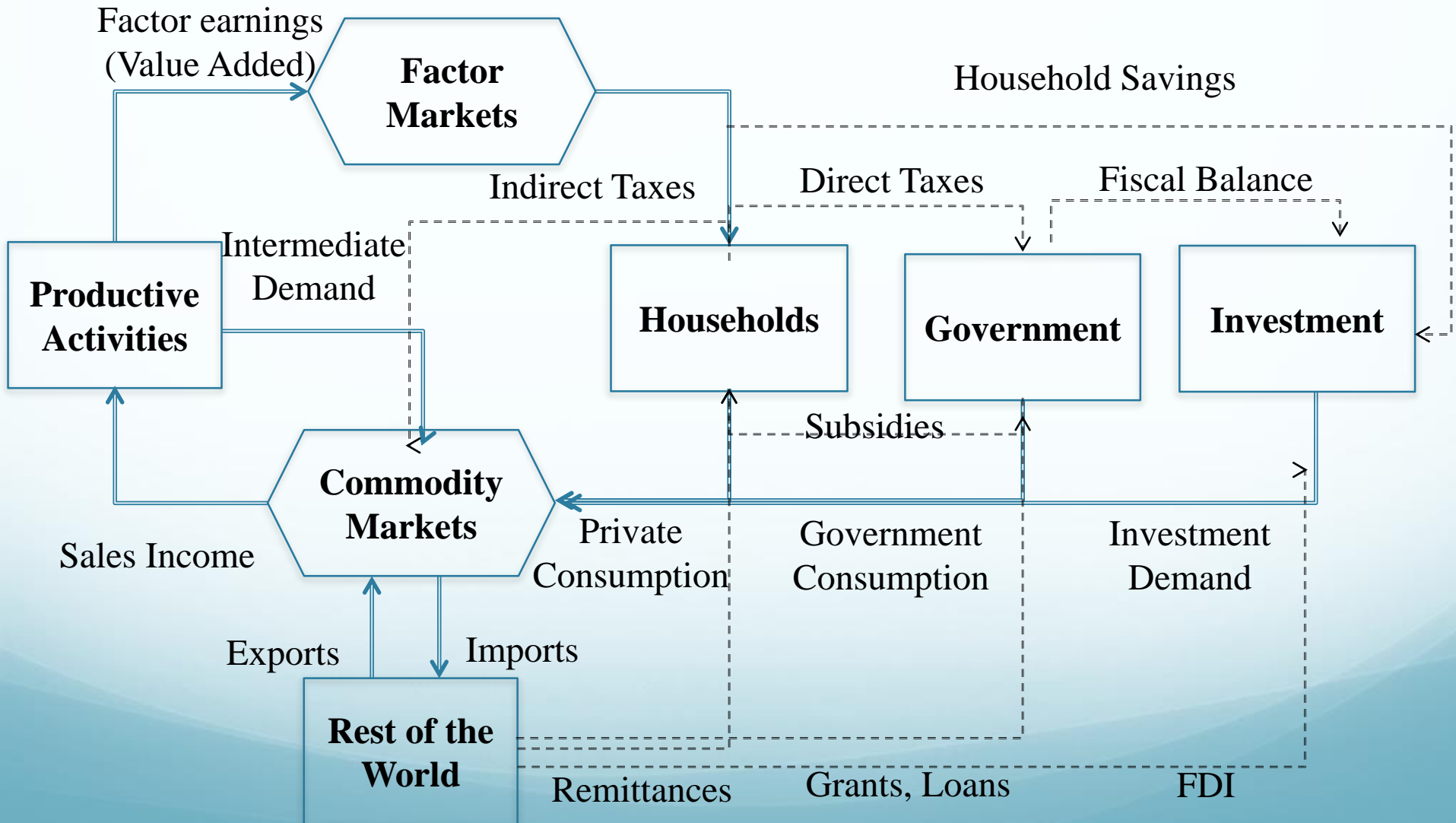
	Simple	Complex
Orthodox	<ul style="list-style-type: none">• SAM, I-O Multiplier• Neoclassical Growth Model	<ul style="list-style-type: none">• CGE Model (Static, Dynamic)• Large-scale macro-econometric model
Heterodox	<ul style="list-style-type: none">• Simple SysDyn• Simple ABM	<ul style="list-style-type: none">• System Dynamics• Agent-based, computational models

Continued Reliance on Social Accounting Matrices for Registering Economic Transactions Across Sectors, Institutions and Factors of Production

	ACTIVITIES	COMMODITIES	FACTORS	INSTITUTIONS
ACTIVITIES		DOM SUPPLY		
COMMODITIES	I-O			DEMAND
FACTORS	VALUE ADDED			
INSTITUTIONS	SUBSIDIES	INDIRECT TAX, IMPORTS	FACTOR PAYMENT TO HH	DIRECT TAX, TRANSFERS, SAVINGS, CAB

- At one point in time (Does not pick up changing technologies, supply / demand relationships)
- Not all factors of production included (Labor, Capital, Sometimes Land)
- Retains all faults and weaknesses attributed to national accounts to deal with natural phenomena

