

LACSH index: Modelling National Latent Socioeconomic Health and Examination of Policy Effects

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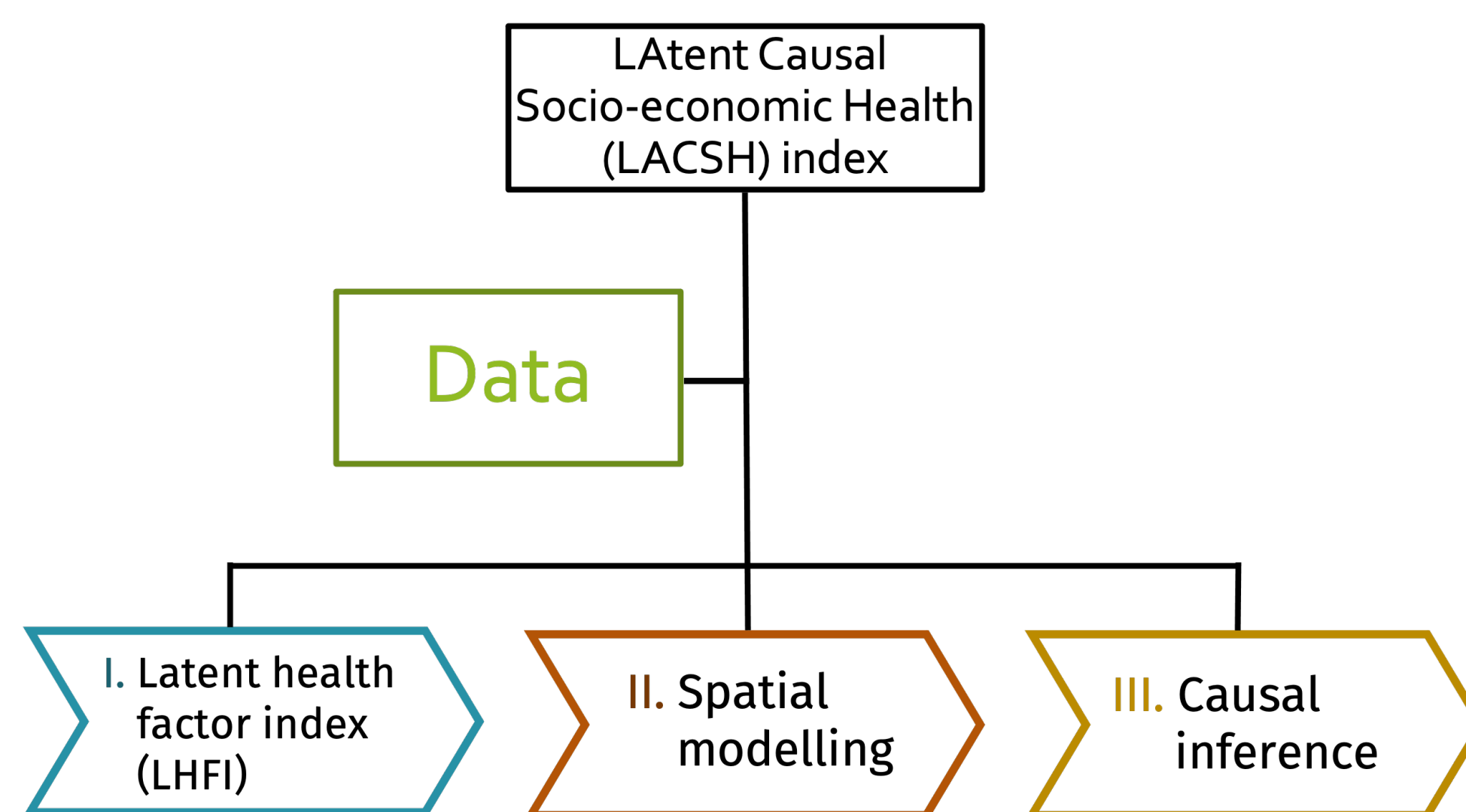
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MOTIVATION

- There exists many conventional ways of constructing indices in attempt to quantify a country's socio-economic health as **an alternative measure to Gross Domestic Product (GDP)**.
- But none to our knowledge so far that uses a **model-based approach** to reflect the notion of 'health' being inherently *latent*[1].
- Most existing indices only give us a point estimate where our approach gives a credible interval **to account for its uncertainty**.
- Causal modeling will allow us to **disentangle the causes and effects** embedded in the factors influencing health and the metrics.

