Demographic Change, Household Structure and Income Inequality

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Background

- OECD (2008): *"Growing unequal"*: increasing inequality
- Question: what are the causes?
- OECD: high correlation between changing household composition and increasing inequality in West Germany (1985-2005): 88%
- this has lead to a fierce policy debate in Germany
- however: result was a mistake! (Correct figure is 12%!)

This talk

- How can we assess the question "*What drives rising inequality?*"?
- Different methods:
  - Subgroup decomposition of inequality measures
  - Counterfactual reweighting techniques
    - ★ OECD: special case: shift-share analysis without control variables
- Examples for Germany:
  - A. Peichl, N. Pestel and H. Schneider (2010): *Does Size matter?: The Impact of Changes in Household Structure on Income Distribution in Germany*, CESifo Working Paper 3219
  - Biewen, M., Juhasz, A. (2010): *Understanding Rising Income Inequality in Germany*, IZA Discussion Paper No. 5062.

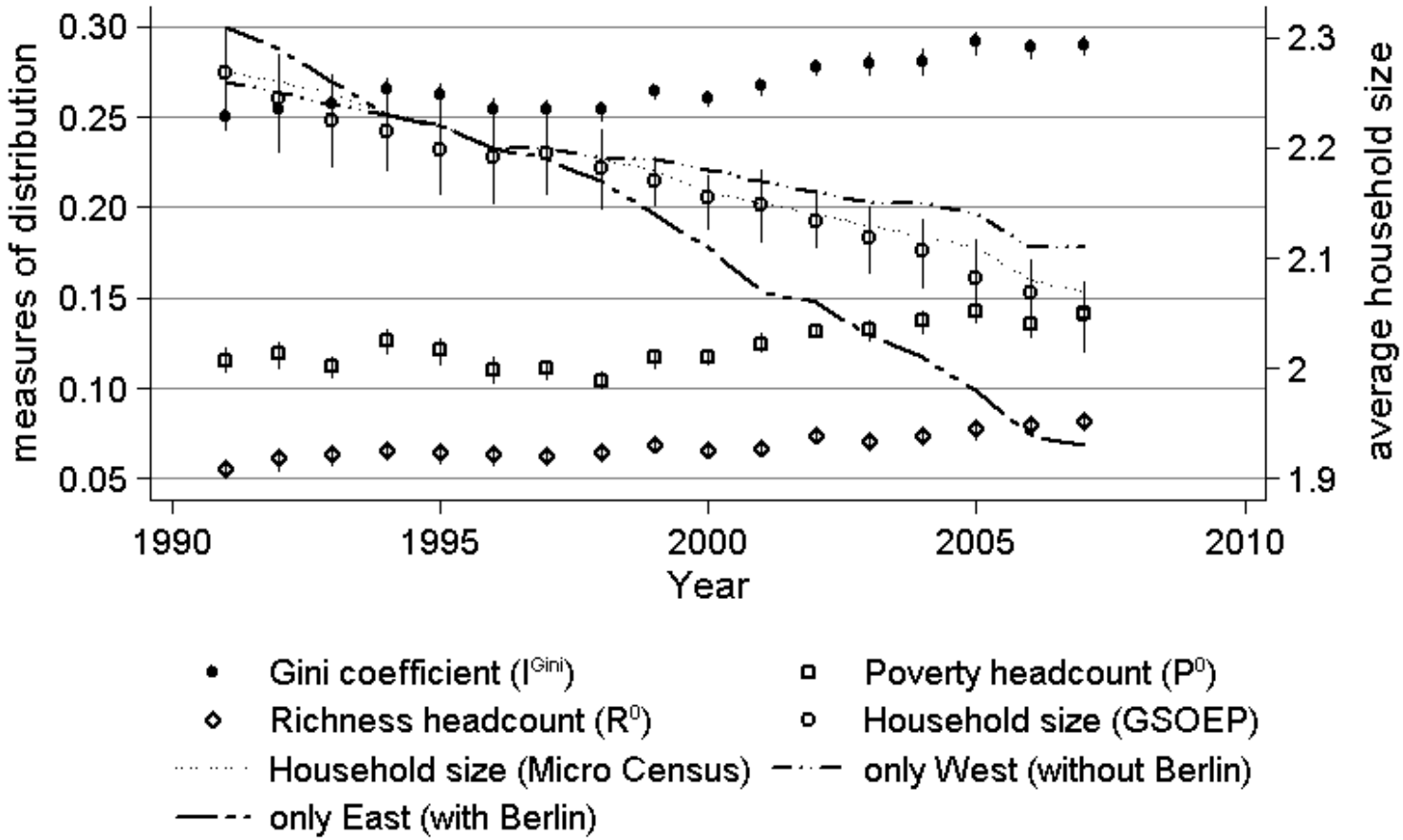
Outline

1. Why Germany?

Widening income gap, declining household size

- since reunification: inequality of disposable income distribution increased considerably (*Bach et al., 2009; Peichl et al., 2010*)
