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

Universal Health Coverage Index

64%
of people are covered on essential service
WHO Global, 2015

❖ 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

Esping-Andersen’s *three worlds*

Three dimensions:
- Regulation
- Financing
- Provision

Three actor types
- State
- Society
- Private/Market


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<table>
<thead>
<tr>
<th>Healthcare system type</th>
<th>Regulation</th>
<th>Financing</th>
<th>Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal-type: State Healthcare System</td>
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<td>State</td>
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<tr>
<td>State-based mixed-type</td>
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<td>Societal</td>
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<td>State-based mixed-type</td>
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<td>Ideal-type: Societal Healthcare System</td>
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<td>Societal-based mixed-type</td>
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<tr>
<td>Ideal-type: Private Healthcare System</td>
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<td>Private-based mixed-type</td>
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<tr>
<td>Ideal-type: Private Healthcare System</td>
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<td>Private</td>
<td>State</td>
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<td>Pure mixed-type</td>
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<td>Societal</td>
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<tr>
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<td>Societal</td>
<td>State</td>
<td>Private</td>
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<tr>
<td>Coverage</td>
<td>Universal: everyone is automatically covered at birth (most countries) or after a certain age or condition (US Medicare and VA)</td>
<td>Non-universal: people have to acquire insurance. Some will remain uninsured.</td>
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<tr>
<td>Model</td>
<td>Single payer, single provider (also called Beveridge model or socialized medicine)</td>
<td>Single payer, multiple providers (also called Bismarck model, Sickness Funds or Social Health Insurance)</td>
<td></td>
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<tr>
<td></td>
<td>Healthcare is provided and financed by the government through taxes.</td>
<td>Healthcare is provided by doctors in private facilities. The majority of medical bills are paid by the government.</td>
<td></td>
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<tr>
<td></td>
<td>Employers and employees fund national health insurance through compulsory payroll taxes. Health insurance companies are private but non-profit, and are regulated.</td>
<td>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.</td>
<td></td>
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<td></td>
<td>Patients pay out-of-pocket for healthcare. They may or may not have private insurance privately or through their jobs.</td>
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<tr>
<td>Relevant</td>
<td>UK (10.2%)</td>
<td>Canada (10.5%) (=)</td>
<td>Germany (11.0%)</td>
</tr>
<tr>
<td>examples</td>
<td>Cuba (11.5%) (*)</td>
<td>Taiwan (6.60%) (=)</td>
<td>Switzerland (11.4%)</td>
</tr>
<tr>
<td>from the</td>
<td>Japan (11.4%)</td>
<td></td>
<td>Japan (11.4%)</td>
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<tr>
<td>world (and</td>
<td>The U.S. is the only industrialized country without universal health coverage. Overall, the US spends 17.2% of its GDP in healthcare.</td>
<td></td>
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</tr>
<tr>
<td>% of GDP</td>
<td>India (4.7%)</td>
<td></td>
<td>China (5.6%)</td>
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<tr>
<td>spent in</td>
<td></td>
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<td>healthcare</td>
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<td>US example</td>
<td>VA (Veterans Administration)</td>
<td>Medicare and part of Medicaid</td>
<td>Affordable Care Act (ACA)</td>
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<tr>
<td>Care coordination</td>
<td>● ● ● ●</td>
<td>● ● ●</td>
<td>● ●</td>
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<td>Cost control</td>
<td>● ● ● ●</td>
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</table>
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

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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)

<table>
<thead>
<tr>
<th>Configuration #</th>
<th>UVC Level</th>
<th>UVC Trend</th>
<th>CBR Trend</th>
<th>Scenario #</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>-</td>
<td>-</td>
<td>Scenario 1 (Base)</td>
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<tr>
<td>2</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>3</td>
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<td>5</td>
<td>-</td>
<td>-</td>
<td>Increasing</td>
<td>Scenario 5</td>
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<tr>
<td>6</td>
<td>Low</td>
<td>-</td>
<td>-</td>
<td>Scenario 6</td>
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<td>11</td>
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<td>Increasing</td>
<td>Decreasing</td>
<td>Scenario 11</td>
</tr>
</tbody>
</table>
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

Healthcare Fund

Cost-Sharing Level

Coverage level

Public Scheme Benefit Package

Population Health status

CID per Capita

Healthcare Buffer Variables

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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

Şanser Güz, Gönenç Yücel, Özge Karanfil
Model Structure - Healthcare Demand sector

**Crude Death Rate (World Bank)**

- 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

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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