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Dynamic Analysis of Public Health Insurance Programmes

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Socio-economic System Dynamics (SESDYN) Research Laboratory

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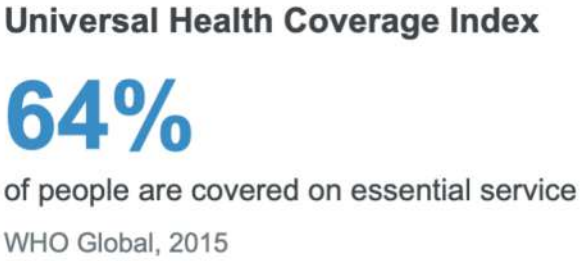
Introduction

Universal Health Coverage

...all people have access to the health services they need, when and where they need them, without financial hardship. It includes the full range of essential health services, from health promotion to prevention, treatment, rehabilitation, and palliative care. (WHO, 2015)

UHC through Public Health Insurance



- Naturally challenging in mid- and low- income countries
- Demographic challenges threaten the continuity of UHC in high income countries as well, through:
  - Aging population
  - Increased chronic disease prevalence
  - Increased comorbidity

Healthcare System Typologies

	Healthcare system type	Regulation	Financing	Provision
1	*Ideal-type: State Healthcare System*	*State*	*State*	*State*
2	State-based mixed-type	State	State	Societal
3	State-based mixed-type	State	State	Private
4	State-based mixed-type	State	Societal	State
5	State-based mixed-type	State	Private	State
6	State-based mixed-type	Societal	State	State
7	State-based mixed-type	Private	State	State
8	Societal-based mixed-type	State	Societal	Societal
9	Societal-based mixed-type	Societal	State	Societal
10	Societal-based mixed-type	Societal	Societal	State
11	*Ideal-type: Societal Healthcare System*	*Societal*	*Societal*	*Societal*
12	Societal-based mixed-type	Societal	Societal	Private
13	Societal-based mixed-type	Societal	Private	Societal
14	Societal-based mixed-type	Private	Societal	Societal
15	Private-based mixed-type	State	Private	Private
16	Private-based mixed-type	Private	State	Private
17	Private-based mixed-type	Private	Private	State
18	Private-based mixed-type	Societal	Private	Private
19	Private-based mixed-type	Private	Societal	Private
20	Private-based mixed-type	Private	Private	Societal
21	*Ideal-type: Private Healthcare System*	*Private*	*Private*	*Private*
22	Pure mixed-type	State	Private	Societal
23	Pure mixed-type	State	Societal	Private
24	Pure mixed-type	Private	State	Societal
25	Pure mixed-type	Private	Societal	State
26	Pure mixed-type	Societal	State	Private
27	Pure mixed-type	Societal	Private	State

Esping-Andersen's *three worlds*

Three dimensions:

- Regulation
- Financing
- Provision

Three actor types

- State
- Society
- Private/Market

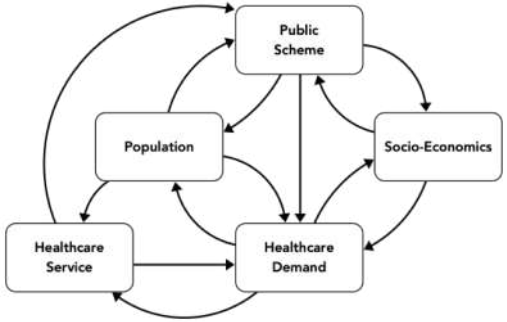
Wendt, C., Frisina, L., & Rothgang, H. *(2009). Healthcare system types: A conceptual framework for comparison. Social Policy and Administration,* 43(1), 70–90. https://doi.org/10.1111/j.1467-9515.2008.00647.x

Coverage	Universal: everyone is automatically covered at birth (most countries) or after a certain age or condition (US Medicare and VA)			Non-universal: people have to acquire insurance. Some will remain uninsured.	
Model	**Single payer, single provider** (also called Beveridge model or socialized medicine)	**Single payer, multiple providers**	**Multiple payers, multiple providers** (also called Bismarck model, Sickness Funds or Social Health Insurance)	**Multiple payers (private insurance), multiple providers**	**Out-of-pocket**
How it works	Healthcare is provided and financed by the government through taxes.	Healthcare is provided by private doctors in private facilities. The majority of medical bills are paid by the government.	Employers and employees fund national health insurance through compulsory payroll taxes. Health insurance companies are private but non-profit, and are regulated.	A variety of payers, including state- and federal-level plus commercial health insurance companies reimburse healthcare providers on a fee-for-service basis. Most people have insurance through their employer.	Patients pay out-of-pocket for healthcare. They may or may not have private insurance privately or through their jobs.
Relevant examples from the world (and % of GDP spent in healthcare)	UK (10.2%) Cuba (11.1%*)	Canada (10.5%) Taiwan (6.60%*)	Germany (11.0%) Switzerland (11.4%) Japan (11.4%)	The U.S. is the only industrialized country without universal health coverage. Overall, the US spends 17.2% of its GDP in healthcare.	India (4.7%) China (5.6%)
US example	VA (Veterans Administration)	Medicare and part of Medicaid	Affordable Care Act (ACA)	Most commercial health plans	Self-insured or non-insured
Care coordination	● ● ● ●	● ● ●	● ●	● ●	●
Cost control	● ● ● ●	● ● ● ●	● ● ●	● ●	●

Research Objectives

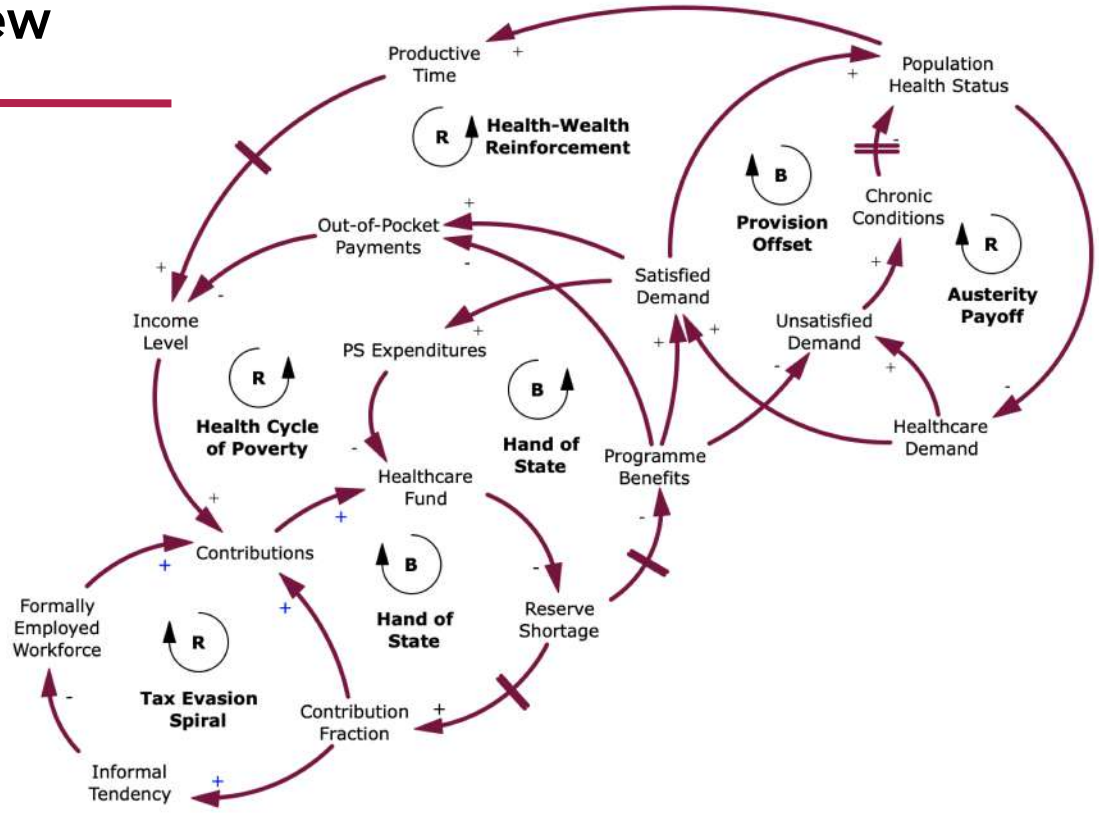
- Modeling of a state-run healthcare fund with a single plan
- Exploring the causal structure underlying public health insurance programmes that is run by employee contributions
- Understanding the system behavior under different scenarios
- Testing policy options
- Comparative performance analysis of healthcare systems