  - widening of market incomes / weakening bargaining power of unions?
  - structural change in household formation?
- observe sharp fall in average household size in Germany since early 1990s
  - second-lowest among OECD countries after Sweden
  - especially number of one- and two-person households increased
- link between trends: analysis of income distribution based on equivalent incomes
  - equivalence scales account for household structure (size and age)
  - i.e. changes in household structure *c.p.* influence income distribution

Widening income gap, declining household size II



Source: German Micro Census and GSOEP, own calculations.
Confidence intervals (95 per cent) based on 500 bootstrap replications.

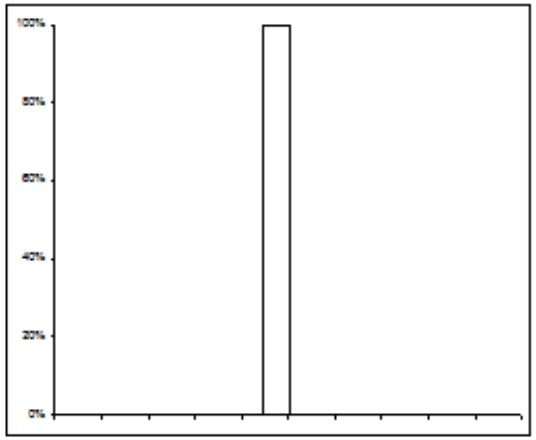
2. Equivalence-weighting

Intuition

- economic well-being considered as *individual* experience
- **however:** individually received incomes *not* used for analysis of income distribution
- **reasons:**
  - dependent persons without resources for consumption
  - economies of scale in household consumption unconsidered
  - comparison of individuals irrespective of household size
- equivalent incomes serve as proxies for economic well-being

Household Structure and Income Inequality

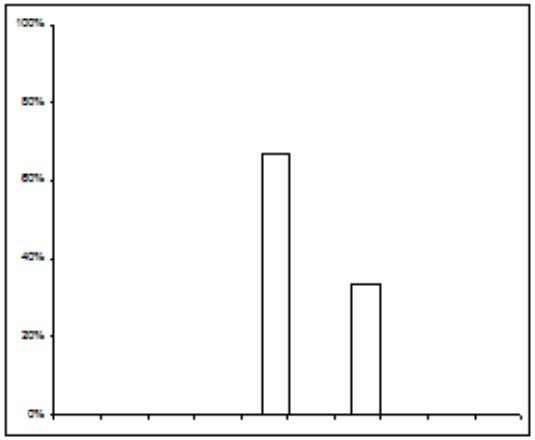
Income:	-	-	-	X	-	-	-	X
Equivalence scale:	.5	.3	.3	1	.5	.3	.3	1