LACSH BUILDING BLOCKS AND DATA



DATA

We utilise data on 120 nations. The current chosen set of metrics (Y), binary treatment variable (T) and covariates (X) are:

X, COVARIATES

- + Forest area
- + Mean years of schooling
- + Access to elec., rural
- + Popn., total

T, POLICY (TREATMENT) VARIABLE

- 1) Mandated maternity leave days (MML)
- 2) Government expenditure on health (GGHE) per capita

Y, METRICS

- + Education index
- + Popn., urban (% of total)
- + Corrupt. Percept. Index
- + POLITY index
- + Infant mortality rate
- + Employ. to popn. ratio(%)
- + Renewable energy consumption(%)
- + Popn. with ≥ secondary educ. (≥ 25 y/o %)
- + Popn. density
- + Popn., ages 65 and older
- + Life expectancy
- + GNI per capita
- + Unemploy. rate (%)
- + Internet users (% of popn.)
- + Prop. of parliamentary seats held by women (%)

MODEL

LHFI

$$y_i|a, H_i, \Sigma_Y \stackrel{ind.}{\sim} MVN(aH_i, \Sigma_Y)$$

$$H|\beta, T, R, \Sigma_H \sim TMVN(\mu, \Sigma_H)1\{H_{anc} < 0\}$$

$$T_i|Z_i^*, \gamma, \sigma_T^2 \stackrel{i.i.d.}{\sim} N(Z_i^* \gamma, \sigma_T^2)$$

$$\text{where } [\mu]_i = \beta_0 + \beta_1 T_i + \beta_2 T_i^2 + \beta_3 R_i + \beta_4 R_i^2 + \beta_5 T_i R_i$$

$$R_i = r(T_i, \gamma, Z_i^*, \sigma_T^2)$$

$$= \frac{1}{\sqrt{2\pi}\sigma_T} \exp\left(-\frac{1}{2\sigma_T^2}(T_i - Z_i^* \gamma)^2\right)$$

$$\Sigma_H = \sigma_H^2 \Omega(d, \phi)$$

$$\Omega(d, \phi) = \begin{bmatrix} 1 & \rho_{12} & \cdots & \rho_{1n} \\ \rho_{21} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \rho_{n-1,n} \\ \rho_{n1} & \cdots & \rho_{n,n-1} & 1 \end{bmatrix}$$