Model Structure - Overview



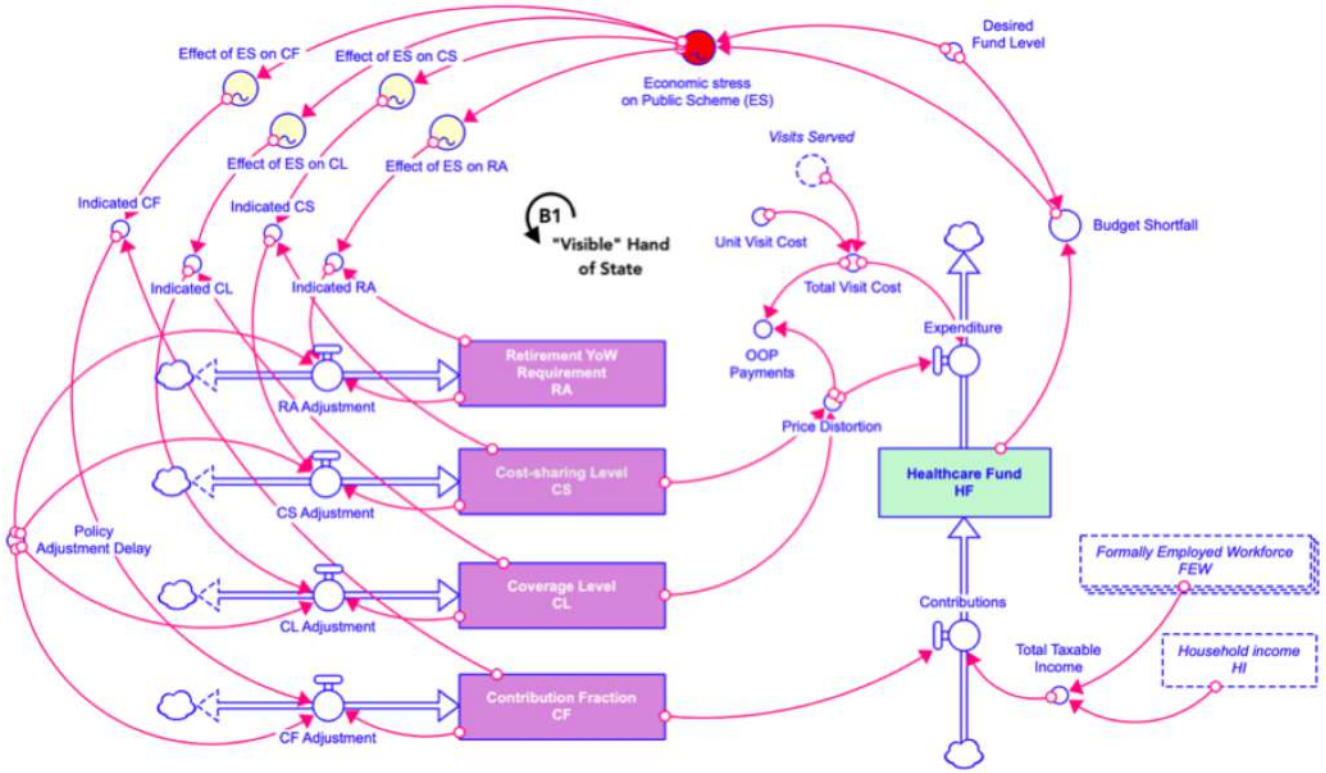
B - Hand of State
B - Provision Offset

R - Austerity Payoff
R - Tax Evasion Spiral
R - Health-Wealth
R - Health Poverty Trap



Model Structure - Public Scheme sector

Healthcare Fund
Economic Stress
Policy Adjustment process

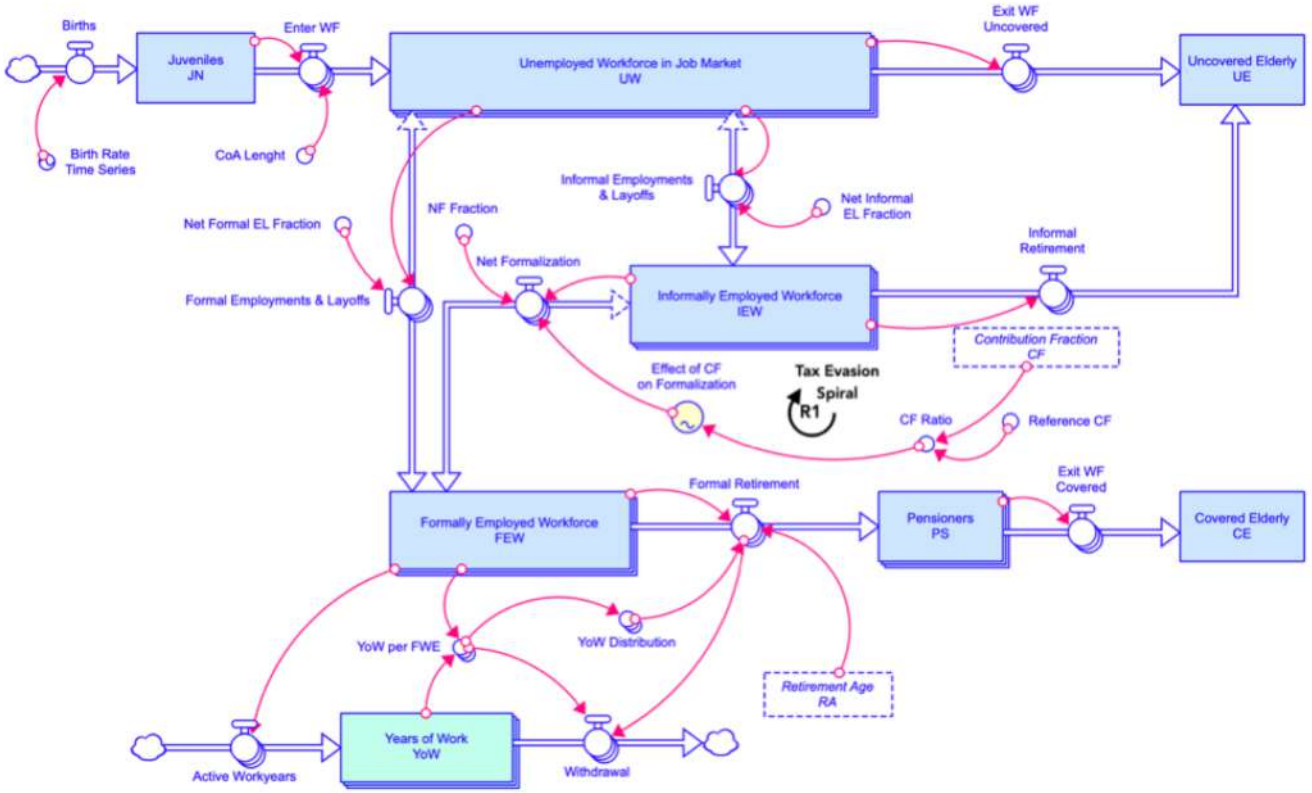


Model Structure - Population sector

Aging chain
[0-20, 20-35, 35-50, 50-65, 65+]

