

QUANTIFYING MENTAL HEALTH

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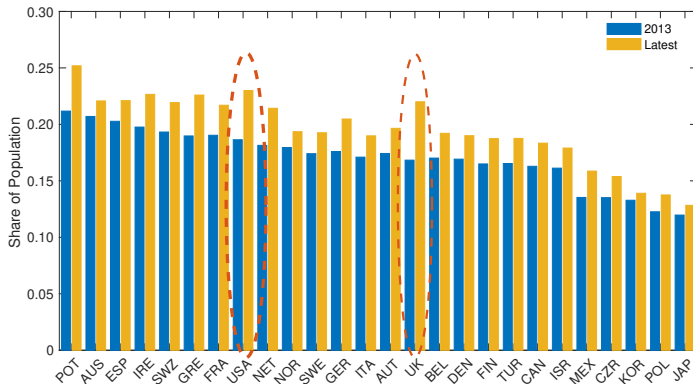
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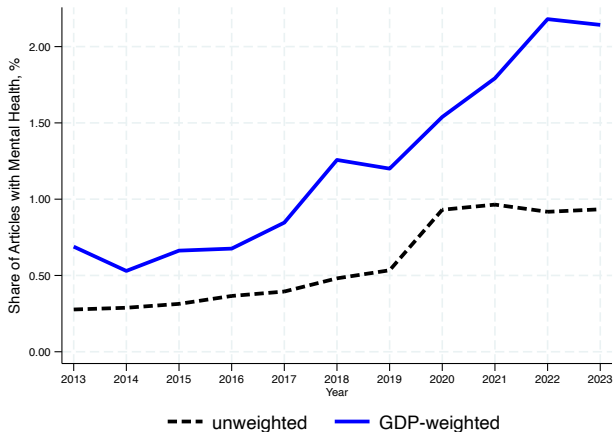
THE STATE OF GLOBAL MENTAL HEALTH



Notes: Fraction of the whole population affected by mental illness. Source: Global Burden of Disease 2025 Database

- Share of the population that is affected by mental illness is rising

THE RISE OF MENTAL HEALTH RISK



Notes: Unweighted and GDP-weighted averages of national shares of articles that contain “mental health”. Sample: 37 countries and 67 news outlets. Source: authors’ calculation and Factiva.

► Increased attention from newspapers around the world

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Research Question: What are the positive and normative implications of rising mental health risk?

WHAT IS MENTAL HEALTH?

- ▶ Minor stress -> neuro-immunal adaptation -> allostasis -> homeostasis
- ▶ Excess stress -> allostatic overload (McEwen 1998) -> poor health outcomes (Guidi et al 2021)
- ▶ E.g. low control at work increases hypertension and heart disease risk (Schnall et al 1992, Bosma et al 1997)
- ▶ **Psychological** impulse, **physiological** impact

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- ▶ **Psychological** impulse, **physiological** impact
- ▶ **Our approach:** mental health as a **measurable, durable object**; can deplete (stress) and replenish (treatment)
- ▶ Mental health impacts utility (quality of life), productivity (focus, control), and longevity (death risk)
- ▶ Full information and rational expectations

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 - ▶ Tax-funded disability benefits and unemployment insurance

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 - ▶ Aggregate mental health **externality** — human capital ingredient

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 - ▶ Optimal tax-funded mental health **subsidy**

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2. New facts on the global rise of mental health risk

- ▶ News outlets (39 countries), US congress hearings, earnings calls

MAIN RESULTS

1. Positive

- ▶ Equilibrium poverty-depression traps
- ▶ Overcoming the treatment stigma **lowers** C but **increases** welfare \mathcal{W}
- ▶ Canceling disability benefits can **lower** C and \mathcal{W}

MAIN RESULTS

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2. Normative

- ▶ Optimal mental health subsidy = **3%** of GDP
- ▶ Can **increase** mental well-being, treatment prevalence, and output
- ▶ Impact on welfare unclear; depends crucially on the stigma
- ▶ Combine with welfare-preserving stigma compensation
- ▶ Practical policy = **treatment subsidy** + **de-stigmatization communication**

LITERATURE

- ▶ **Physiologic response to stress** - Selye (1936), McEwen (1998), Guidi et al. (2021)
- ▶ **Health as a durable capital good** - Grossman (1972), Ehrlich and Chuma (1990), Dalgaard and Strulik (2014)
- ▶ **Investment in human capital** - Mincer (1958), Becker (1962)
- ▶ **Health and macro** - De Nardi (2004), Capatine (2015), Russo et al (2024), Nardi et al. (2025), Russo (2025), Ashwin et al (2025), Danesh et al (2025)
- ▶ **Mental health and macro** - Abramson, Boerma, and Tsyvinski (2025), Naik (2025), Schindler and Scott (2025)