Circular Flow Diagram



Welfare Considerations as Ultimate Goals for Modeling Process

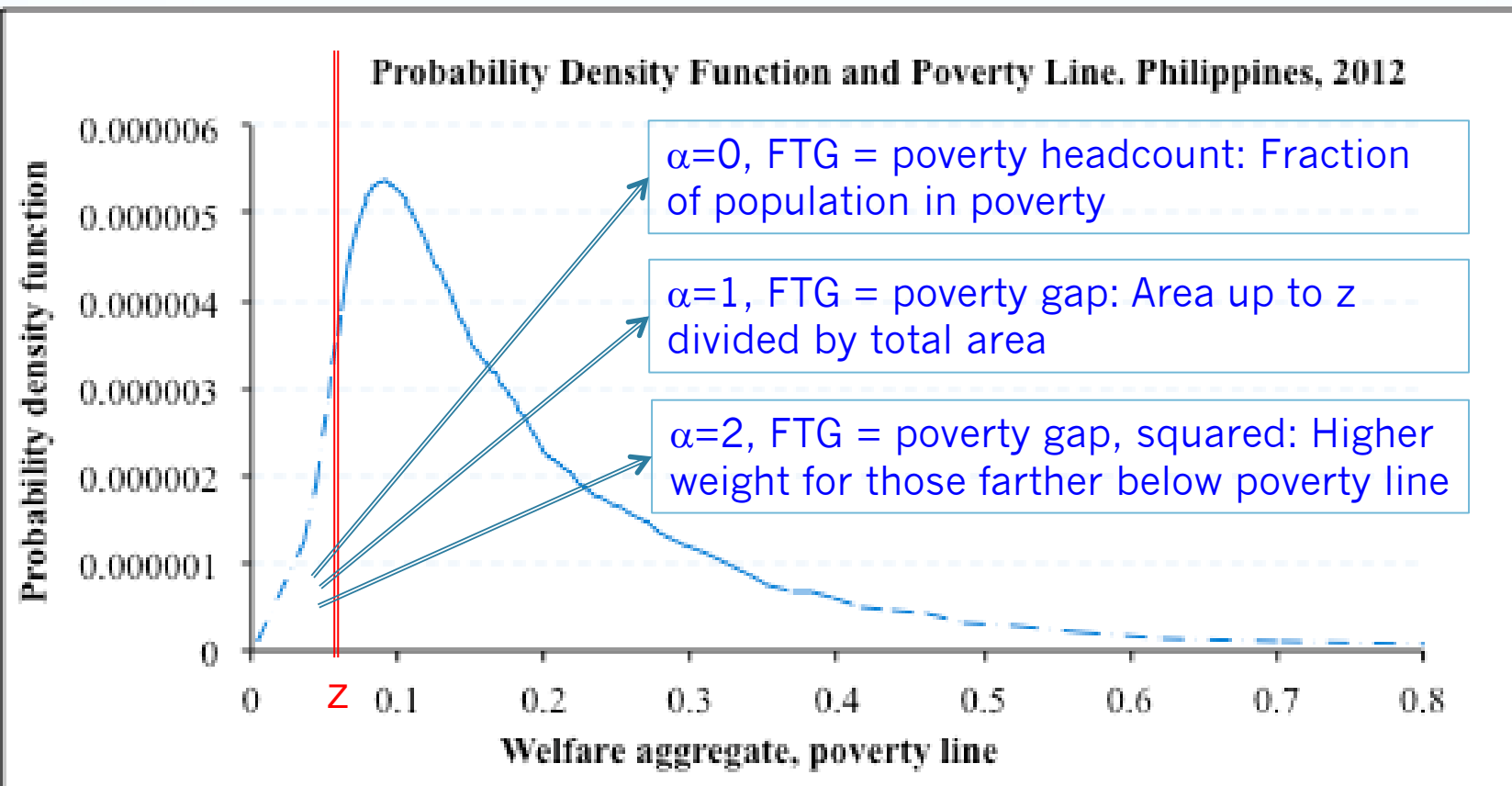
$$FTG_{\alpha} = \frac{1}{N} \sum_{i=1}^H \left(\frac{z - y_i}{z} \right)^{\alpha}$$

N = Total population

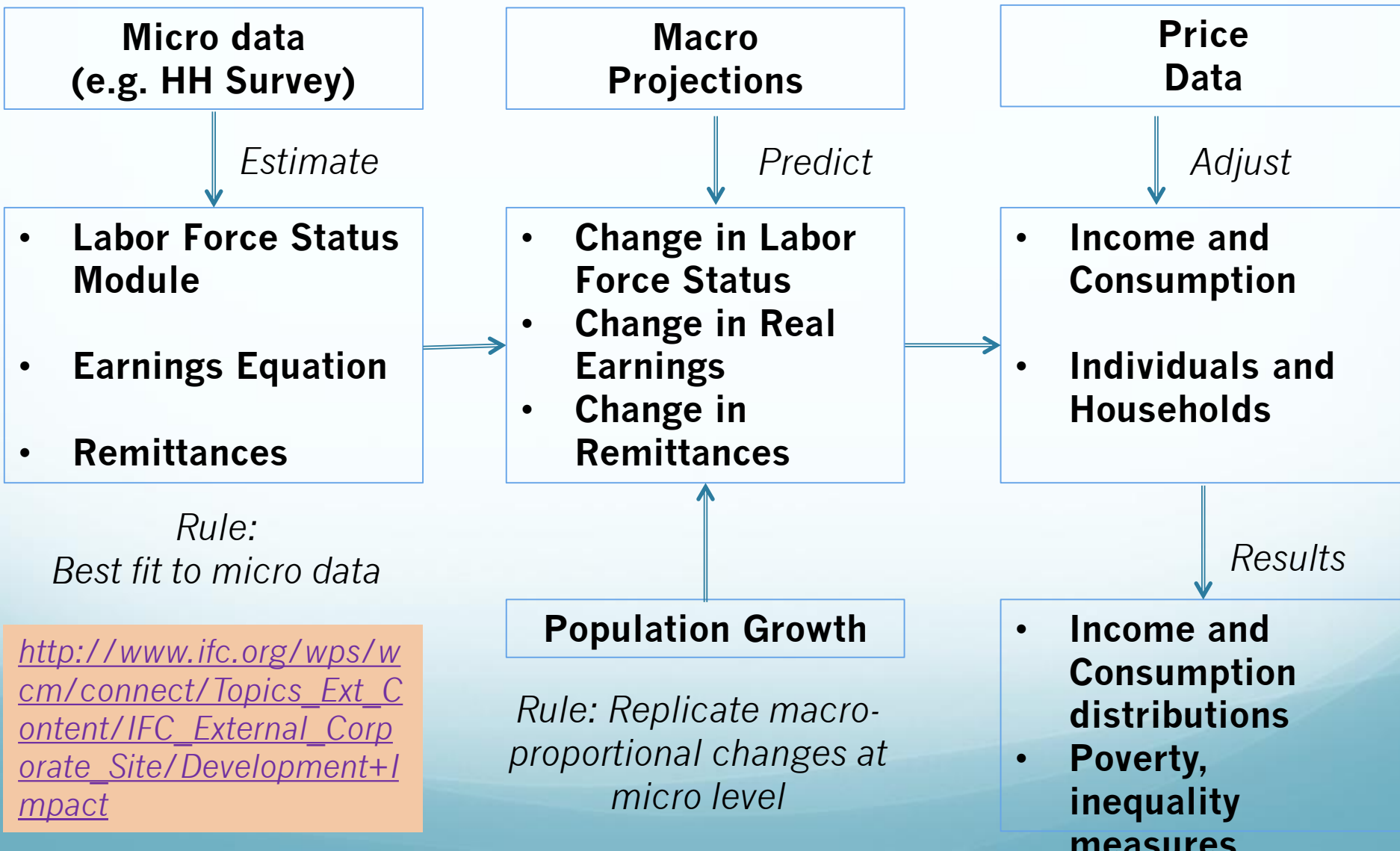
z = Poverty line (\$\$)

y_i = Income of HH or individual

H = Number of poor (number of people with y_i < z)

