

# Decomposing lifetime income inequality

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# Introduction

- Inequality of **annual** income has been studied extensively
  - Income taxes and transfer programs provide insurance and redistribution and have powerful effects on inequality of annual income
  - Inequality of annual income partly driven by transitory shocks or age-specific events.
- We focus instead on inequality of **lifetime** income
  - Define lifetime income as all income from first entering the labor force until age 60
  - Emerging literature exploring inequality of lifetime earnings
  - No clear evidence how taxes and transfers affect different dimensions of inequality of lifetime income

## Introduction: Aim of this paper

- The aim of this paper is to decompose lifetime income inequality and to provide evidence about the distributive and insurance function of taxes and transfers when focusing on lifetime income

# Introduction: Lifetime income inequality

- The inequality of lifetime income inequality can be decomposed into two components:
  - 1 Between-endowment inequality of lifetime income
    - Difference in expected lifetime income due to differences in endowments
  - 2 Within-endowment inequality of lifetime income
    - Difference in realized lifetime income due to individuals experiencing different shocks or making different choices conditional on endowments

# Introduction: Function of fiscal policy

- **Redistributive** function of fiscal policy: Effect of taxes and transfers on between-endowment inequality of lifetime income
  - Best assessed with reference to lifetime income, which fully captures the expected income consequences of individual's endowments
- **Insurance** function of fiscal policy: Effect of taxes and transfers on within-endowment inequality of lifetime income
  - If individuals can fully save and borrow, lifetime income risk is the relevant income risk when assessing well-being
  - In case of credit constraints policy should also use information about the inequality of annual income

## Contributions of the paper

- Show how income taxation and three transfer programs (unemployment insurance, social assistance and disability benefits) affect inequality by redistributing lifetime income
- Show how well income taxation and transfers insure lifetime income risk
- Show how specific life-time risks, such as employment and health risks, are insured by income taxation and transfer programs

# Literature I

- Lifetime inequality
  - Inequality in lifetime earnings is markedly lower than inequality in annual earnings (e.g. Kopczuk et al. (2010), Bönke et al. (2015), Bowlus and Robin (2012))
  - A large share of lifetime inequality is due to differences in endowments (e.g. Flinn (2002) and Huggett et al. (2011))
- Role of taxes, pensions and transfers on inequality
  - Large effects of taxes and transfers on annual income (e.g. Piketty and Saez (2007) and Heathcote et al. (2010).)
  - Levell et al. (2015) and Brewer et al. (2012) analyze the effects of taxes and family-related benefits on the inequality of lifetime income without distinguishing between redistributive and insurance effects.

# Literature II

- Evaluation of taxation and specific transfer programs using life-cycle models
  - Studies show that people value pensions and specific transfer programs (see, e.g., Hugget and Para (2010), Low et al. (2010), Low and Pistaferri (2015) or Haan and Prowse, 2015).
- Evidence that individuals are subject to lasting earnings, health and employment shocks, see e.g. Meghir and Pistaferri (2010)
  - These studies suggest that both the transitory and permanent shocks create risk in lifetime earnings.
  - Blundell et al. (2015) show that taxes and benefits reduce transitory and permanent income shocks.

# Outline

- Model, institutions and data
- Redistributive effects of taxes, pensions and transfers on lifetime inequality
- Insurance effects of taxes, pensions and transfers on lifetime inequality
- Insurance effects of taxes, pensions and transfers on lifetime inequality induced by employment and health shocks

# Three key informational requirements

- 1 Information on earnings, taxes and transfers in each year of the life cycle
  - to calculate lifetime income before and after taxes and transfers
- 2 Individual-level information about endowments that drive lifetime outcomes
  - to separate between-endowment-group inequality from within-endowment-group inequality
  - to distinguish the insurance and redistributive effects of taxes and transfers
- 3 Information about how individual's labor supply and savings respond to changes in employment and health risks
  - to accurately predict how lifetime inequality is shaped by changes in risk and how well the taxes and transfers insure these risks

