# The state of the model

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How much does mental health (MH) inequality matter for lifetime
earnings inequality?
Eventually: how much does lifetime earnings inequality matter for
mental health inequality?

- Estimate a life-cycle model of consumption, labor, wealth with
  heterogeneous MH

- Run counterfactuals with no MH inequality, compare
  earnings/labor inequality

- Run counterfactuals with no lifetime earnings/labor inequality,
  compare mental health inequality

## Model in words

- Households (HH) live $J$ periods
- Derive utility from consumption and leisure
- Make continuous choices in labor $n$, consumption $c$, and future assets $a'$
    - Note: may switch to discrete labor choice in future
- Constrained by expendable income and time endowment
- Wage follows a quadratic process in age and agents smooth consumption by saving
- Assets must remain above a borrowing constraint
- Two kinds of types are decided at birth
    - Health type $H$ (bad, good) which effects the total time endowment
    - Labor productivity $\gamma$ (low, medium, medium high, high) effects the wage process

## Utility and time endowment

Individuals derive period utility from consumption and leisure

$$u\left(c_j, l_j\right) = \frac{\left(c_j^{\alpha} l_j^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}$$

where the time endowment is s.t.

$$l_j = 1 - \phi_n n_j - \phi_H \left(1 - H\right)$$

$\phi_n$ the time cost of work $> 1$ to account for commuting etc, $\phi_H$ is the time cost of bad health, $H \in \{0, 1\}$ is health status

## Consumption constraints

Choices must be s.t.

$$c + a' = z\left(\gamma, j, H\right) \cdot n + a\left(1 + r\right); \forall j$$

$$a_0 = a_{J+1} = 0;$$

and

$$a_j > -\kappa, \text{ and } c_j, n_j \geq 0; \forall j.$$

With $\ln z\left(\gamma, j, H\right) = w_{0\gamma_i} + w_1 j + w_2 j^2 + w_H H$ where the linear coefficient depends on productivity type $\gamma_i$. $\kappa$ is the borrowing constraint.

## HH sequential optimization problem

$$\max_{\{c_j, n_j, a_{j+1}\}} \sum_{j=0}^{j=J} u\left(c_j, 1 - \phi_n n_j - \phi_H \left(1 - H\right)\right)$$

s.t.

$$\sum_{j=0}^{j=J} \frac{c_j - z\left(\gamma, j\right) n_j}{(1+r)^j} = 0$$

or equivalently

$$c_j + a_{j+1} = z\left(\gamma, j, H\right) + a_j \left(1 + r\right); \forall j$$

$$a_0 = a_{J+1} = 0;$$

with $a_j > -\kappa$, and $c_j, n_j \geq 0; \forall j$.

## HH recursive optimization problem

The individual's problem:

$$V_j(a, \gamma, H) = \max_{c, n, a'} \left\{ u\left(c, 1 - \phi_n n - \phi_H(1 - H)\right) + \beta V_{j+1}(a', \gamma, H) \right\}$$

s.t.

$$c + a' = z(\gamma, j, H) \cdot n + a(1 + r); \forall j$$

$$a_0 = a_{J+1} = 0;$$

and

$$a_j > -\kappa, \text{ and } c_j, n_j \geq 0; \forall j$$

## Exogenous parameters

The benchmark exogenous parameters are set as follows

- $R$ is set to a reasonable value for the risk free rate
- $\beta$ is set equal to $\frac{1}{R}$
- $\sigma$ the CRRA parameter is set close to 1 so utility
  $\rightarrow \log\left(c_j^{\alpha} l_j^{1-\alpha}\right)$
- $\phi_H$ the health time cost is taken approximately from Capatina (2015)
- $\phi_n$ labor time cost is set so that $0.40\phi_n = 0.45$ Capatina (2015)
    - i.e. 40 hour work week requires 5 additional hours commuting etc.
- $\omega_{H=1}$ population weight of the healthy is set to match cutoffs suggested in UKHLS data
- $[w_{0\gamma 1}, w_{0\gamma 2}, w_{0\gamma 3}, w_{0\gamma 4}]$ set at $[5, 10, 15, 20]$