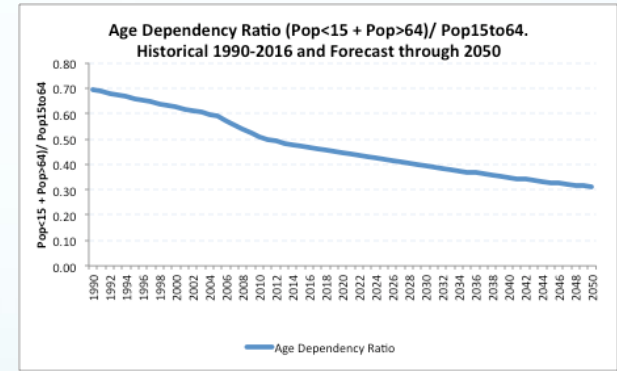
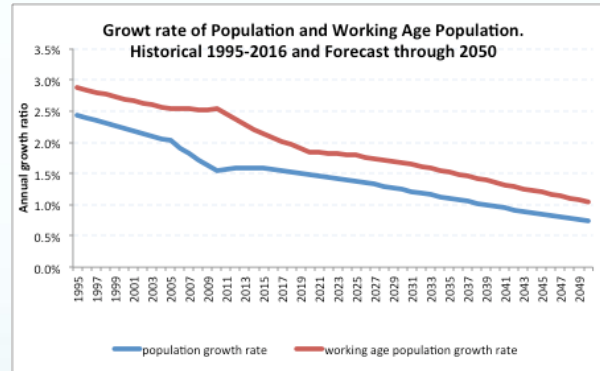
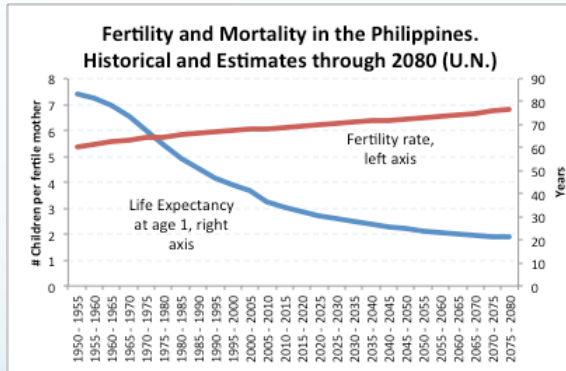
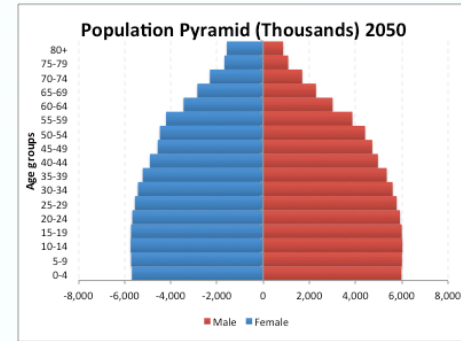
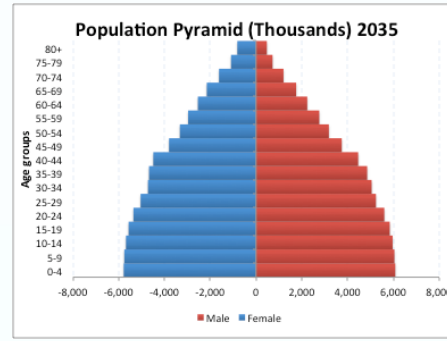
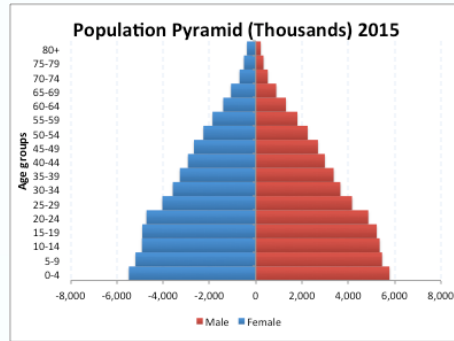
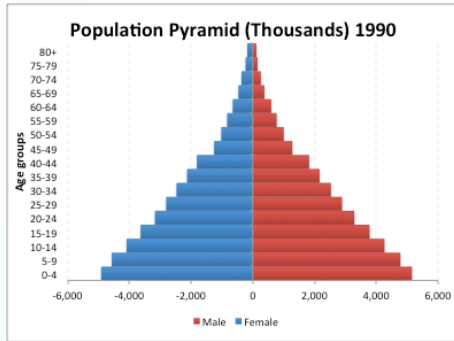


Poverty and Distributional Impacts. Top-Down Approach: ADePT Simulation



Demographics

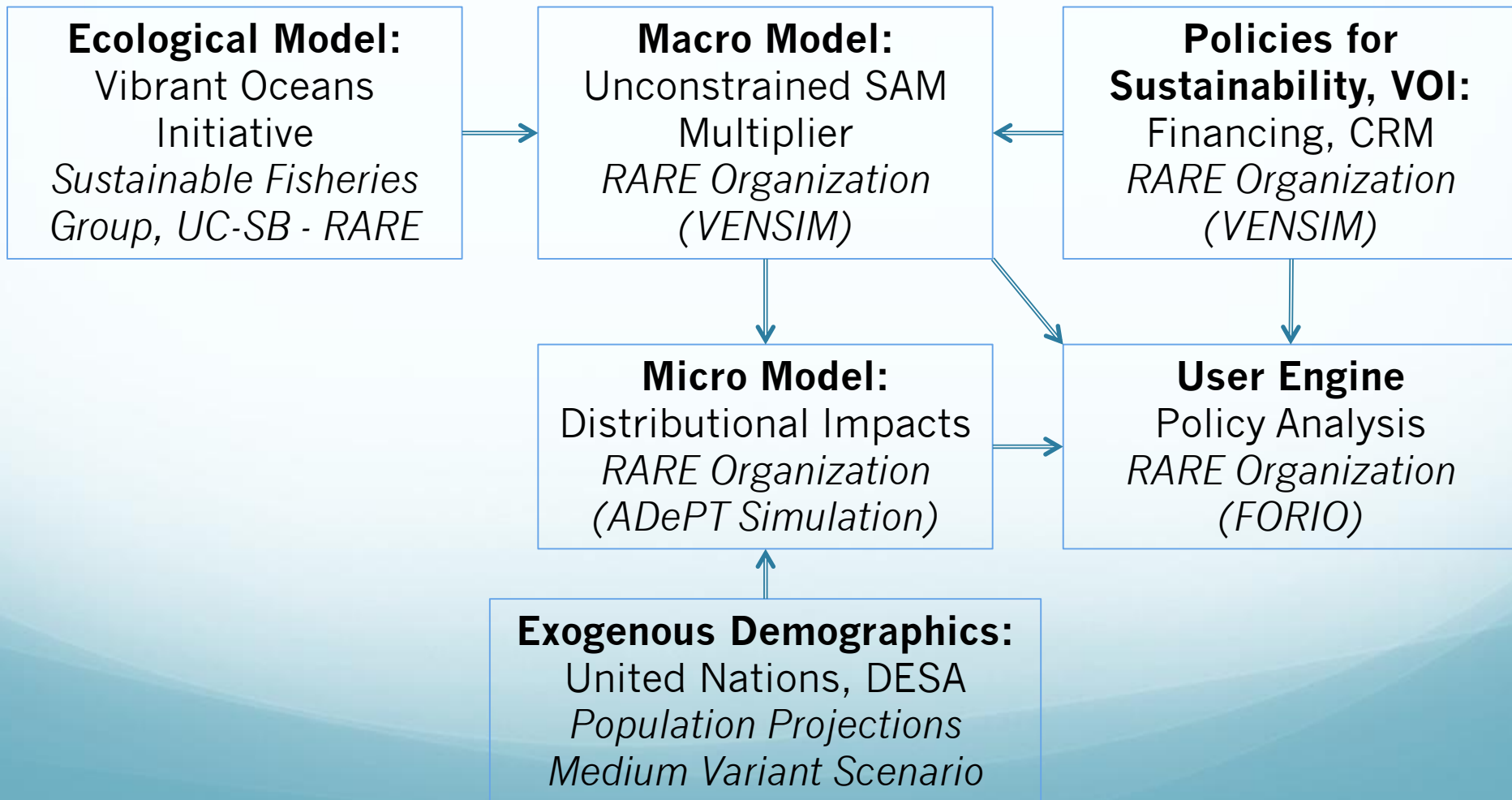
(Example from the Philippines, based on UN Estimates)