# A model of lifetime income

- We derive required information from a dynamic life-cycle model with human capital accumulation and labor market frictions that includes taxes and transfers
- Each year between first entering the labor market and retirement, individuals with different endowment choose:
  - Consumption
  - Labor supply (unemployment, employment or retirement)
- Over their lifetime individuals face health and employment risks
- Taxes and transfers provide partial insurance and redistribute between individuals

# A model of lifetime income

- **Endowments:** Individual endowment is two dimensional:
  - Educational endowment is  $\text{Educ}_i \in \{7, \dots, 18\}$
  - Productive ability is  $\eta_j \in \{\eta_1, \eta_2, \eta_3\}$
  - A proportion  $\rho_j$  of individuals are productive type  $j$  where  $\sum_{j=1}^3 \rho_j = 1$

# A model of lifetime income

- **Health risk**

- Individual has good health when he first enters labor market
- Health then evolves stochastically: each year, individual transitions between good and bad health with probabilities that depend non-parametrically on education and age
- Health affects employment risk, wages, and disability benefits

# A model of lifetime income

- **Employment risk**

- Employed individuals are at risk of job separations, which forces individual into unemployment
- Unemployed individuals need job offer to move into employment
- Job separation and job offer probabilities depend on education, health and age

- The job separation and job offer probabilities are given by:

$$\Gamma_{i,t}^j = \Lambda \left( \phi_1^j + \phi_2^j 1(\text{Educ}_i \geq 12) + \phi_3^j \text{Health}_{i,t} + \sum_{k=4}^6 \phi_k^j 1(\text{Age}_{i,t} \geq [50 + (k-4) \times 5]) \right) \text{ for } j \in \{s, o\}, \quad (1)$$

- where  $\Lambda(\cdot)$  is the logistic distribution function

# A model of lifetime income

- **Earnings and wages**

- If employed, annual labor earnings equal  $40 \times 52 \times W_{i,t}$
- Hourly wage,  $W_{i,t}$ , depends on education, experience, health and productive ability

- The log hourly wage is given by:

$$\begin{aligned} \log(W_{i,t}) = & \psi_1 \text{Ed}_i + (\psi_2 \text{Ex}_{i,t} + \psi_3 \text{Ex}_{i,t}^2) \times 1(\text{Ed}_i < 12) + \\ & (\psi_4 \text{Ex}_{i,t} + \psi_5 \text{Ex}_{i,t}^2) \times 1(\text{Ed}_i \geq 12) + \psi_6 \text{Health}_{i,t} + \eta_i \end{aligned} \quad (2)$$

- where  $\text{Ex}_{i,t}$  denotes experience, defined as the number of years that the individual was employed before the current year
- We allow for measurement error in wages: sample log wages are given by  $\log(W_{i,t}) + \mu_{i,t}$  where  $\mu_{i,t} \sim \mathbb{N}(0, \sigma_\mu^2)$

# A model of lifetime income

- **Preferences:** Individual derives flow utility from consumption & labor supply
- The individual's per-period utility function is given by:

$$U(c_{i,t}, l_{i,t}, \varepsilon_{i,t}) = \alpha_1 \times \frac{(c_{i,t} \times [1 + \alpha_2 1(l_{i,t} = E)])^{1-\gamma}}{(1-\gamma)} + \varepsilon(c_{i,t}, l_{i,t}) \quad (3)$$

- $1(l_{i,t} = E)$  is an indicator for employment
- $\varepsilon_{i,t}(c_{i,t}, l_{i,t})$  is a type 1 extreme value distributed preference shock
- $\alpha_1$  weights the utility of consumption relative to preference shock
- $\alpha_2$  measures the disutility for work,
- $\gamma$  is the coefficient of relative risk aversion.