Model

STANDARD MODEL

- ▶ Canonical [Aiyagari \(1994\)](#) heterogeneous-agent framework
- ▶ Time is discrete and infinite: $t = 0, 1, \dots$
- ▶ Unit-mass continuum of ex-ante identical households
- ▶ Endogenous capital accumulation: $a_t \geq \underline{a}$
- ▶ Idiosyncratic employment risk: $z_t \in \{0, 1\}$ and income $y_t(a, z)$
- ▶ Unemployment insurance $(1 - z)uw$, $0 \leq u \leq 1$

PREFERENCES

- ▶ Durable mental health stock: $\mathbf{m}_t \geq \underline{\mathbf{m}}$
- ▶ Agents maximize: $\mathbb{E} \sum_{t=0}^{\infty} \beta^t \mathcal{U}(c_t, \mathbf{m}_t, t_t)$
- ▶ Utility flow: $\mathcal{U}(c, \mathbf{m}, t) = \log(c) + \varphi_{\mathbf{m}} \log(\mathbf{m}) - \varphi_t t$
- ▶ Mental health and quality of life: $\mathcal{U}_{\mathbf{m}} > 0, \mathcal{U}_{\mathbf{m}\mathbf{m}} < 0$
- ▶ Consumption-mental health trade-off: $\varphi_{\mathbf{m}} > 0$
- ▶ Treatment effectiveness function: $\psi(i), \psi' > 0, \psi'' < 0$
- ▶ Treatment cost function: $\xi t, \xi > 0$
- ▶ Treatment stigma: $\varphi_t > 0$
- ▶ Mental health depreciation: $\delta_{\mathbf{m}}$

TECHNOLOGY

- ▶ Mental health and productivity: $(1 + \zeta_{\mathbf{m}})zw$
- ▶ Idiosyncratic stress risk: $s_t \in \{0, 1\}$
- ▶ Stress damage function: $\vartheta_s s + \vartheta_z(1 - z)$
- ▶ Endogenous death risk: $\varepsilon(\mathbf{m}), \varepsilon' < 0$
- ▶ Disability benefits: $sdw, 0 \leq d \leq 1$
- ▶ Ergodic labor income tax: $\tau = \frac{\lambda_u}{\lambda_e}u + \frac{\lambda_s}{\lambda_e}d$
- ▶ 4-state (employment x stress) Markov transition matrix: Π
- ▶ Labor hours L normalized to 1

AGGREGATION

- ▶ Cross-sectional distribution: $\mu(a, \mathbf{m}, z, s)$
- ▶ Aggregate stock of capital: $K_t = \int a d\mu$
- ▶ Law of motion of capital: $K_{t+1} = (1 - \delta)K_t + I_t$
- ▶ Aggregate stock of mental health: $M_t = \int \mathbf{m} d\mu$
- ▶ Final goods production: $Y_t = K_t^\alpha M_t^\gamma L^{1-\alpha-\gamma}$
- ▶ Market return: $r = \alpha \left(\frac{K_t}{L} \right)^{\alpha-1} \left(\frac{M_t}{L} \right)^\gamma - \delta$
- ▶ Wage rate: $w = (1 - \alpha - \gamma) \left(\frac{K_t}{L} \right)^\alpha \left(\frac{M_t}{L} \right)^\gamma$
- ▶ Market clearing: $C_t + I_t + I_t^m = Y_t$

HOUSEHOLD PROBLEM

$$V_t(a, \mathbf{m}, z, s) = \max_{c \geq 0, a' \geq \underline{a}, t \geq 0} \log(c) + \varphi_m \log(\mathbf{m}) - \varphi_t t +$$

$$\beta \mathbb{E}_{z', s'} \left[(1 - \varepsilon(\mathbf{m}')) V_{t+1}(a', \mathbf{m}', z', s') | z, s \right]$$

subject to:

$$c + a' + \xi t \leq (1 + r)a + zw(1 - \tau)(1 + \zeta \mathbf{m}) + (1 - z)uw + sdw$$

$$\mathbf{m}' = (1 - \delta_m)\mathbf{m} + \phi(t) - \vartheta_s s - \vartheta_z(1 - z)$$