Equivalence weighted income distribution

Household Structure and Income Inequality

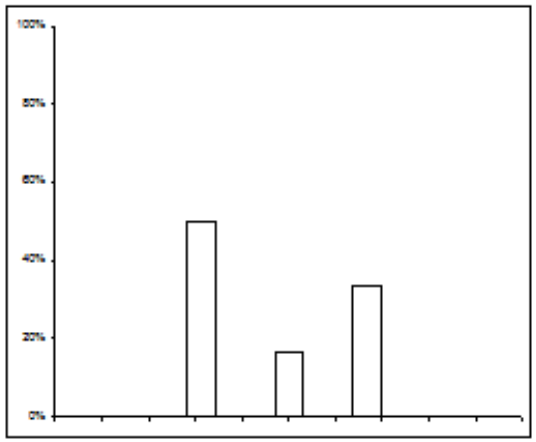
Income:	-	-	-	X		-	X
Equivalence scale :	.5	.3	.3	1		.5	1



Equivalence weighted income distribution

Household Structure and Income Inequality

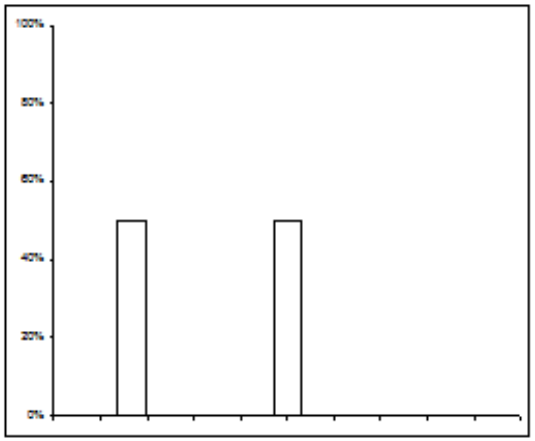
Income :	X/2	-	-	X/2	-	X
Equivalence scale :	1	.3	.3	1	.5	1



Equivalence weighted income distribution

Use of per capita incomes can increase the effect

Income :	X/2	-	-	X/2		-	X
Equivalence scale :	1	1	1	1		1	1



Equivalence weighted income distribution

3. Methodology

3.1 Subgroup Inequality Decomposition

- Shorrocks (1980, 1984); **Mookherjee/Shorrocks (1982)**
- **Jenkins (1995)**, Martin (2006)

Mean logarithmic deviation

- most suitable: Generalized Entropy (GE) inequality measures
- decomposable for population subgroups $k \in \{1, \ldots, K\}$

$$I_0 = \frac{1}{n} \cdot \sum_{i=1}^{n} ln\left(\frac{\bar{y}}{y_i}\right) \tag{1a}$$

$$= \sum_{k=1}^{K} v_k \cdot I_{0k} + \sum_{k=1}^{K} v_k \cdot ln\left(\frac{\bar{y}}{\bar{y}_k}\right) \tag{1b}$$

- y_i: equivalent individual income
- $\bar{y}$: population mean income
- v_k: proportion of population subgroup k
- $I_{0k}/\bar{y}_k$: inequality/mean income of subgroup k

Decomposition I

- decomposition of inequality *change* between periods t and $t+1$ *(see Mookherjee/Shorrocks, 1982)*

$$\Delta I_0 \approx \sum_{k=1}^{K} \bar{v}_k \cdot \Delta I_{0k} + \sum_{k=1}^{K} \bar{I}_{0k} \cdot \Delta v_k + \sum_{k=1}^{K} \left[\bar{\lambda}_k - \overline{ln(\lambda_k)} \right] \cdot \Delta v_k + \sum_{k=1}^{K} \left(\bar{\theta}_k - \bar{v}_k \right) \cdot \Delta ln(\bar{y}_k) \quad (2)$$

  - $\lambda_k = \bar{y}_k / \bar{y}$: ratio of subgroup k's mean income to total mean income
  - $\theta_k = v_k \cdot \lambda_k$: income ratio of group k
  - symbol with bar denotes average over periods t and $t+1$