# A model of lifetime income

- **Value function:** Consumption and labor supply are chosen each period to maximize the expected value of discounted lifetime utility
- The value function is given by:

$$V_t(\mathbf{s}_{i,t}) = \max_{\{c,l\} \in \mathbb{D}(\mathbf{s}_t)} \{U(c,l, \varepsilon_{i,t}) + \beta E_t V_{t+1}(\mathbf{s}_{i,t+1})\}, \quad (4)$$

- where  $\beta$  is the discount factor, and  $\mathbb{D}(\mathbf{s}_t)$  is the choice set available to the individual in year  $t$ .
- Choice constrained by:
  - Job offers and job separations
  - Intertemporal budget constraint

# A model of lifetime income

- **Intertemporal budget constraint:**

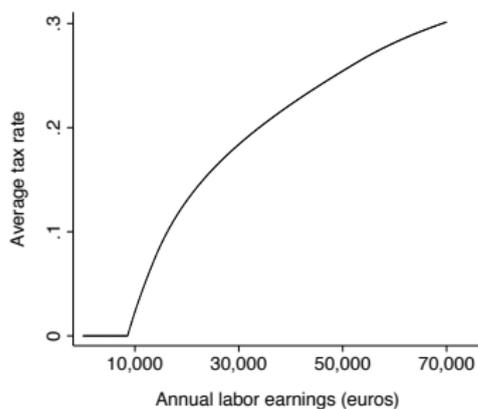
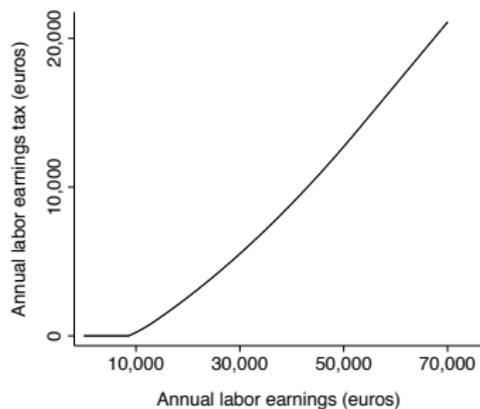
$$A_{i,t} = (1 + r)A_{i,t-1} + \text{PostTPTIncome}(\text{Wage}_{i,t}, l_{i,t}, rA_{i,t-1}) - c_{i,t}$$

- $\text{PostTPTIncome} =$  Post tax-pensions-transfers income
- Taxes, pensions and transfers thus affect:
  - annual income (post tax-pension-transfer)
  - lifetime income (post tax-pension-transfer)
  - inequality of annual income
  - inequality of lifetime income

# Taxes, pension and transfers

- **Taxes** Income is subject to progressive taxes on labor earnings and on investment income, and to a social security tax
- **Pension** Retired individuals of age 60 or above receive annual pension benefits proportional to lifetime earnings with actuarial adjustment for retirement before 65
- **Unemployment Insurance** Replaces 60% of past earnings for first year of each unemployment spell
- **Disability benefits** Individuals in bad health may retire at any age. Prior to 60, disability benefits proportional to previous earnings plus imputed future earnings
- **Social Assistance** Guarantees wealth-poor households a minimum income (income of last resort)

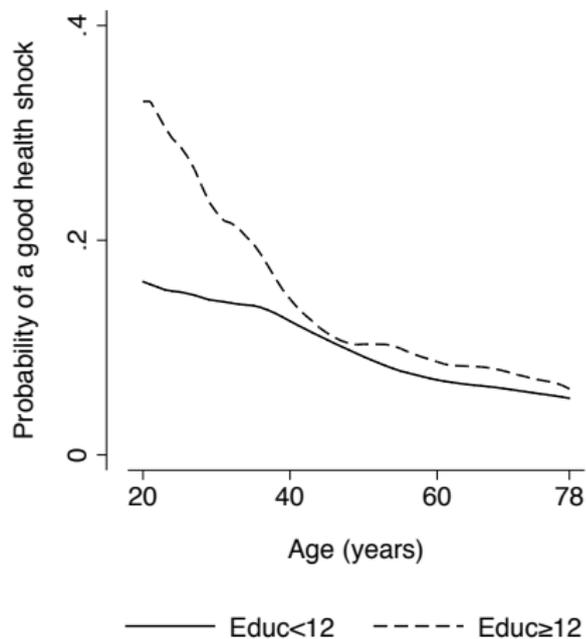
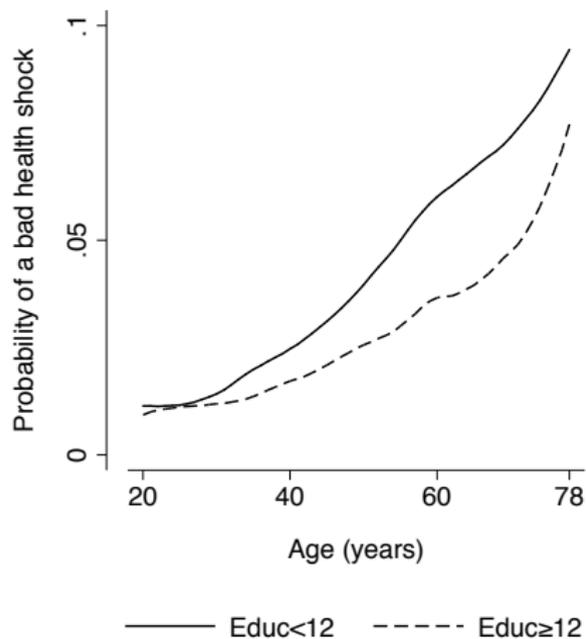
# Tax on annual labor earnings