## Calibrated parameters overview

The endogenous parameters are calibrated to match data moments as follows

- Wage process parameters
    - The weights on $w_{0_{\gamma_i}}$ are set so that mean and std. dev. of wage match the data at $j = 0$
    - $w_1$ is set so that wage growth matches that from beginning of life to peak wage
    - $w_2$ is set so that wage decline matches that from the peak wage to end of life
    - $w_H$ is set so that the wage premium matches the average premium for being healthy
- $\alpha$ is set so that weighted mean hours worked over the lifecycle match mean hours worked in the data

# Endogenous calibration process

1. Generate weights on $w_{0_{\gamma_i}}$ s.t. that the mean and sd. of wages at $j = 0$ match the data.

2. Calibrate $w_1$ so that wage growth from the $j = 0$ wage to the max wage matches that in the data
   - Check the tolerance for $w_1$ and the weighted $w_{0_{\gamma_i}}$ moments (which remain unchanged), if not within tolerance go back to step 1

3. Calibrate $w_2$ so that wage decline from the max wage to the wage at $j = J$ matches that in the data
   - Check the tolerance for $w_2$, $w_1$ and the $w_{0_{\gamma_i}}$ moments, if not within tolerance go back to step 1

4. Calibrate $w_H$ so that wage decline from the max wage to the wage at $j = J$ matches that in the data
   - Check the tolerance for $w_H$, $w_2$, $w_1$ and the $w_{0_{\gamma_i}}$ moments, if not within tolerance go back to step 1

# Exogenous parameters 1

| Parameter | Description | Value | Source |
|-----------|-------------|-------|--------|
| $R$ | Gross interest rate | 1.02 | Benchmark |
| $\beta$ | Patience | 0.9804 | $1/R$ |
| $\sigma$ | CRRA | 0.9999 | Benchmark |
| $\phi_n$ | Labor time-cost | 1.125 | Benchmark |
| $\phi_H$ | Health time-cost | 0.1 | Benchmark |
| $\omega_{H=1}$ | Healthy pop. weight | 0.5 | UKHLS |
| $\omega_{H=0}$ | Unhealthy pop. weight | 0.5 | $1 - \omega_{H=1}$ |

# Calibrated parameters 1

| Parameter | Description | Par. Value | Target Moment | Target Value | Model Value |
|-----------|-------------|------------|---------------|--------------|-------------|
| $\alpha$ | $c$ utility weight | 0.4023 | Mean hours worked | 33.85 | 33.79 |
| $w_1$ | Linear wage coeff. | 0.0196 | Wage growth | 25.68% | 25.75% |
| $w_2$ | Quad. wage coeff. | -0.0004 | Wage decay | 20.29% | 20.27% |
| $w_H$ | Health wage coeff. | 0.0488 | Healthy wage premium | 4.83% | 4.88% |

# Calibrated parameters 2: weights and wage constant

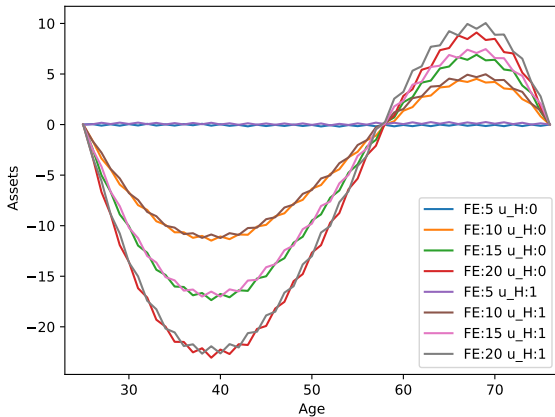| Constant wage coeff. | Ability Level | Value | Weight |
|---|---|---|---|
| $w_{0\gamma_1}$ | Low | 5 | 0.02 |
| $w_{0\gamma_2}$ | Medium | 10 | 0.52 |
| $w_{0\gamma_3}$ | Medium High | 15 | 0.42 |
| $w_{0\gamma_4}$ | High | 20 | 0.04 |
| Target Moment | Target Value | Model Value | |
| Mean wage, $j=0$ | 12.664 | 12.664 | |
| SD wage, $j=0$ | 3.135 | 3.135 | |