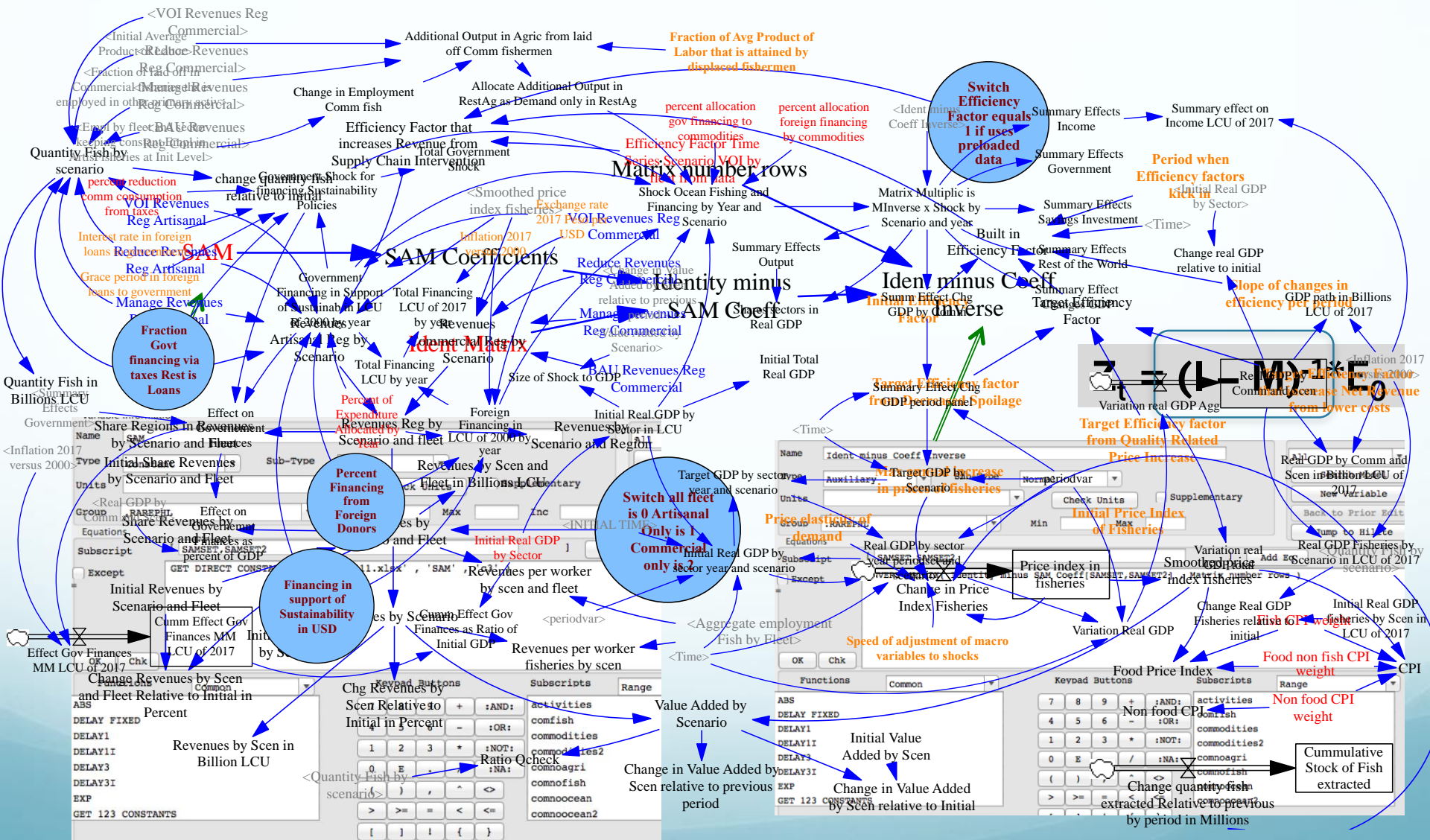
An ongoing Demographic, affects the age structure of population and dependency ratios has important implications about the supply of labor and employment dynamics:

- Demographic Dividend in Developing Countries
- Post Transition - Aging in Advanced Economies