# Data, Sample and Estimation

- Model parameters estimated using sample from the German Socio-Economic Panel (2004–2012)
  - Sample is restricted to men aged 20–64 years
  - 15,862 individual-year observation on 3,154 distinct individuals
- Variables used in analysis:
  - ① Labor supply status (employment, unemployment, retirement)
  - ② Wages
  - ③ Experience, education, health status
- Solve model by backwards recursion with Keane-Wolpin approximation to value function
- Estimation using maximum likelihood

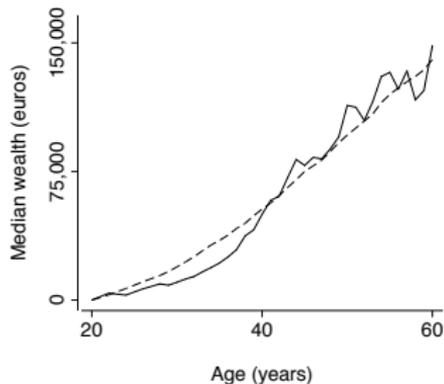
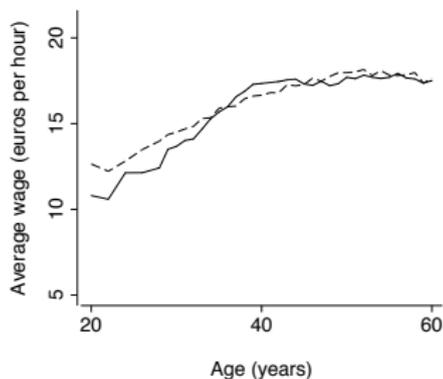
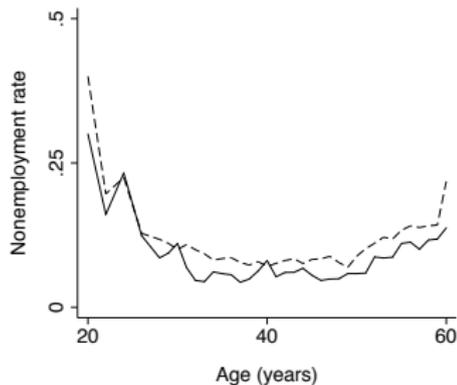
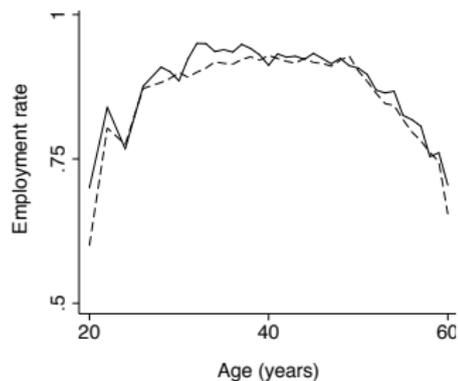
# Estimated health risks