Tax evasion spiral

Retirement by YoW coflow



Model Structure - Healthcare Demand sector

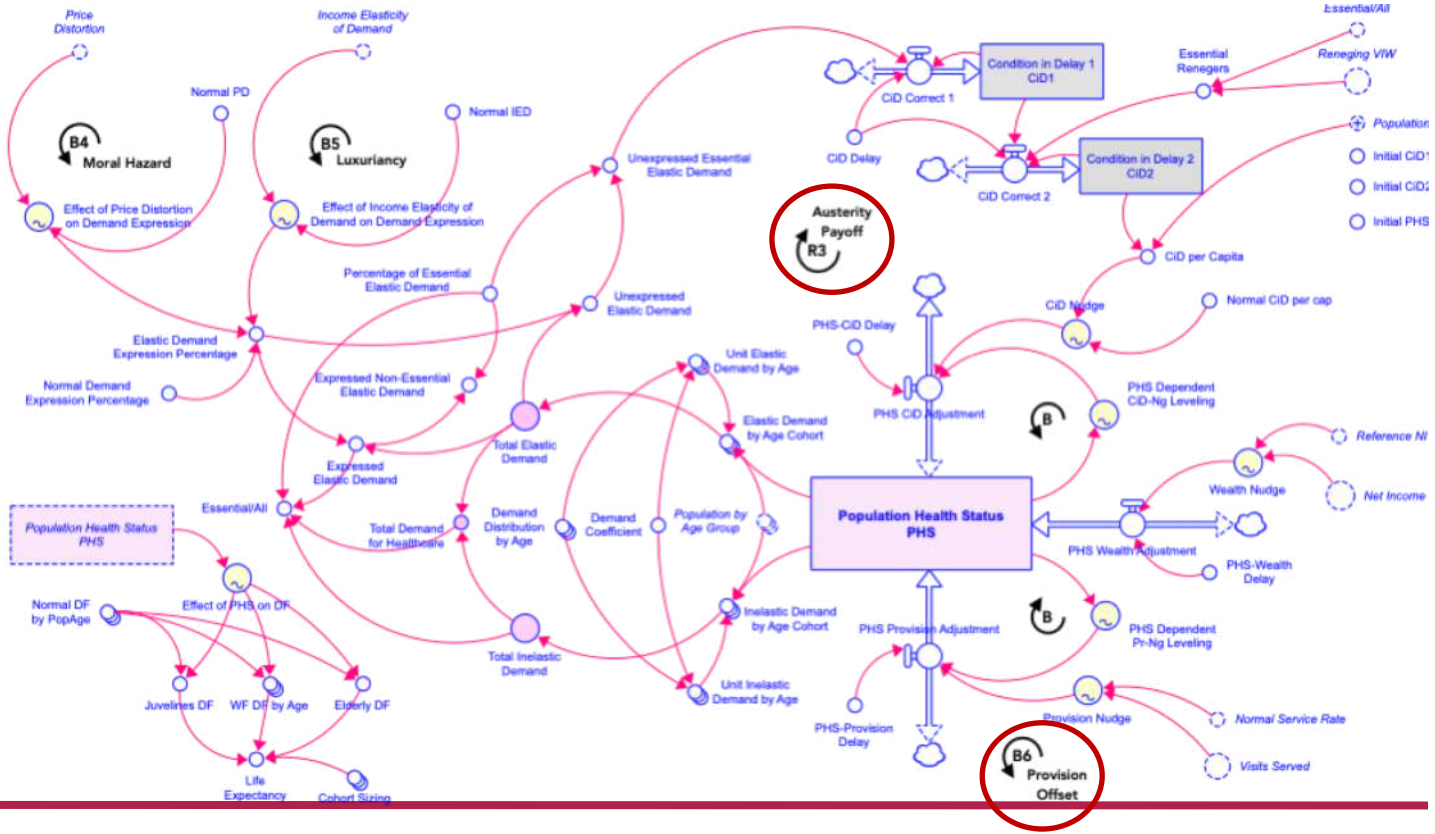
Price Elastic vs Price Inelastic

Population Health Status vs Condition in Delay

Healthcare Demand generation

Moral hazard

PHS effect on death fractions

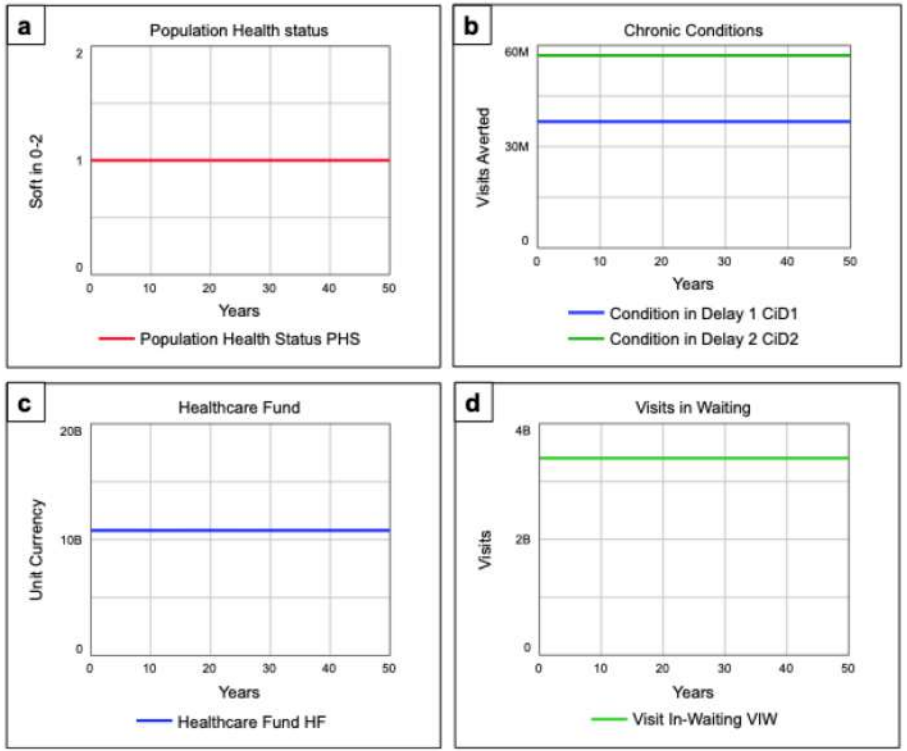


Equilibrium Run

Principle of collective annual equivalence

Unit Visit Cost calibrated s.to

HF Expenditures = HC Contributions



Scenario Analysis

The three input parameters

- Crude Birth Rate trend (increasing, decreasing)
- Unit Visit Cost (high, low)
- Unit Visit Cost trend (increasing, decreasing)

Configuration #	UVC Level	UVC Trend	CBR Trend	Scenario #
1	High	-	-	Scenario 1 (Base)
2	-	Increasing	-	Scenario 2
3	-	Decreasing	-	Scenario 3
4	-	-	Decreasing	Scenario 4
5	-	-	Increasing	Scenario 5
6	Low	-	-	Scenario 6
7	High	Decreasing	-	Scenario 7
8	Low	Increasing	-	Scenario 8
9	-	Increasing	Increasing	Scenario 9
10	Low	-	Decreasing	Scenario 10
11	Low	Increasing	Decreasing	Scenario 11