$$a' \in \mathcal{K}, \mathbf{m}' \in \mathcal{N}, t \in \mathcal{T}$$

$$a' \geq \underline{a}$$

$$\mathbf{m}' \geq \underline{\mathbf{m}}$$

CALIBRATION

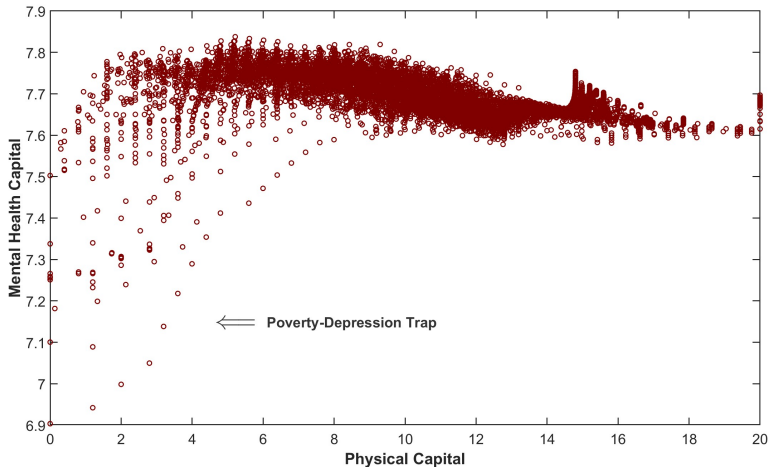
Standard			
	Description	Value	Target
\underline{a}	Lower bound on physical capital	-1	Standard
z_t	Idiosyncratic employment risk	{0,1}	Unemployed or Employed
u	Unemployment insurance, % of average wage	0.16	Institute for Fiscal Studies
β	Discount factor	0.96	Standard
α	Physical capital share	0.3	Standard
δ	Physical capital depreciation rate	0.025	standard
Mental Health			
γ	Mental health capital share	0.05	Expenditure share in UK
\underline{m}	Lower bound mental health capital	0.01	Normalization
s_t	Idiosyncratic stress risk	{0,1}	Stressed or Not Stressed
d	Disability benefit, % of average wage	0.14	Institute for Fiscal Studies
φ_t	Treatment stigma	0.58	Rethink.org
φ_m	Mental health in utility	0.25	
ψ_1	Treatment effectiveness, linear	1	
ψ_2	Treatment effectiveness, quadratic	0.6	
ξ	Treatment cost, linear	1	
δ_m	Mental health depreciation rate	0.1	
ζ	Mental health and individual productivity	0.25	
ϑ_s	Allostatic load from stress state	0.5	
ϑ_z	Allostatic load from unemployment state	0.5	
ε_0	Death risk, constant	0.01	
ε_1	Death risk, linear	-0.001	

CALIBRATION

Parameter	Description	Value	Target
Π_{zs}	Transition matrix	[0.09 0.01 0.6 0.3; 0.09 0.01 0.6 0.3; 0.08 0.02 0.2 0.7; 0.08 0.02 0.2 0.7]	Ergodic shares
$\lambda_{z=0,s=1}$	Unemployed and stressed	8.1%	IFS
$\lambda_{z=0,s=0}$	Unemployed and not stressed	1.9%	IFS
$\lambda_{z=1,s=1}$	Employed and stressed	24%	IFS
$\lambda_{z=1,s=0}$	Employed and not stressed	66%	IFS