$$\rho_{nm} = \exp(-d_{nm}/\phi) = \rho_{mn}$$

Spatial modelling

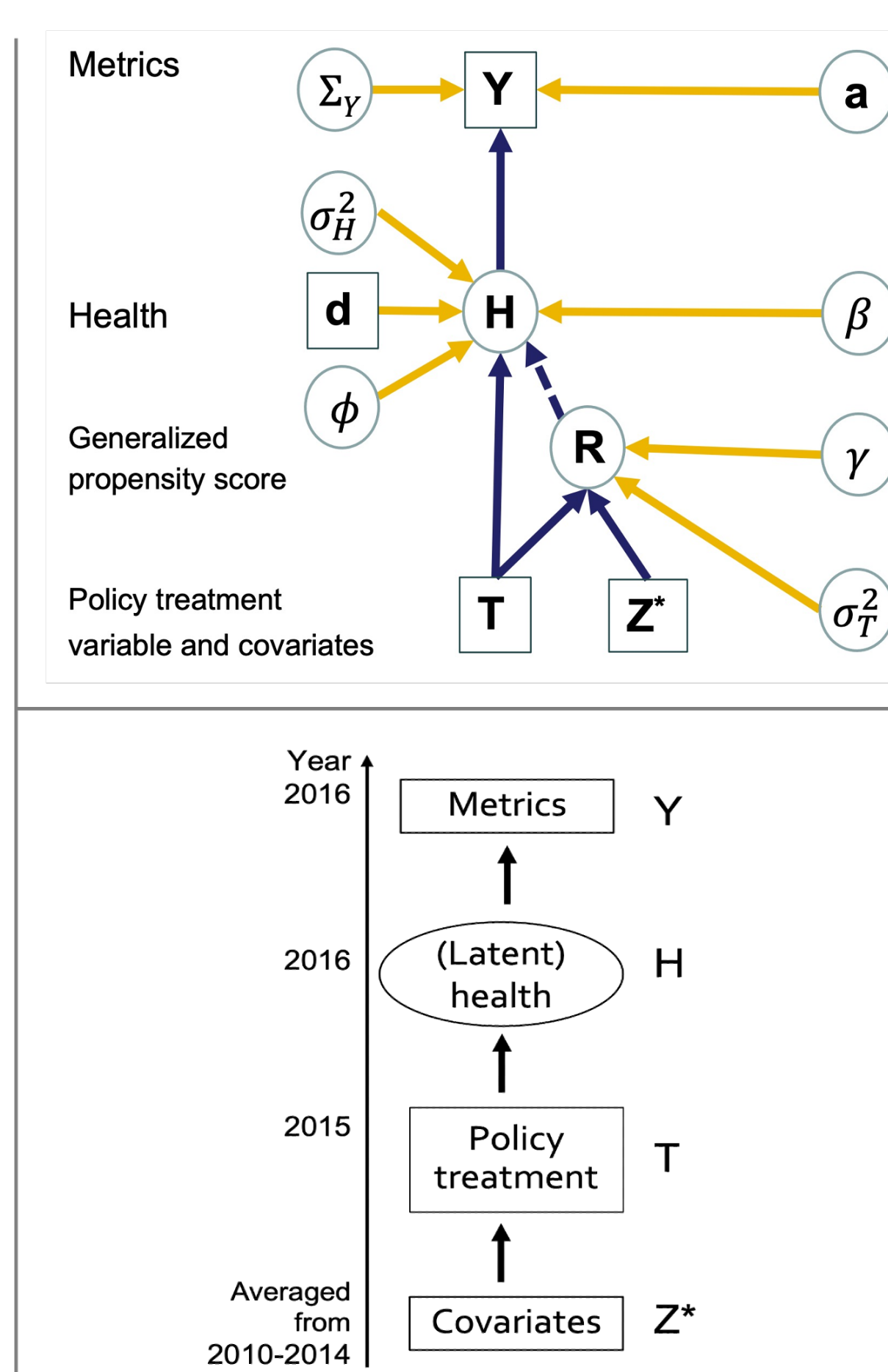


FIG. 1: TOP PANEL: Directed acyclic graph (DAG) (dark purple arrow) and the models inference graph (all arrows) where the dashed arrow indicates cutting the feedback.

BOTTOM PANEL: Extension of the Latent Health Factor Index (LHFI) framework with causal modeling.