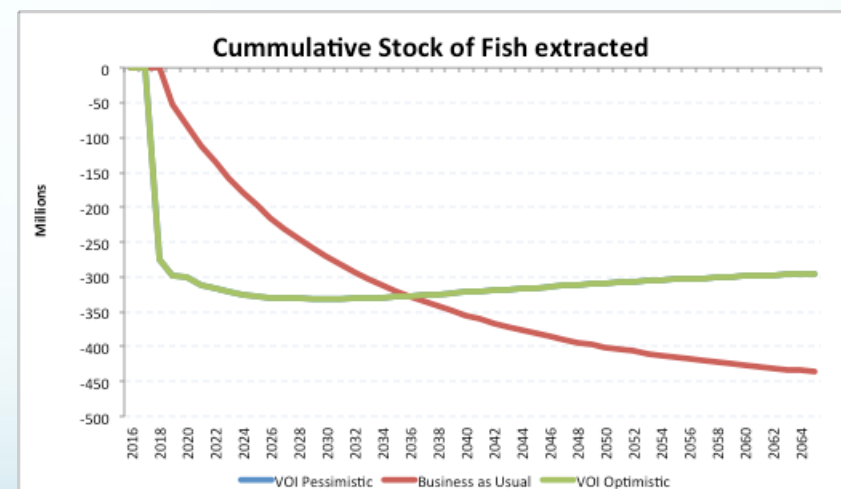
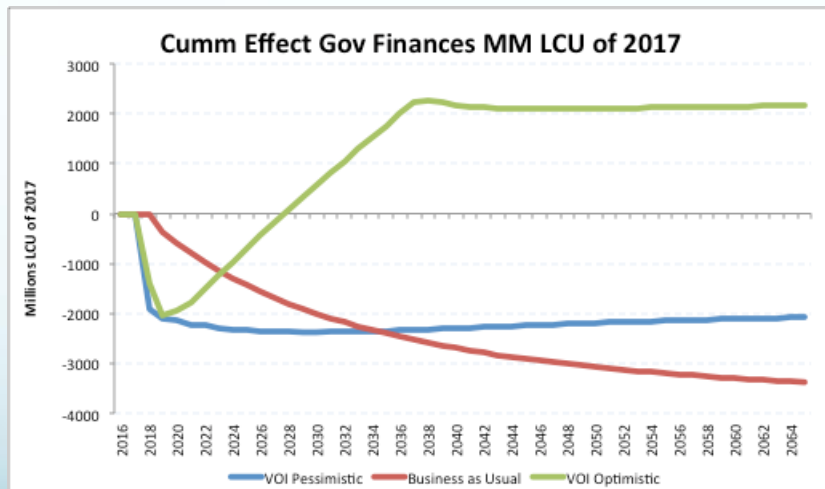
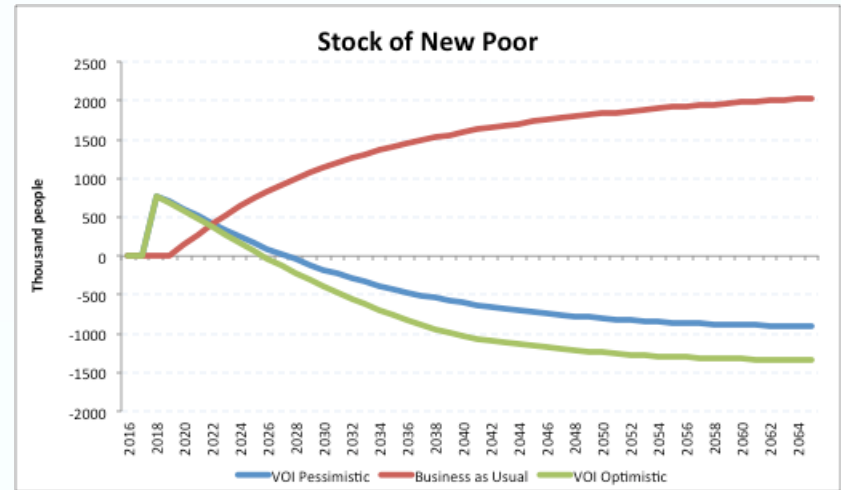
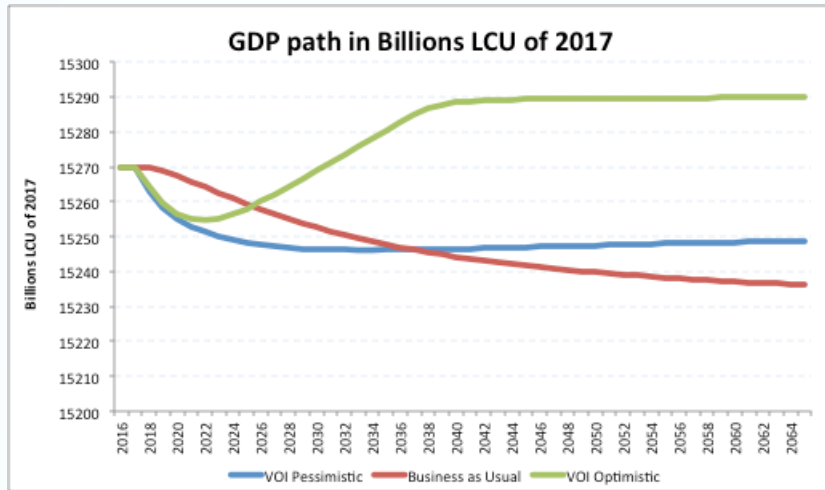
A Model for Socio-Economic Analysis of Policies for Sustainability of Fisheries in the Philippines