# Parameter estimates

	<u>Estimate</u>	<u>Standard error</u>
<hr/> <b>Panel I: Utility function</b> <hr/>		
$\alpha_1$ (Weight on utility from consumption and leisure)	3.498	0.0827
$\alpha_2$ (Disutility of employment)	0.380	0.0082
<hr/> <b>Panel II: Wage equation</b> <hr/>		
$\eta_1$ (Intercept for productive type 1)	2.083	0.0112
$\eta_2$ (Intercept for productive type 2)	1.733	0.0112
$\eta_3$ (Intercept for productive type 3)	1.342	0.0113
$\psi_1$ (Educ/10)	0.532	0.0067
$\psi_2$ (Exper/10 $\times$ 1(Educ<12))	0.230	0.0055
$\psi_3$ (Exper/10 $\times$ 1(Educ $\geq$ 12))	0.277	0.0058
$\psi_4$ (Exper <sup>2</sup> /100 $\times$ 1(Educ<12))	-0.036	0.0012
$\psi_5$ (Exper <sup>2</sup> /100 $\times$ 1(Educ $\geq$ 12))	-0.044	0.0013
$\psi_6$ (Health)	0.009	0.0040
<hr/> <b>Panel III: Productive ability type probabilities</b> <hr/>		
$\rho_1$ (Fraction of productive ability type 1)	0.287	0.0095
$\rho_2$ (Fraction of productive ability type 2)	0.466	0.0108

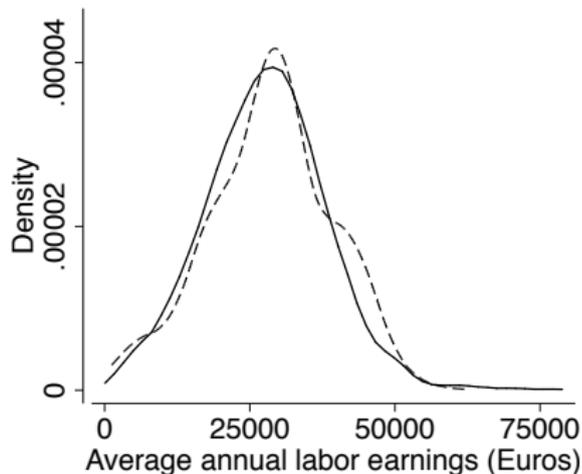
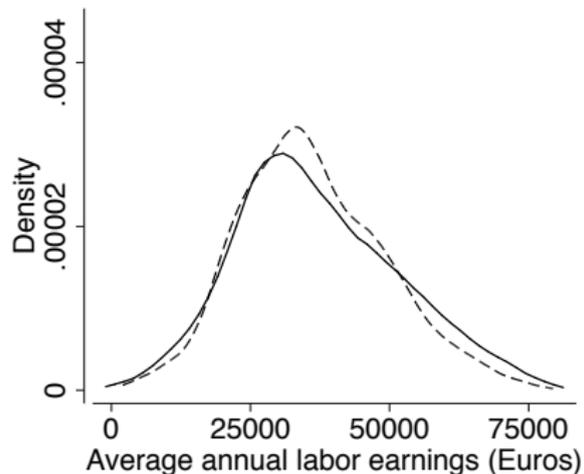
# Model fit: Observed and predicted age profiles



# Model fit: Observed and predicted wage distributions



# Observed and predicted persistence in labor earnings



# Model validation: Gini coefficients

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	<u>Sample simulated using estimated model</u>	<u>Sample of administrative social security records</u>
Annual earnings	0.319	0.336
Lifetime earnings	0.208	0.212

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# Simulations based on the model

- ① Decomposition of income inequality
  - Redistribution of income taxation and transfer programs
  - Insurance of income taxation and transfer programs
- ② Insurance of income taxation and transfer programs for employment risk
- ③ Insurance of income taxation and transfer programs for health risk

# Sources of income inequality

$$\begin{array}{rcl} \text{Inequality of annual income} & & \text{Within-individual-inequality} \\ \text{(Total inequality)} & = & \text{of annual income} \\ & & + \text{Between-endowment} \\ & & \text{inequality of lifetime income} \\ & + & \text{Within-endowment} \\ & & \text{inequality of lifetime income} \end{array}$$