# Aggregate wage fit
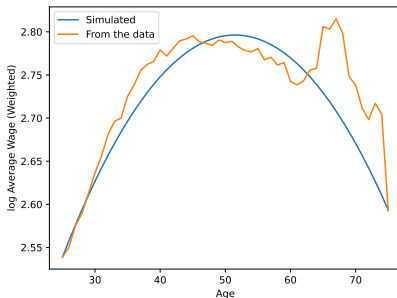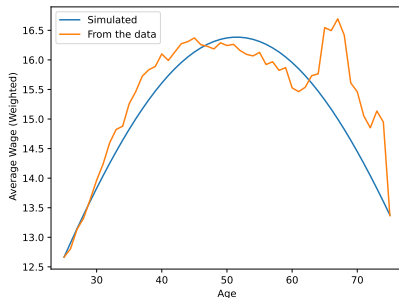
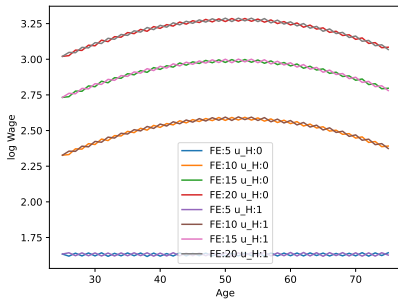# Aggregate labor fit
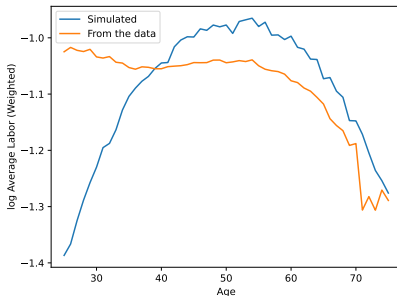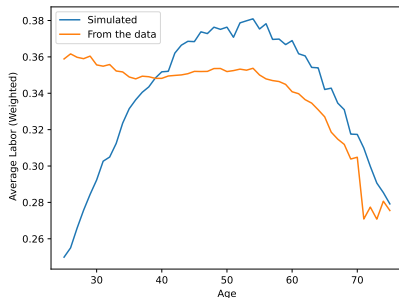
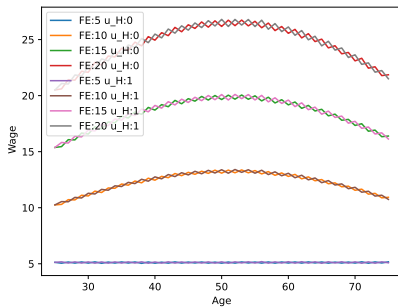# Aggregate employment fit
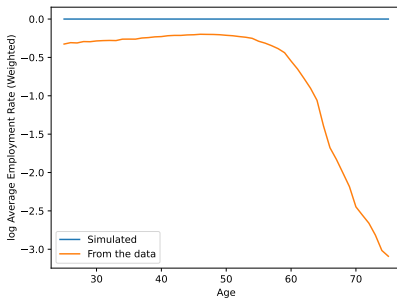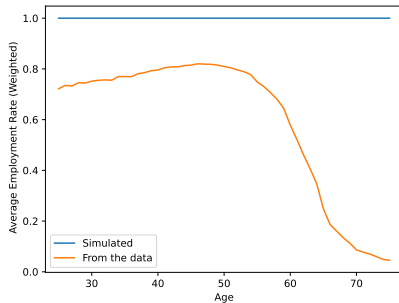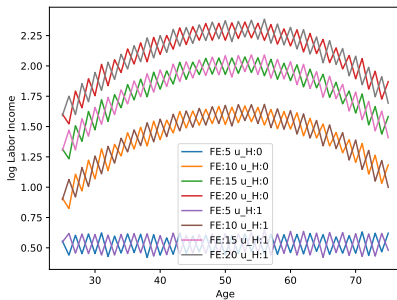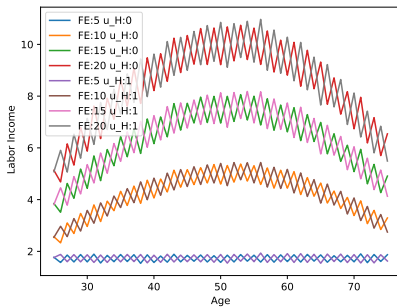
# Labor profiles
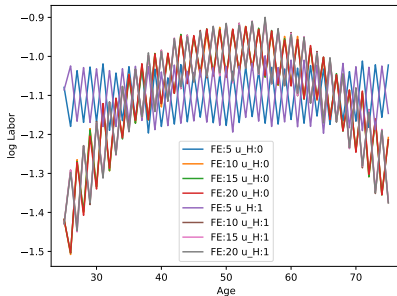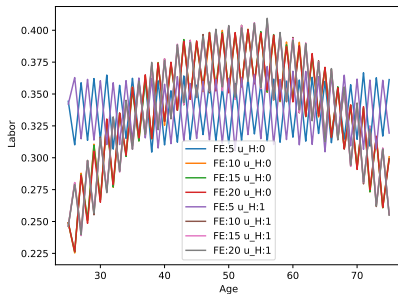
# Consumption profiles
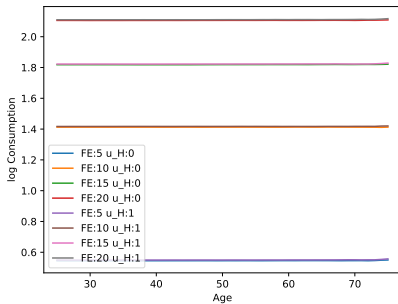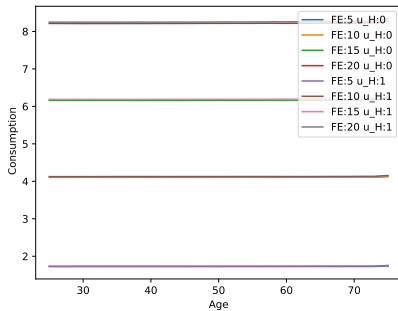
# Asset profiles