AVERAGE DOSE RESPONSE CURVE

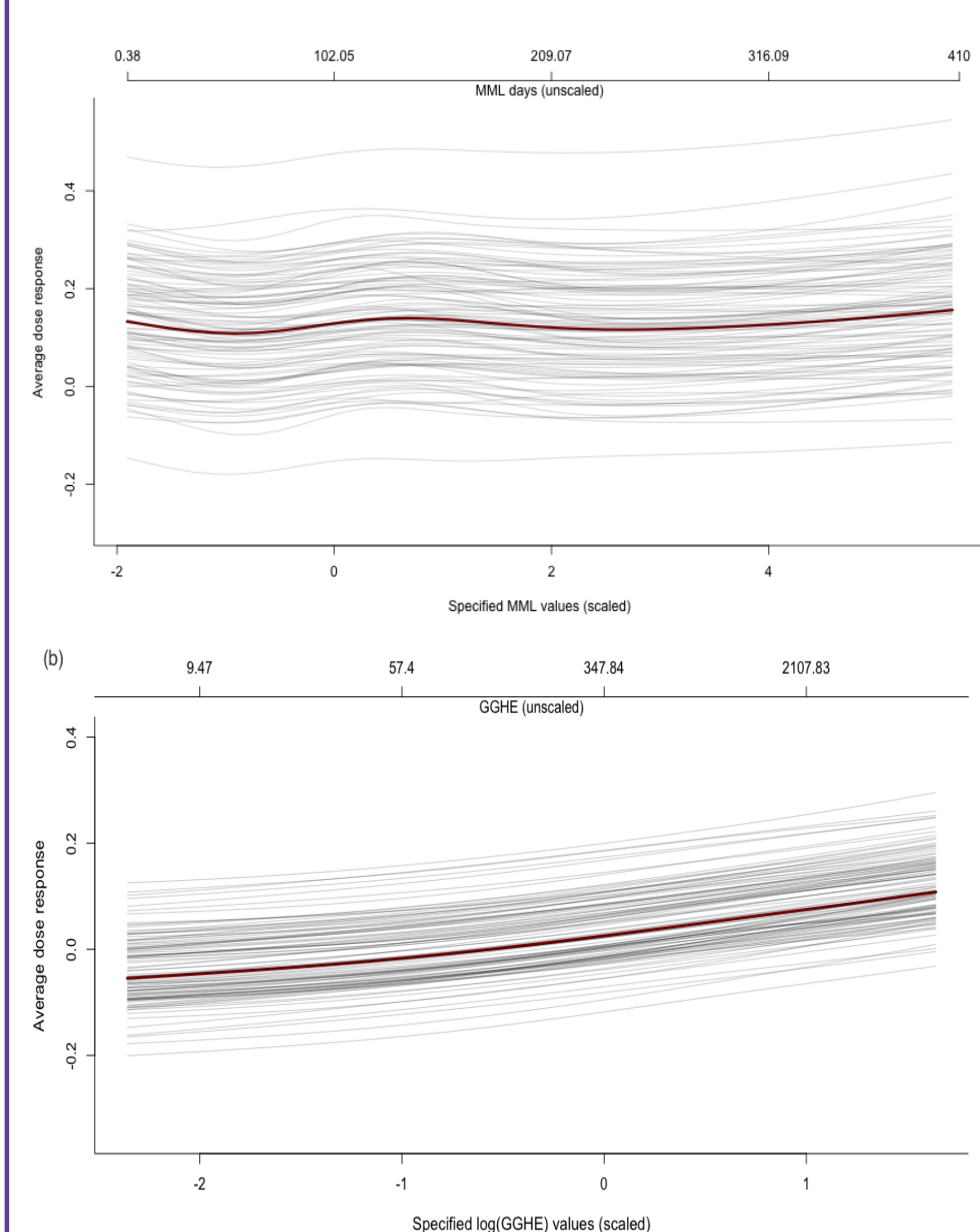


Fig. 2: Examination of policy effects of (a) MML and (b) GGHE on latent health

RANKING COMPARISON ACROSS LACSH 1.0 (MML), SPI, HDI, LACSH 2.0 (GGHE)

IncomeGroup — High income — Upper middle income — Lower middle income — Low income