- Apply this decomposition to earned income and post-tax, transfer and pension income
- Learn about **redistribution** of lifetime time from between-endowment inequality of lifetime income
- Learn about **insurance** of lifetime income risk from within-endowment inequality of lifetime income

# Inequality in annual & lifetime income

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	Inequality of earnings and income ( $100 \times$ squared coefficient of variation)		
	Annual	Within-individual	Lifetime
Earnings (Labor earnings+interest income)	13.88	7.27	6.60
Income (Earnings–taxes+transfers)	8.06	4.50	3.56
Share of earnings inequality offset by taxes and transfers ( $1 - \text{Income}/\text{Earnings}$ )	0.42	0.38	0.46

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# Inequality in lifetime income

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	Inequality of lifetime earnings and lifetime income ( $100 \times$ squared coefficient of variation)		
	Lifetime	Within-endowment	Between-endowment
Earnings (Labor earnings + interest income)	6.60	1.03	5.57
Income (Earnings – taxes + transfers)	3.56	0.52	3.04
Share of earnings inequality offset by the tax-and-transfer system ( $1 - \text{Income} / \text{Earnings}$ )	0.46	0.49	0.45

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# Inequality in lifetime income

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	Lifetime ineq ( $100 \times$ Squared coef of variation)		
	Total	Within-endowment	Between-endowment

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## Panel II: Share lifetime earnings inequality offset by taxes and transfers

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Taxes and all transfer programs	0.46	0.49	0.45
Taxes	0.26	0.09	0.29
All transfer programs	0.20	0.41	0.16
Specific transfer programs:			
UI	0.04	0.08	0.03
SA	0.16	0.22	0.14
DB	0.01	0.10	-0.01

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# How do taxes, and transfers insure employment risks?

## ① Increase in job separations

- Increasing separation to reduce employment level by 5 percentage points

## ② Reduction in job offers

- Decrease job offers to reduce employment level by 5 percentage points

## ③ Increase in shock persistence

- Decrease job offers as before and decrease separation to keep employment level
- In the model we account for labor supply and consumption responses to the shocks

# Increase in within-endowment-group inequality: Employment

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	Lifetime employment rate	Unemployment spells per person	Unemployment spell duration
Baseline employment risk	0.86	1.03	3.61
Increase probability of job separation	0.85	1.12	3.63
Decrease probability of job offer	0.85	0.81	4.85
Increase persistence of employment shocks	0.86	0.75	4.83

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# Increase in within-endowment-group inequality: Employment

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Panel II: Reduction of inequality due to taxes and transfers (in %)

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Taxes and all transfer programs	0.55	0.57	0.55
Taxes	0.11	0.12	0.12
All transfer programs	0.44	0.45	0.43
Specific transfer programs:			
UI	0.10	0.02	0.01
SA	0.27	0.39	0.39
DB	0.07	0.03	0.03

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# Summary and Conclusion

- Redistribution of lifetime income
  - Taxes and transfers combined eliminate approximately half of the average difference in earnings between individuals with different endowments of education and productive ability
  - All three transfer programs are effective at redistributing lifetime income, but Social Assistance is most effective program
- Insurance of lifetime income
  - Taxes and transfers combined mitigate around half of all lifetime income risk
  - Taxes do only provide little insurance
  - Among the three transfer programs, Social Assistance is most effective program

# Summary and Conclusion

- Insurance of employment risks
  - Taxes and transfers combined provide partial insurance
  - Social Assistance is most effective program
- Insurance of health risks
  - Taxes, transfers and pensions provide insurance combined provide partial insurance
  - Social Assistance and Disability are most effective programs - no effect of the pension system

# Summary and Conclusion

- Lifetime income differences are important
- For policy evaluation and design, it is important to consider the effects of taxes and transfers on lifetime inequality
- Some policy implications:
  - Social assistance benefits are most effective program for both redistribution and insurance
  - Despite being earnings-related, UI has role for redistributing lifetime income (due to higher job-separation among individuals with expected lifetime income)
  - Since taxes are based on annual earnings they have only moderate impact on insurance of life cycle risks - consider taxation of life time earnings.