The Model in VENSIM

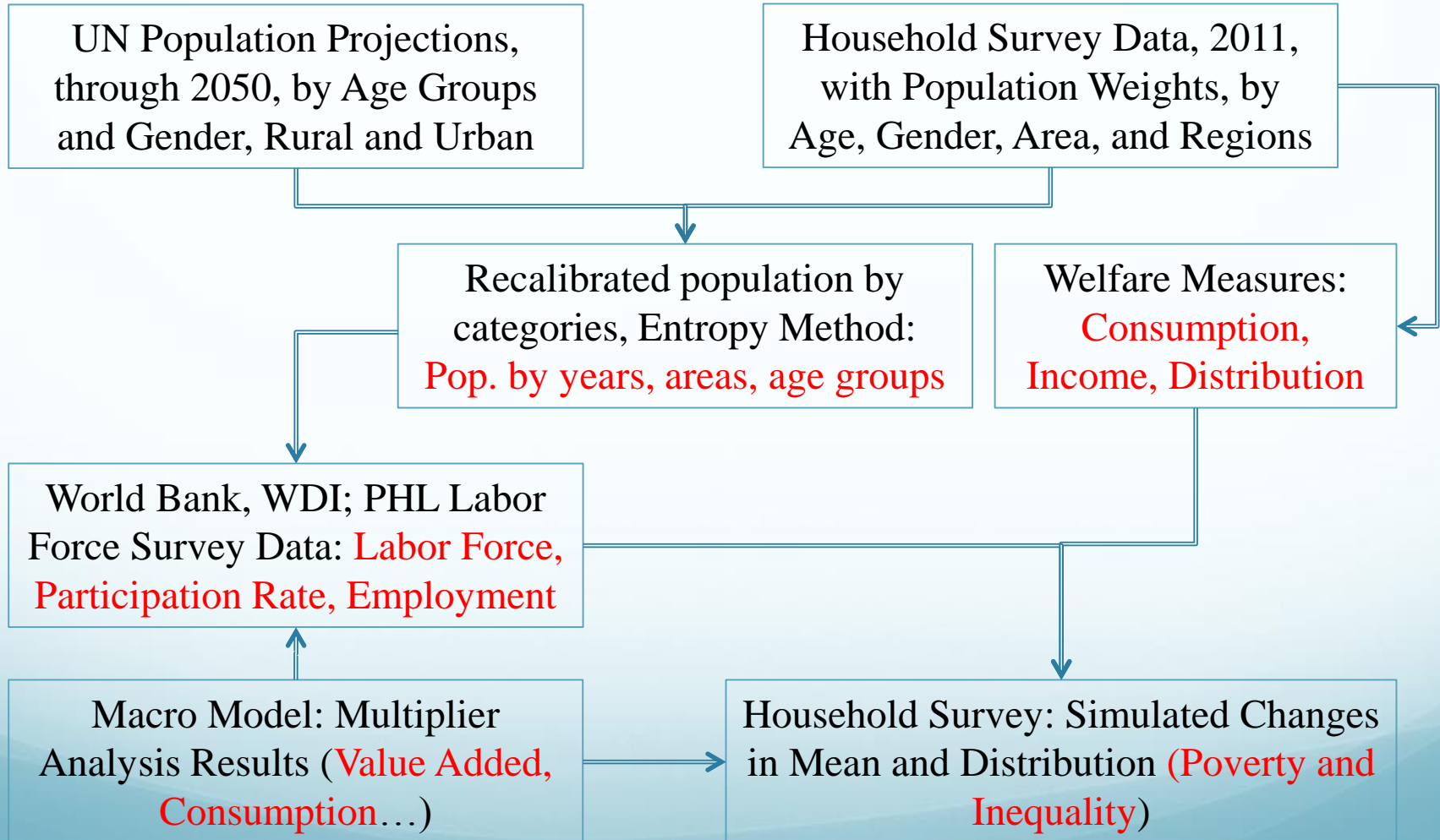


Outputs from Socio Economic Model



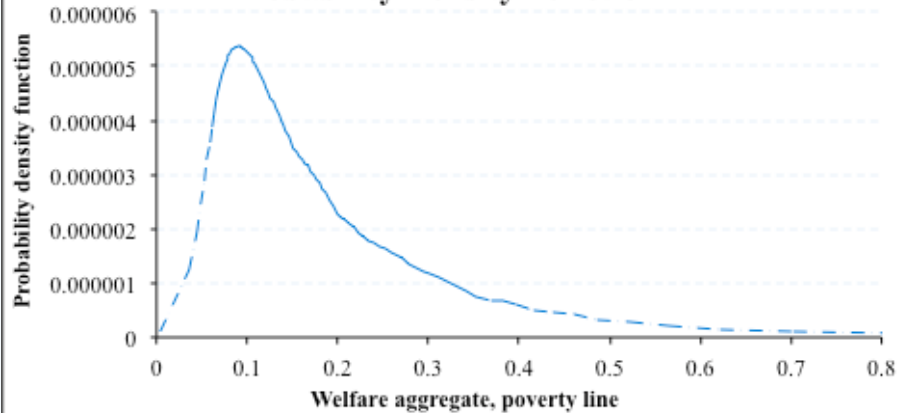
- BaU: Do Nothing, Over-fishing
- VOI Pessimistic: Sustainable fishing, no VOI Financing, no Efficiencies
- VOI Optimistic, Sustainable fishing, VOI financing, Efficiencies