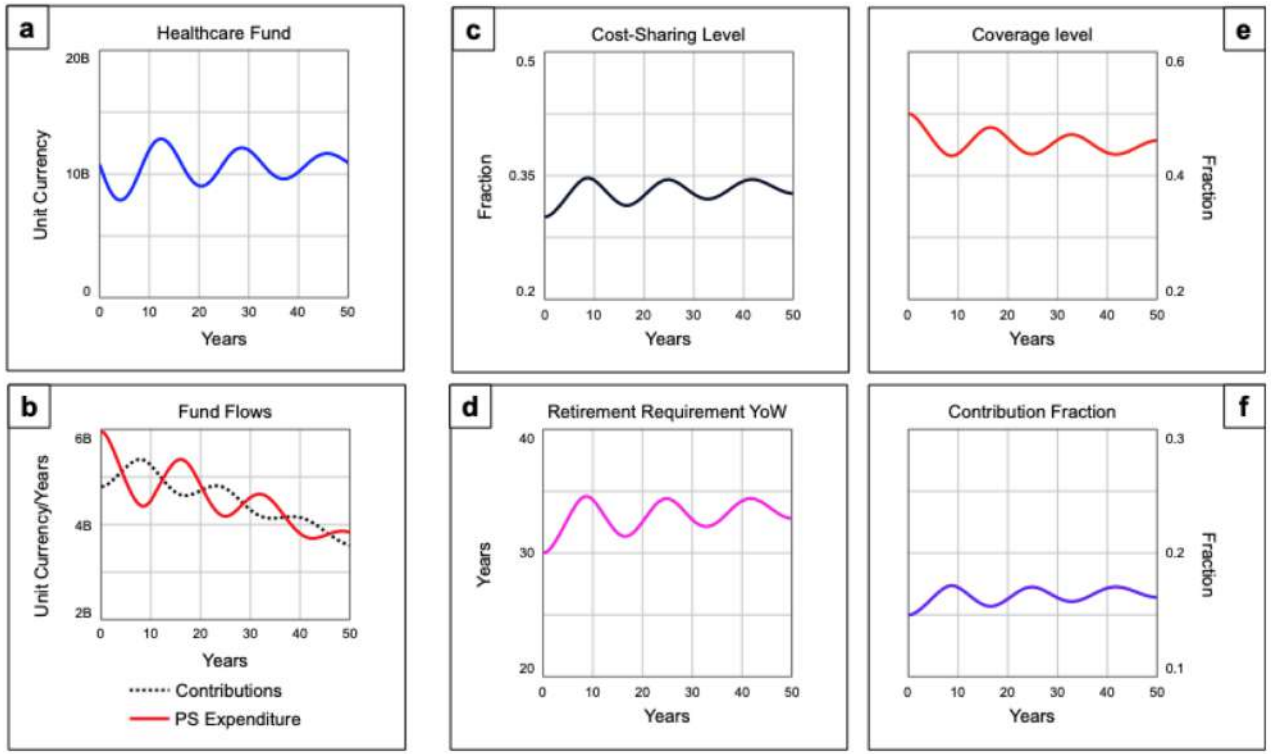
Scenario Analysis - High Unit Cost Scenario

UVC = 50

Large oscillations in public programme benefits

Sequential austerity and generosity periods

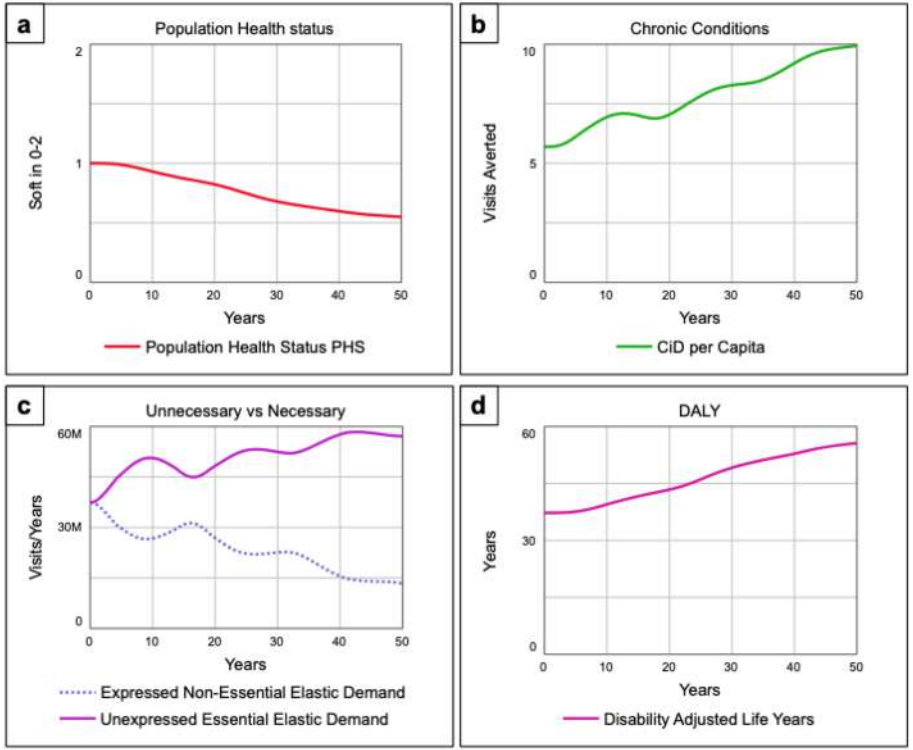
A minor reduction trend

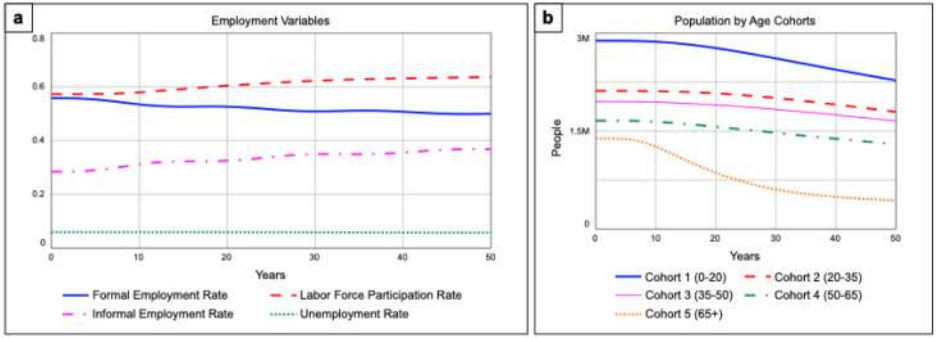


Scenario Analysis - High Unit Cost Scenario

Decreased Formal Employment
Tax evasion spiral is the culprit

A worsening trend in population health
Decline in PHS
Further accumulation of chronic conditions





Policy Analysis

1. Immigration Policies
    1. Unemployed Workforce (UW) Immigration
    2. Formally Employed Workforce (FEW) Immigration
2. Government Contribution
    1. Direct GC
    2. Buffer Stock GC
3. Capacity Building

Policy Analysis - Immigration Policies

PULSE function into

FEW Formally Employed Workforce

UW Unemployed Workforce

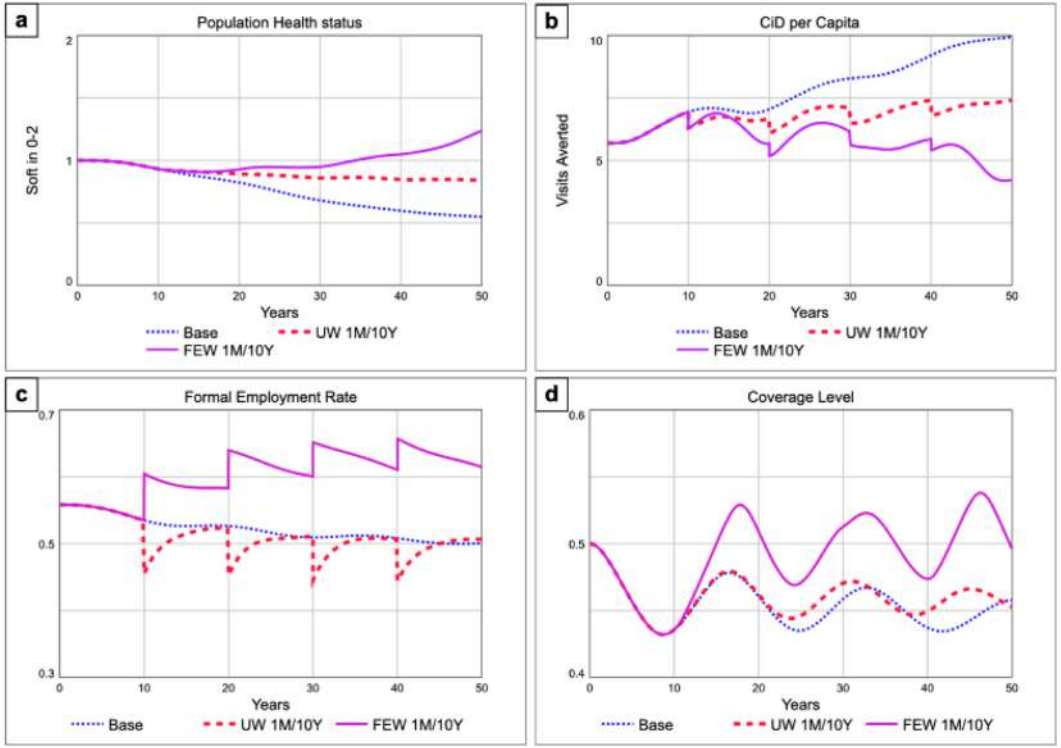
In the first set;