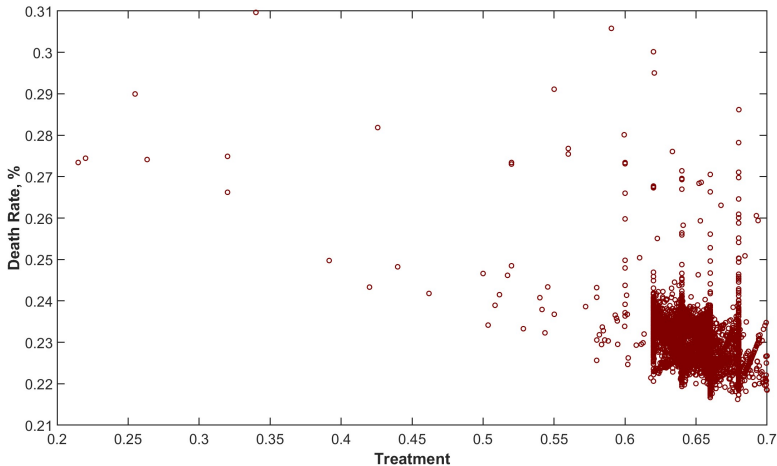
Positive Analysis

POVERTY-DEPRESSION TRAPS



Joint distribution of wealth, a , and mental health, m

PREVENTABLE DEATHS



Joint distribution of treatment, t , and death rate, $\varepsilon(m)$

OVERCOMING MENTAL HEALTH STIGMA

Panel A: Treatment Stigma		
	Baseline	No Stigma
Stigma	0.5	0
Panel B: Aggregate Outcomes		
	Baseline	No Stigma
Consumption	1.183	0.891
Output	2.091	2.178
Physical Capital	10.474	11.489
Mental Health Capital	7.598	9.904
Treatment	0.646	1.000
Death Rate	0.231	0.000
Welfare	0.352	0.458

Policies that tackle mental health stigma can be (very) welfare-improving

A key research area in psychology (Fox et al 2017)

Happy-but-poor equilibrium? Not quite

Money does buy happiness but happiness \neq consumption

CANCELLING DISABILITY BENEFITS

Panel A: Policy Choice		
	Baseline	No Disability Benefits
Stigma	0.14	0
Panel B: Aggregate Outcomes		
	Baseline	No Disability Benefits
Consumption	1.183	1.160
Output	2.091	2.118
Physical Capital	10.474	10.855
Mental Health Capital	7.598	7.935
Treatment	0.646	0.687
Death Rate	0.231	0.202
Welfare	0.352	0.323

Disability benefits crowd out physical investment and reduce GDP

But can increase consumption and welfare (especially of the treated)

Normative Analysis

OPTIMAL MENTAL HEALTH SUBSIDY

Consider the production function:

$$Y_t = K_t^\alpha M_t^\gamma L^{1-\alpha-\gamma}$$

Aggregate mental well-being externality: $\gamma > 0$, $\alpha + \gamma < 1$

Marginal product of aggregate M_t :

$$\frac{\partial Y}{\partial M} = \gamma K^\alpha M^{\gamma-1} L^{1-\alpha-\gamma}$$

The present value of the increase in output:

$$PV = \left. \frac{\partial Y}{\partial M} \right|_{(K^*, M^*)} \times \psi'(T^*) \times \frac{1}{1 - \beta(1 - \delta_m)}$$

OPTIMAL MENTAL HEALTH SUBSIDY

Using the marginal product of M evaluated at (K^*, M^*) :

$$PV = \left[\gamma (K^*)^\alpha (M^*)^{\gamma-1} L^{1-\alpha-\gamma} \right] \psi'(T^*) \frac{1}{1 - \beta(1 - \delta_m)}$$

Pigouvian mental health subsidy s^* :

$$s^* = \frac{\gamma (K^*)^\alpha (M^*)^{\gamma-1} L^{1-\alpha-\gamma} \psi'(T^*)}{1 - \beta(1 - \delta_m)}$$

Treatment is now purchased at the subsidized price $(1 - s^*) \cdot \xi$

Subsidy is financed by a lump-sum tax on workers

Extra transfer: Compensate for the dis-comfort from more treatment

REGULATED EQUILIBRIUM

Panel A: Policy Choice

	Baseline	Subsidy Only	Both Policies
Treatment Subsidy	0.00	0.07	0.07
Welfare Preserving Transfer	0.00	0.00	0.03

Panel B: Aggregate Outcomes

	Baseline	Subsidy Only	Both Policies
Consumption	1.183	1.160	1.191
Output	2.091	2.106	2.092
Physical Capital	10.474	10.662	10.449
Mental Health Capital	7.598	7.880	7.829
Treatment	0.646	0.680	0.674
Death Rate	0.231	0.207	0.211
Welfare	0.352	0.324	0.352