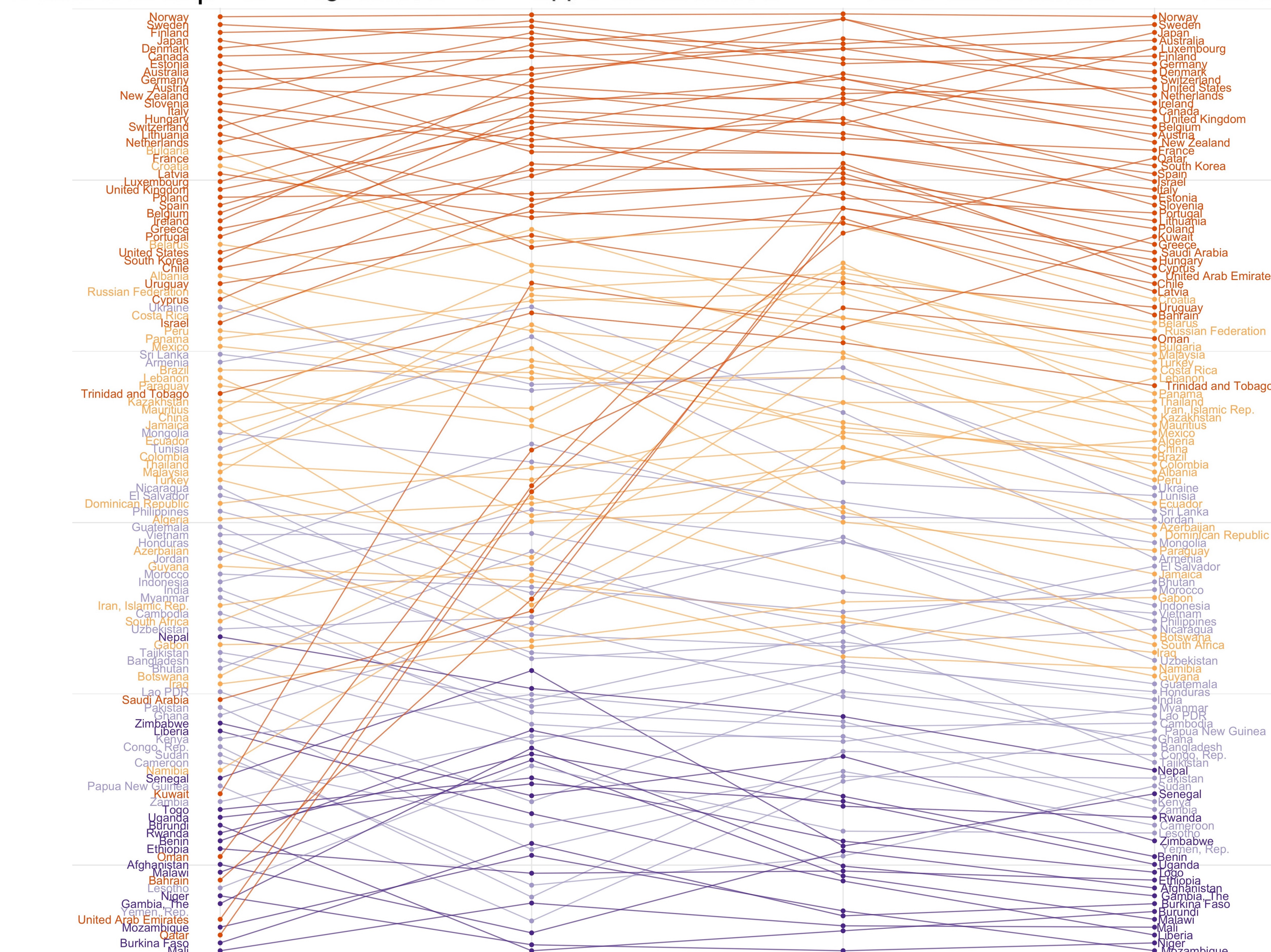


Fig. 3: Ranking comparison across LACSH 1.0 (using MML as treatment variable), Social Progress Index (SPI), Human Development Index (HDI), LACSH 2.0 (using GGHE as treatment variable)

POSTERIOR RANKS

Country	5%	50%	95%	Country	5%	50%	95%
Norway	1	2	10	Netherlands	4	11	17
Sweden	1	4	11	Ireland	4	12	18
Australia	1	5	16	Canada	4	13	20
Japan	1	5	15	Austria	6	14	19
Finland	2	7	15	Belgium	6	14	18
Luxembourg	1	7	14	United Kingdom	6	14	19
Switzerland	2	8	16	New Zealand	5	15	21
Germany	2	8	15	France	9	16	20
Denmark	2	8	16	South Korea	16	21	29
United States	2	9	17	Qatar	10	21	33

Table 1: Posterior median ranks of countries in LACSH 2.0 with GGHE as treatment variable, and associated 90% credible intervals

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