1 Million **FEW/UW** once every 10 years

FEW 1M/10Y & UW 1M/10Y

Increased FER in FEW policies sustains the coverage level and improves PHS

UW policies need some time for their incoming cohorts to get employed

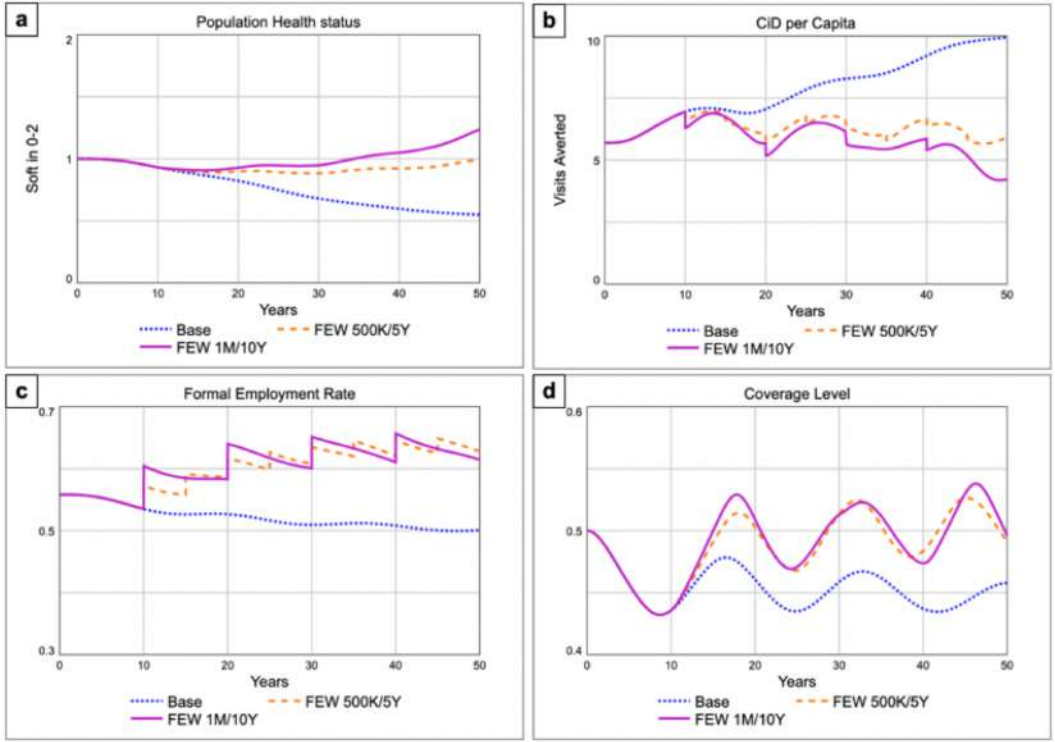


Policy Analysis - Immigration Policies

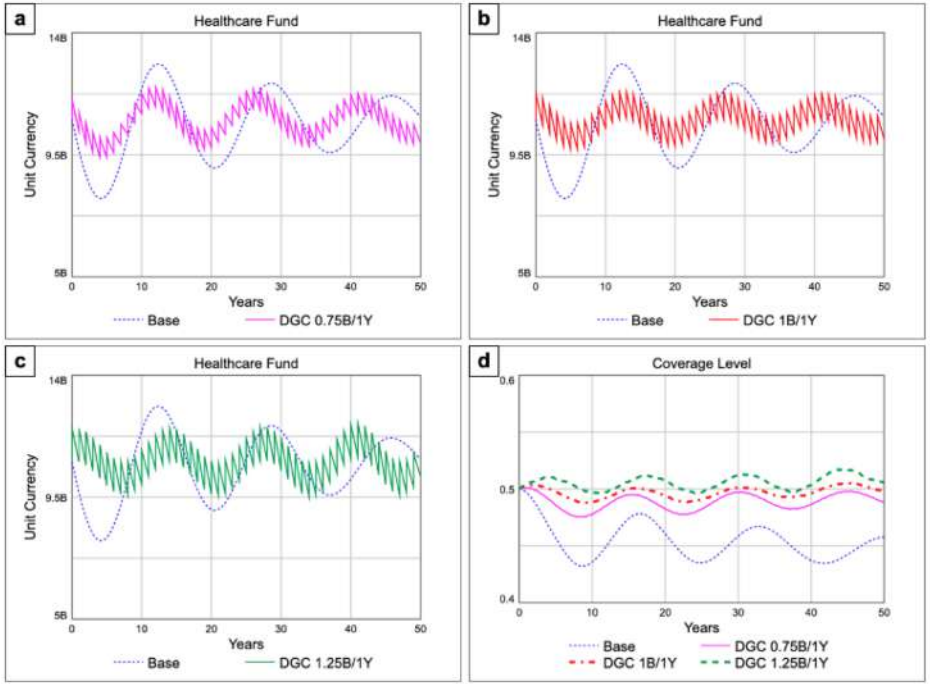
Differing frequencies for FEW policies

FEW 500K/5Y & FEW 1M/10Y

Area under the curve of FER
=
Cumulative Employment
=
Public revenue generation capability