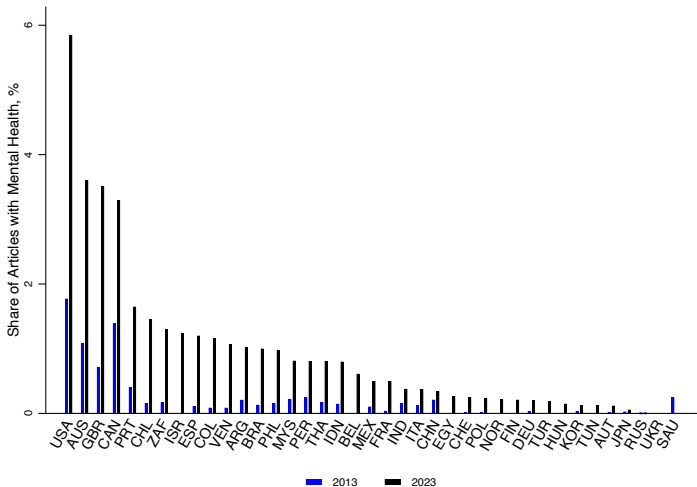
The private market (baseline) under-invests in mental health treatment

Subsidy raises output but extra dis-utility from more treatment

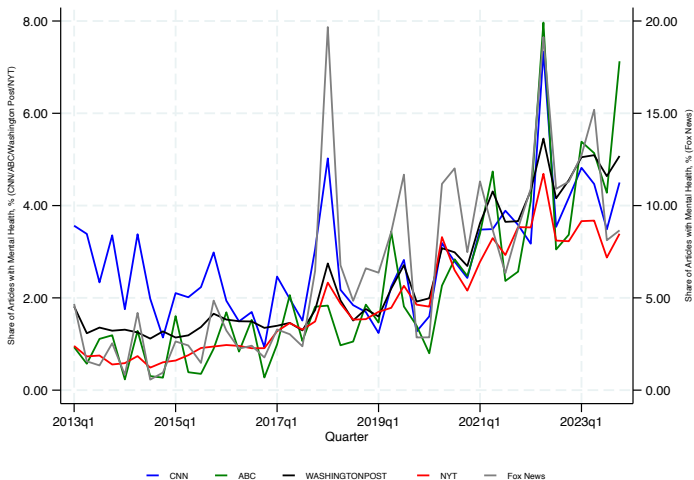
Subsidy + transfer policy raises consumption and is welfare-neutral

Aggregate Data

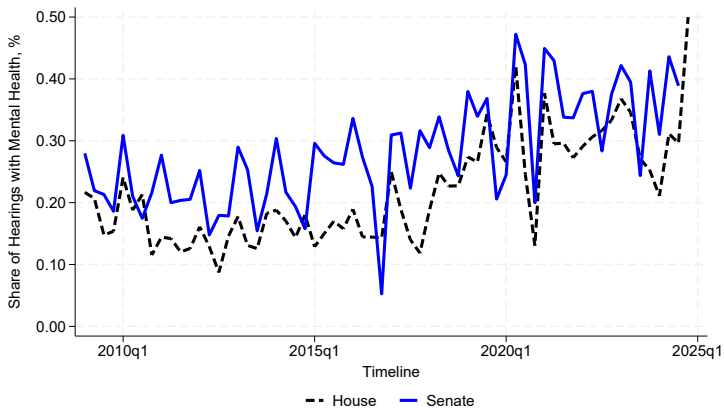
THE GEOGRAPHY OF NEWS-BASED MENTAL HEALTH RISK



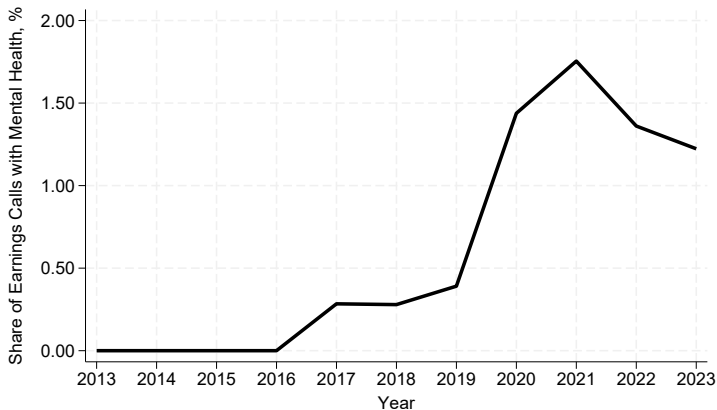
US NEWSPAPERS



US CONGRESS HEARINGS



EARNINGS CALLS



CONCLUSION

- ▶ A macroeconomic model of mental health; no deviation from FIRE
- ▶ Mental well-being as a form of human capital
- ▶ Measurable, durable good - depreciates and replenishes
- ▶ Stigma is critical: measurement and identification are hard
- ▶ Externality and under-investment
- ▶ Public intervention should combine subsidies with communication policy
- ▶ My future work: “Irrational Addiction”