Distributional Impacts Model

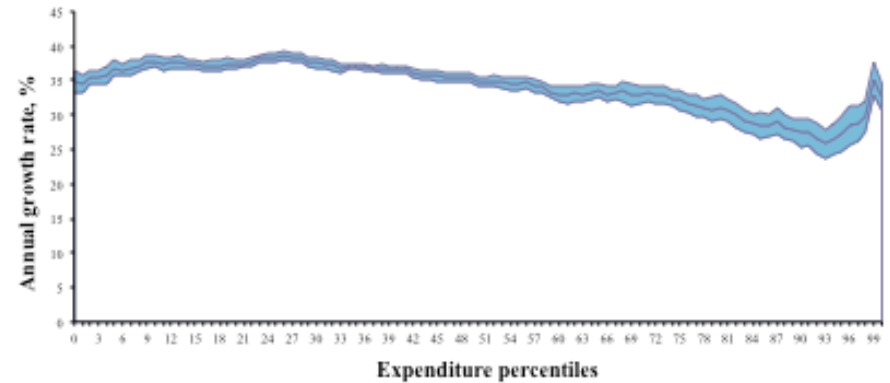


Some Outputs from ADePT Simulation

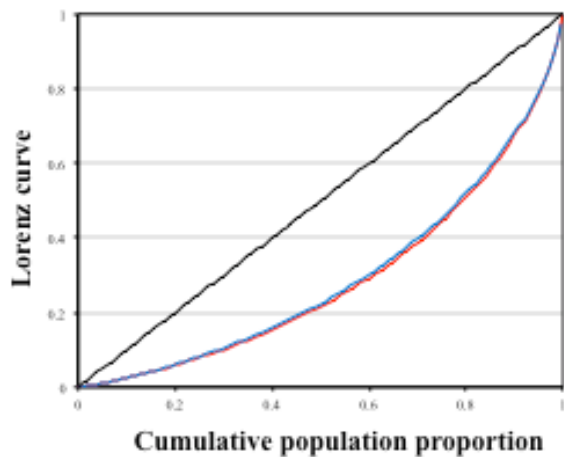
Probability Density Function



Growth Incidence Curve



Lorenz Curve



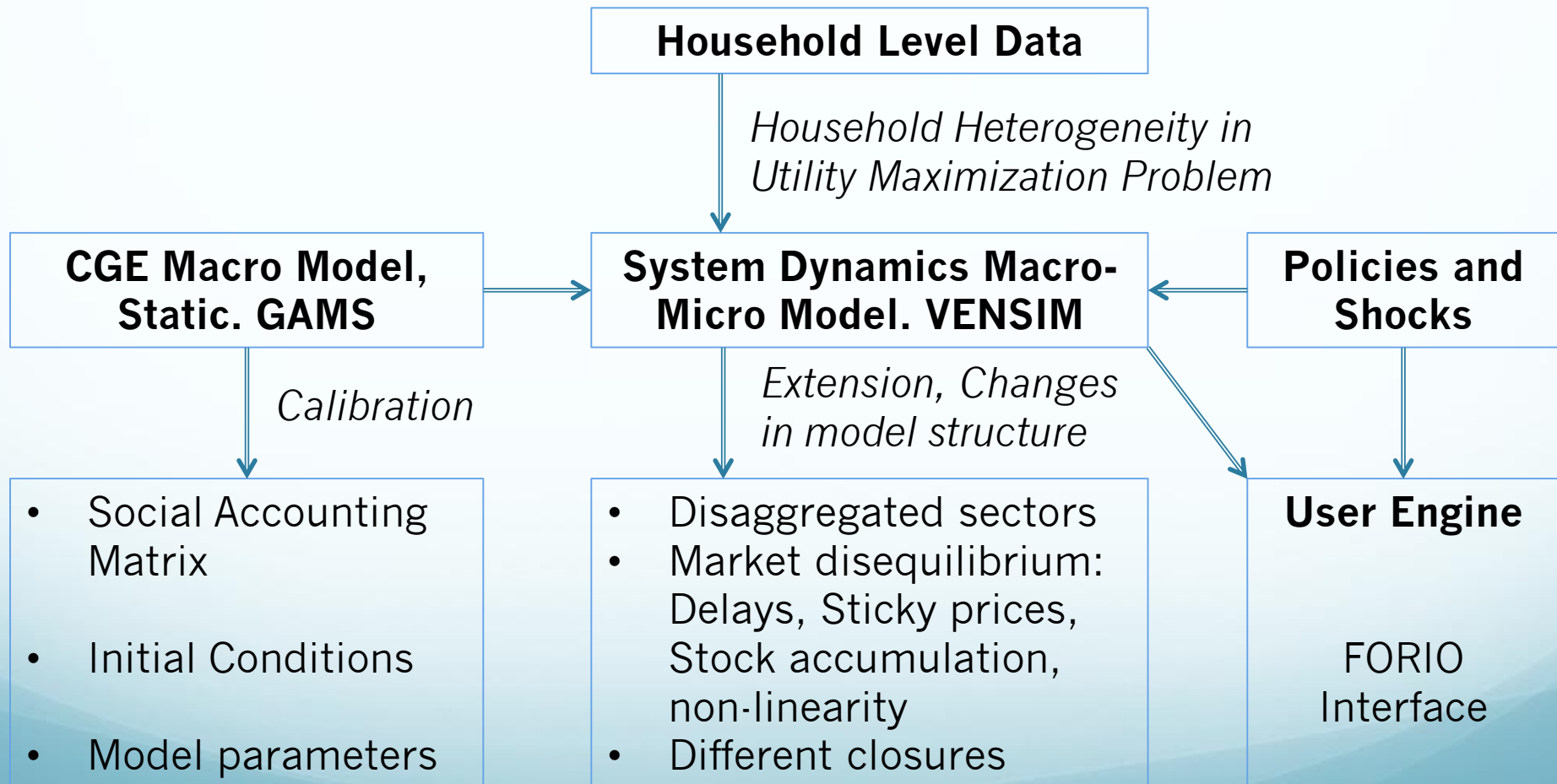
	Poverty Headcount Rate			Poverty Gap		
	PHL2006	PHL2012	Change	PHL2006	PHL2012	Change
Poverty line = poverty line in local currency per month. Equivalent to $1.9 \times 365 / 12 = 57.7917$ \$/m						
Urban	5.4	4.8	-0.6	1.2	1.0	-0.1
Rural	26.9	20.1	-6.9	6.4	4.6	-1.8
Total	16.3	13.2	-3.1	3.8	3.0	-0.8

Analysis

The screenshot shows a web browser window with the following details:

- Browser Tab:** Interface Builder
- Address Bar:** <https://forio.com/epicenter/builder/#/agagern/neda-rare-cba>
- Navigation:** Dashboard | agagern | Project Home Page | Interface Builder
- Page Title:** Unlocking the Potential of Philippines Coastal and Marine Resources through Enhanced Planning and Sustainable Financing - A joint study between RARE and the National Economic and Development Authority of the Philippines (NEDA)
- Logos:** RARE (Rare Area Resources and Ecosystems) and NEDA (National Economic and Development Authority).
- Navigation Menu:** Introduction | Scenario VOI Main Indicators | **User Inputs Financing and Efficiency** | Scenario Manager | Compare VOI vs BAU
- Sub-section:** Regional Allocation GDP Fisheries
- Main Content:**
 - Section:** User defined inputs related to Financing and Efficiency Measures for VOI Scenario
 - Description:** The VOI Scenario includes an injection of financing resources (either from government, foreign donors, or both) that are expected to support livelihood of those whose welfare is affected in the short to medium from reduction in catch, and to pay for initiatives aimed to increase the revenues of fishermen for a given fishing effort. User has the possibility of defining assumptions on financing and efficiency gains fro policies for sustainability of VOI. Predefined values are those in Model Baseline.
 - Financing Options:**
 - Slider: Fraction of Financing from Foreign Donors (set at 50.0%)
 - Text Input: Amount of Financing in support of VOI in US\$ (\$488,560,000.00)
 - Efficiency Measures:**
 - Slider: Target Increase in Revenues from Decreased Spoilage (set at 17.0%)
 - Slider: Target Increase Revenues from Quality Improvements (set at 7.0%)

A Model for Ex-Ante Analysis of Shocks and Development Policies in Ethiopia



Main Features of Model

Static CGE Model

HH Utility Maximization (Stone Geary)

Firms take demand as given, Maximize Profit

12 activities, commodities

Open Economy, Armington, CET

Government collects taxes, spends

Different closures: Savings – Investment;
RER – Foreign Savings

Model calibrated to SAM values

Micro-Macro linkages from SAM, HH data
(Replicate Consumption by Commodity,
Income)

System Dynamics Model (Changes CGE)

Sticky Prices, elasticities

Stock accumulation (inventories by tradable commodities)