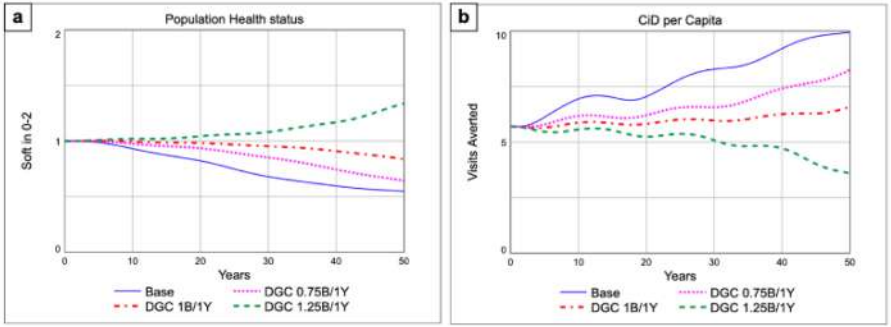


Policy Analysis - Government Contribution Policies

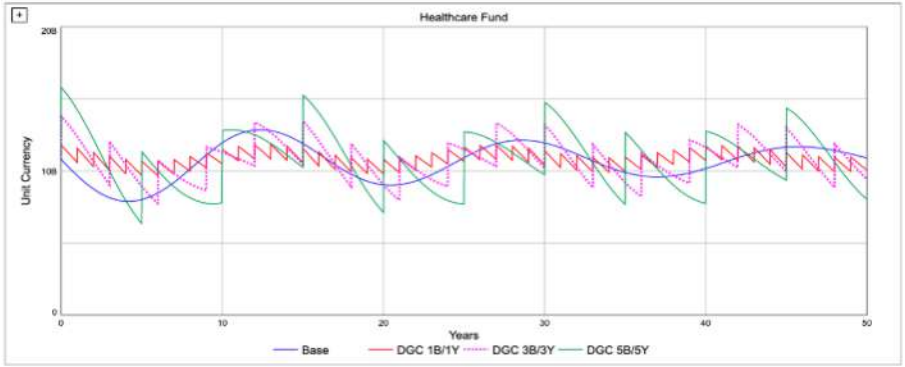


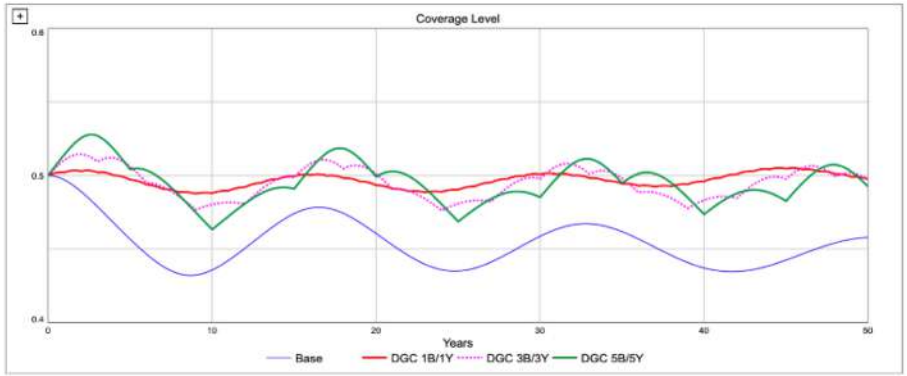
Direct government contributions : PULSE

PULSE with volumes of 0.75, 1, 1.25 Billion/year



Policy Analysis - Government Contribution Policies





Direct government contributions : PULSE
Having the same total contribution amount

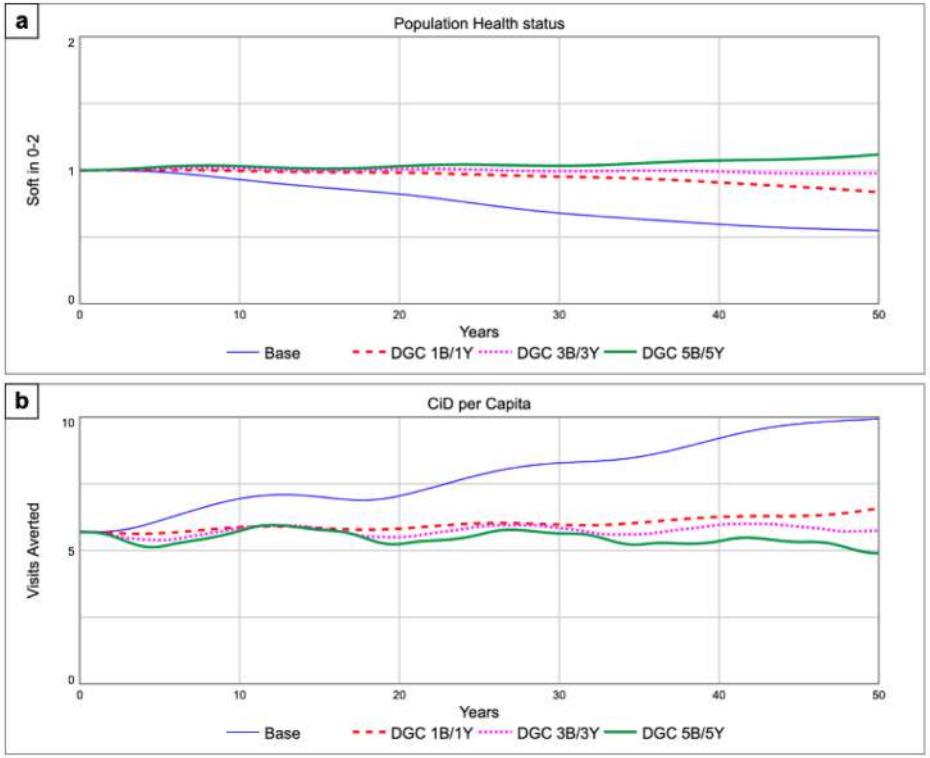
------ DGC 1B/1Y
------ DGC 3B/3Y
------ DGC 5B/5Y

More drastic turns in HF as unit pulse volumes increase

Policy Analysis - Government Contribution Policies

Direct government contributions : PULSE
Having the same total contribution amount

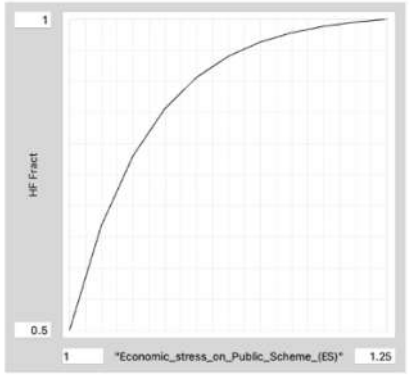
------ DGC 1B/1Y
------ DGC 3B/3Y
------ DGC 5B/5Y



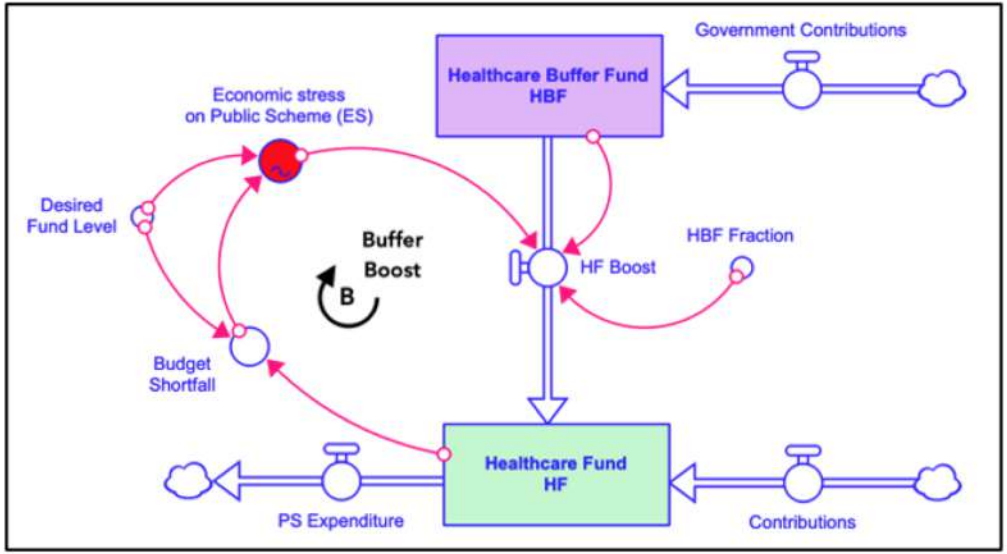
Policy Analysis - Government Contribution Policies (Buffer)

Introducing a buffer stock
Government contributions join the buffer stock
Transferred into HF when in need

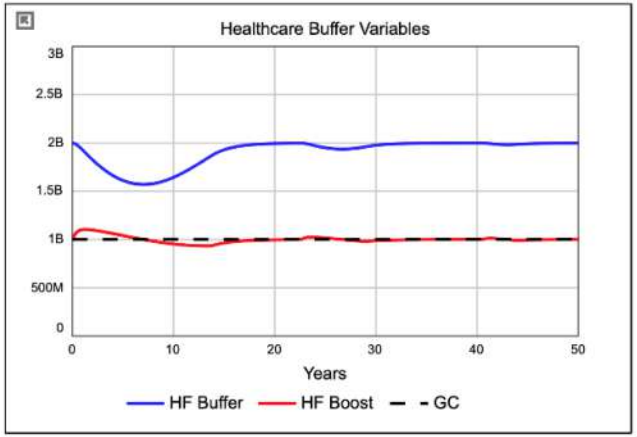
HF Boost = HBF Fraction (ES) x HBF



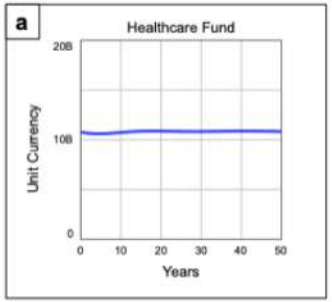
Graphical HF Fract variable as a function of Economic Stress