# Wage profiles

# Labor income

## Mental Health: Next steps

- AR(1) process for health
  - $H = \rho_H H + \varepsilon_H, \varepsilon_H \sim \mathcal{N}\left(\mu_{\varepsilon_H}, \sigma_{\varepsilon_H}\right)$
  - Estimate $\rho_H, \mu_{\varepsilon_H}, \sigma_{\varepsilon_H}$
  - "Theory" of evolution of health types?
    - Additive vs multiplicative in the evolution of health?
    - Discrete health types so will be implemented discretely

- Slides on Abramson et al. (2024)

## Other steps

- Slides on Jolivet and Postel-Vinay (2020)
- Slides on Cronin et al. (2023), De Nardi et al. (2021), Hosseini et al. (2021)
- Fixed cost of labor
- Survival probabilities
- Feedback between mental health and jobs
    - might emphasize the two way causality angle
    - e.g. unemployment, stress $\implies$ poor MH

# Thank You!

**Thank you!**

Any questions? I appreciate your feedback!

# References

📄 Abramson, Boaz, Job Boerma, and Aleh Tsyvinski (Apr. 11, 2024). *Macroeconomics of Mental Health*. DOI: 10.2139/ssrn.4793015. URL: https://papers.ssrn.com/abstract=4793015 (visited on 04/17/2024). Pre-published.

📄 Capatina, Elena (Sept. 1, 2015). "Life-Cycle Effects of Health Risk". In: *Journal of Monetary Economics* 74, pp. 67–88. ISSN: 0304-3932. DOI: 10.1016/j.jmoneco.2015.06.002. URL: https://www.sciencedirect.com/science/article/pii/S030439321500063X (visited on 11/16/2023).

📄 Cronin, Christopher J, Matthew P Forsstrom, and Nicholas W Papageorge (2023). "What Good Are Treatment Effects without Treatment? Mental Health and the Reluctance to Use Talk Therapy". In.