Full developed sectors

(Exogenous) Changes in Price of X, M

Debt accumulation

Additional closure to Model: Restricted vs unrestricted Government Expenditure

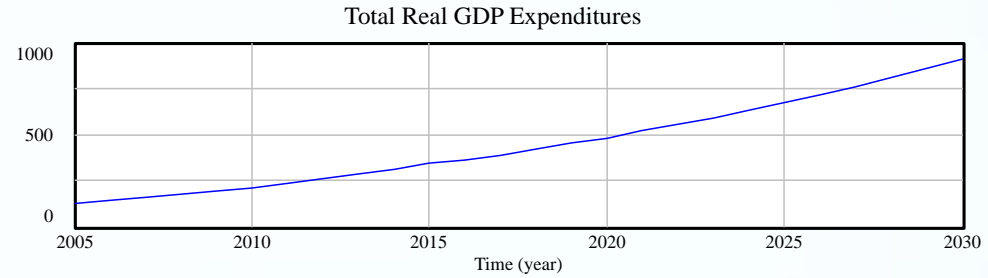
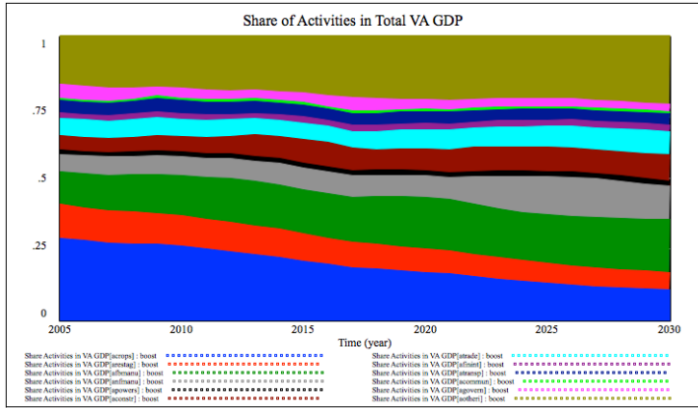
Dynamic calibration to historical period

Top-Down, Bottom-Up model results emerge from feed-back structures, calibration rules, closures and scenarios

Using Ethiopia Model for ex-ante assessment of policies as shocks

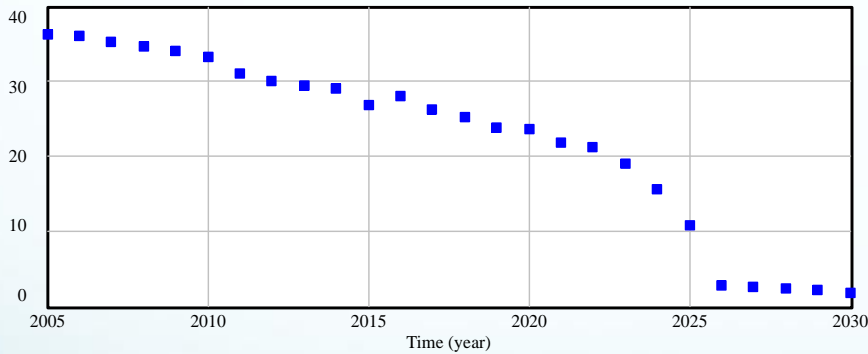
- For assessing expected impacts of policies included in Ethiopia Long Term Development Plan
- Model versatile to “connect” to fully fledged sectors (Including agriculture), modules linked to provision of environmental goods and services
- Convenience of carrying on policy, shock analysis with Top-Down, Bottom-Up structures, under a consistent Macro-Micro framework and given “rules” or “closures”
- Model amenable to compute several indicators included among Sustainable Development Goals

Some Preliminary Charts



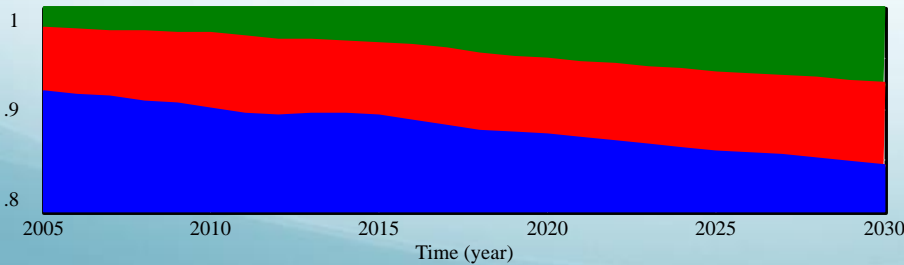
Historic RGDP : Baseline
 "Total Real GDP (RGDPT)" : Baseline
 "Total Real GDP (RGDPT)" : Scenario1

Headcount Poverty from Consumption (Based on 1.9\$/day Poverty Line)



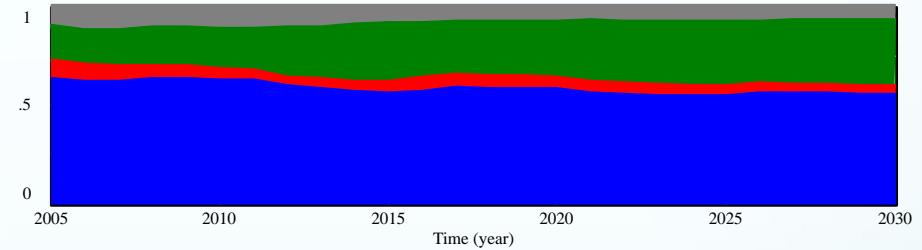
Headcount poverty rate based on HH Consumption : boost
 "Historic Poverty headcount ratio (Equivalent to \$1.90 a day (2005 PPP))" : boost

Quantity of Labor by Education Type



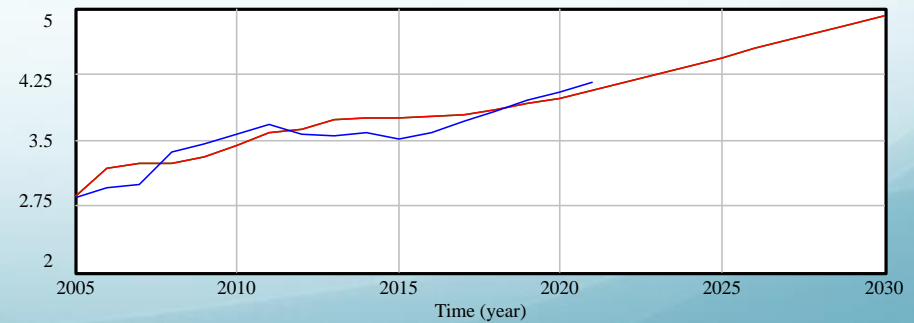
Share of QLabor by Educ Type[labpri] : boost
 Share of QLabor by Educ Type[labsec] : boost
 Share of QLabor by Educ Type[labter] : boost

Aggregate Demand Components: Model



Total Priv Cons to Agg Dem Ratio : boost
 Total Gov Exp to Agg Dem Ratio : boost
 Agg Invest to Agg Dem Ratio : boost
 Total Export to Agg Dem Ratio : boost

Log Total Real Exports: Hist vs Model



Log Hist Tot Exports : Baseline
 Log Tot Exports : Baseline
 Log Tot Exports : Scenario1

Thank You!