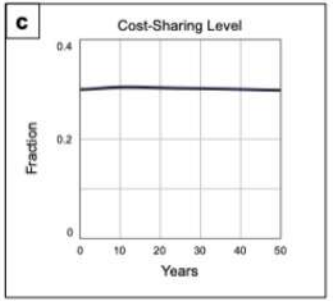
Policy Analysis - Government Contribution Policies (Buffer)

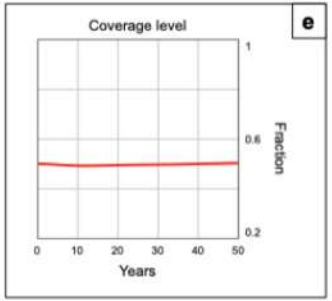


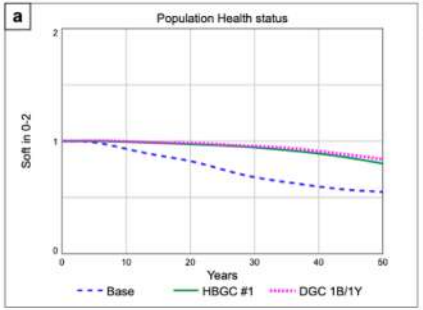
Public Scheme Financials

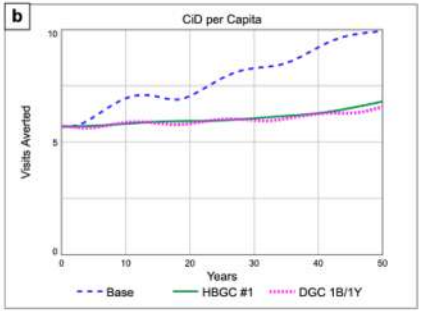


Public Scheme Benefit Package









Conclusions and Future Work

- A broad boundary multi sector system dynamics model

- Increased healthcare costs creates oscillations in public programme benefits that would result in sequential austerity vs generosity periods.

- Less frequent but high volume labor immigration,
- Less frequent but high volume government contributions

  are found to be more effective than steady but low volume counterparts.

Adding a multi-payer sector in order to :

- analyze adverse selection dynamics.
- conduct a comparative analysis of single-payer vs multi-payer model performance under defined scenarios

Thank you!

Q & A & Suggestions

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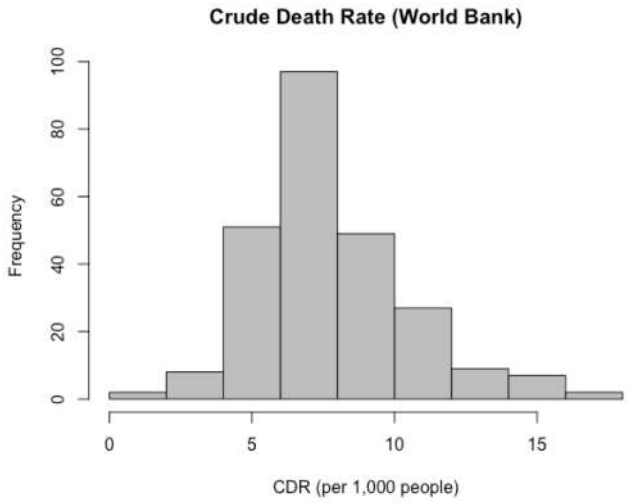
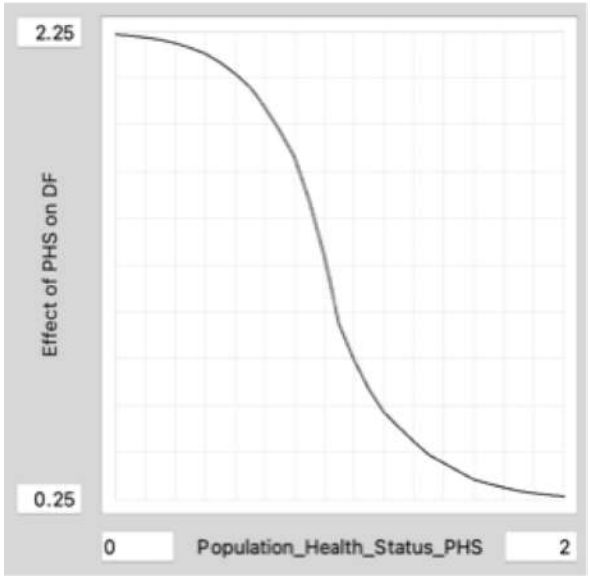
Model Structure - Healthcare Demand sector



CDR histogram of 2020 data for 256 countries

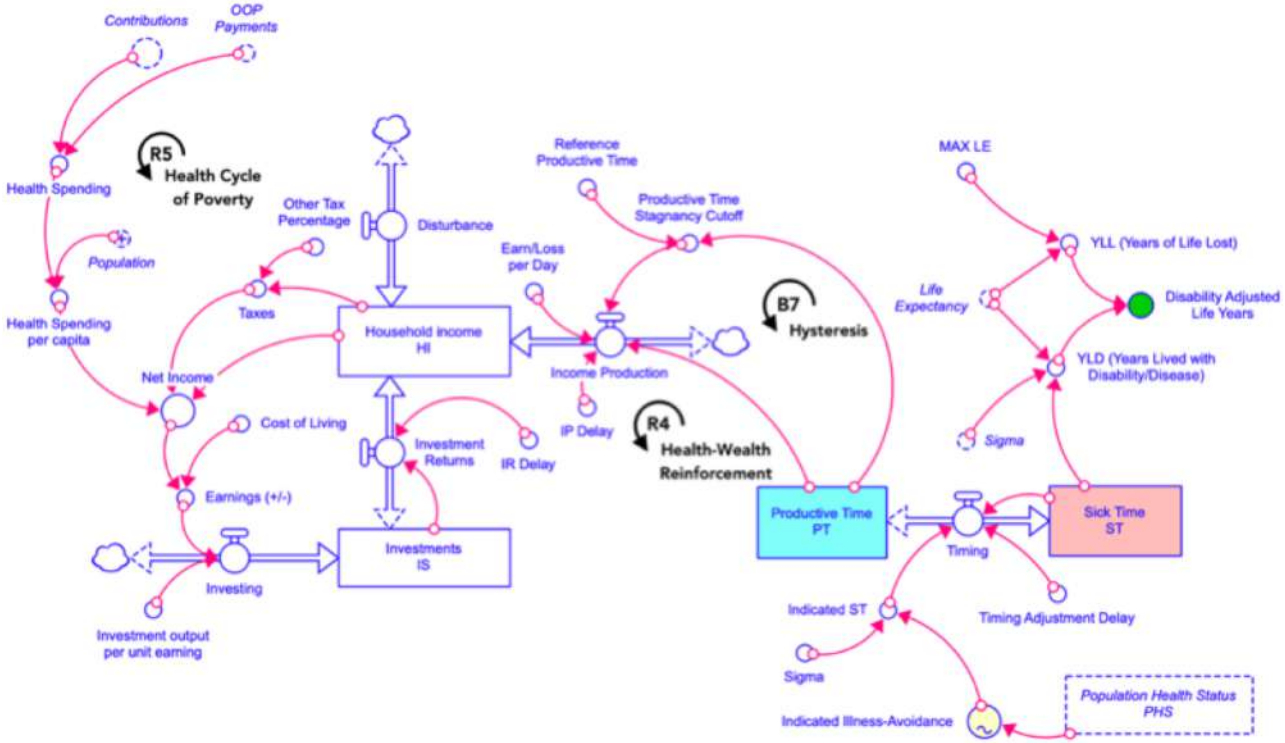


PHS effect on death fractions

Model Structure - Socioeconomics sector

Income generation

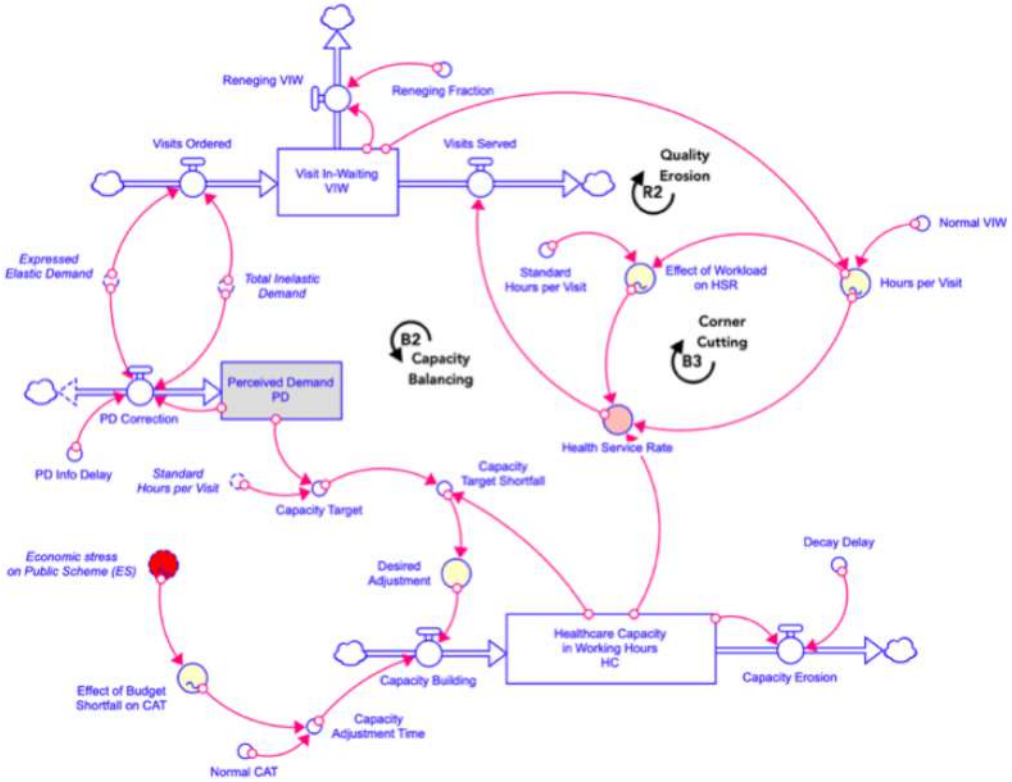
Grossman Model (1972)
Productive time hypothesis



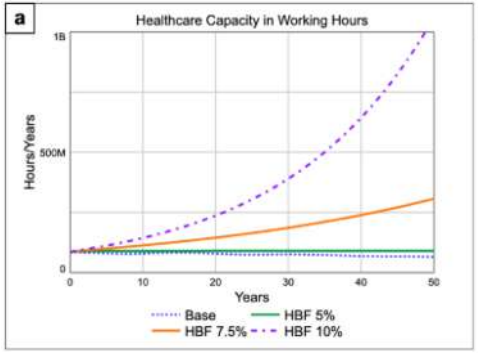
Model Structure - Healthcare Service sector

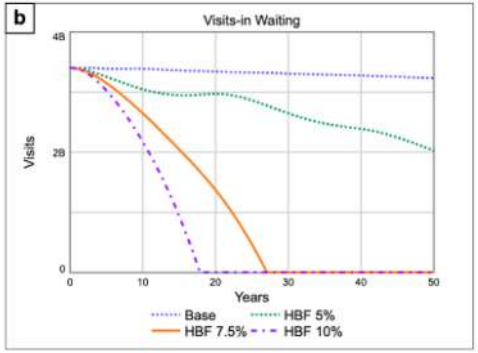
Capacity Building

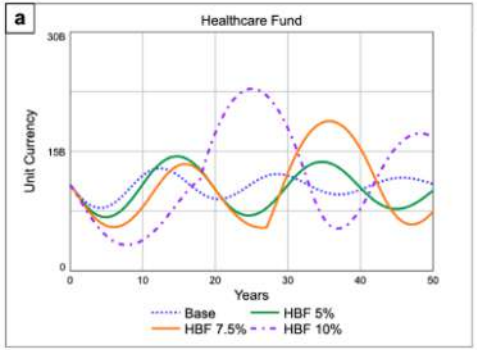
Reneging

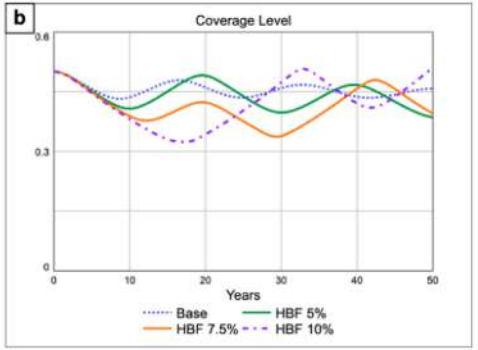


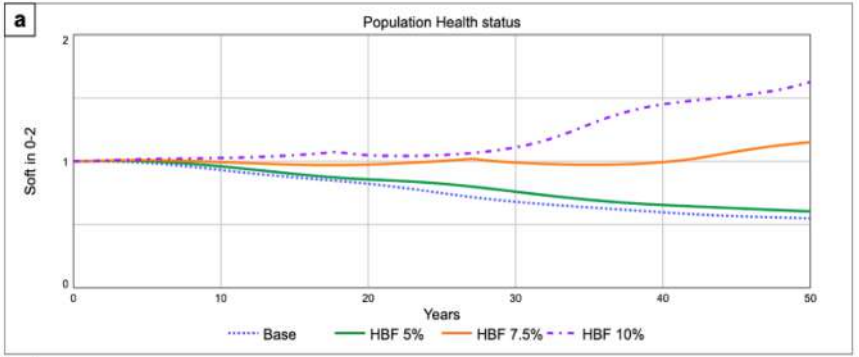
Policy Analysis - Capacity Building

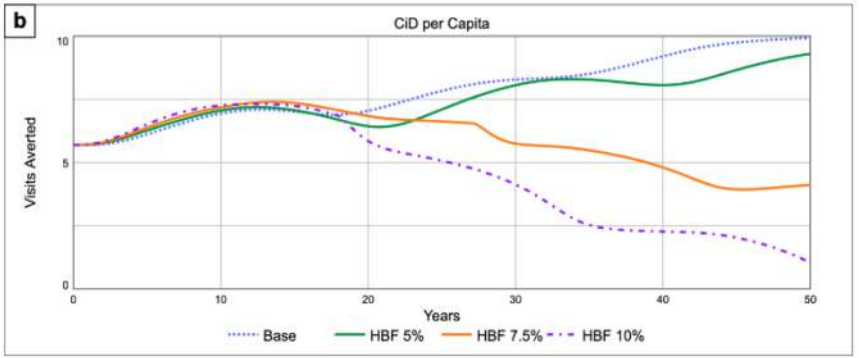












Modelling studies from previous ISDCs

2005 ISDC - Boston, MA, USA

Modeling the Health Insurance System of Germany: A System Dynamics Approach

Stefan Grösser

2015 ISDC - Cambridge, MA, USA

Financial Sustainability of Health Systems Dominated by Private Health Insurance

Nisa Önsel, Yaman Barlas