Decomposition II

$$\Delta I_0 \approx \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta I_{0k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{I}_{0k} \cdot \Delta v_k}_{B}$$

$$+ \underbrace{\sum_{k=1}^{K} \left[\bar{\lambda}_k - \overline{ln\left(\lambda_k\right)}\right] \cdot \Delta v_k}_{C} + \underbrace{\sum_{k=1}^{K} \left(\bar{\theta}_k - \bar{v}_k\right) \cdot \Delta ln\left(\bar{y}_k\right)}_{D} \quad (3)$$

- A: change within population subgroups
- B: change in population composition on within inequality
- C: change in population composition on between inequality
- D: changes in population subgroup mean incomes
- **prior interest:** relative importance of B and C compared to ΔI_0

3.2 Re-weighting

- Di Nardo/Fortin/Lemieux, 1996; **Firpo/Fortin/Lemieux (2010)**
- **Hyslop/Maré, 2005**; Biewen/Juhasz (2010)

Re-weighting procedure

- each individual described by vector (y, x, t)
  - income y, household characteristics x, and time t vector
  - joint distribution $F(y, x, t)$
- joint distribution of income and characteristics: $F(y, x|t)$
- density of income at certain point in time:

$$f_t(y) = \int dF(y, x|t_{y,x} = t) = \int f(y|x, t_y = t) dF(x|t_x = t) \quad (4a)$$

$$\equiv f(y, t_y = t, t_x = t) \quad (4b)$$

- see *Di Nardo/Fortin/Lemieux, 1996; Hyslop/Maré, 2005*

Re-weighting procedure II

- hypothetical counterfactual distribution:

$$f(y, t_y = 2007, t_x = 1991) = \int f(y|x, t_y = 2007) dF(x|t_x = 1991) \quad (5a)$$

$$= \int f(y|x, t_y = 2007) \psi_x(x) dF(x|t_x = 2007) \quad (5b)$$

- re-weighting function:

$$\psi_x(x) \equiv \frac{dF(x|t_x = 1991)}{dF(x|t_x = 2007)} \quad (6)$$

- counterfactual density can be estimated by weighted kernel methods

4. Empirical Strategy

Data and income concept

- German Socio-Economic Panel Study (GSOEP)
  - panel survey of households and individuals in Germany conducted annually since 1984
  - weights allow representativeness for German population
- income concept:
  - pre and post fisc incomes
  - modified OECD equivalence scale
- 16 population groups:
  (No. of adults) X (No. of children) X (No. of earners)

k	adults	children	employed	$v_{k,1991}$	Δv_k	$\bar{y}^{0,post}_{k,1991}$	$\Delta \bar{y}^{0,post}_{k}$	$I^{k,1991}_{0,post}$	$\Delta I^{k}_{0,post}$	$I^{k,1991}_{0,pre}$	$\Delta I^{k}_{0,pre}$	$P^{k,1991}_{0,post}$	$\Delta P^{k}_{0,post}$	$R^{k,1991}_{0,post}$	$\Delta R^{k}_{0,post}$
1	1	no	0	0.090	0.011	14,102.35	1,718.73	0.125	0.029	1.216	-0.096	0.356	-0.032	0.019	0.018
				(0.003)	(0.005)	(391.15)	(471.03)	(0.012)	(0.014)	(0.074)	(0.086)	(0.020)	(0.024)	(0.005)	(0.008)
2	1	no	1	0.067	0.031	21,660.89	48.648	0.135	0.031	0.212	0.142	0.084	0.047	0.095	-0.012
				(0.003)	(0.004)	(679.42)	(1.008).64	(0.019)	(0.030)	(0.026)	(0.037)	(0.011)	(0.015)	(0.015)	(0.016)
3	1	yes	0	0.007	0.006	8,218.39	834.19	0.132	-0.077	0.437	0.635	0.732	-0.014	0.000	0.000
				(0.001)	(0.002)	(566.93)	(635.94)	(0.025)	(0.028)	(0.052)	(0.145)	(0.052)	(0.062)	(0.000)	(0.000)
4	1	yes	1	0.021	0.004	13,726.20	-1,003.54	0.112	-0.032	0.218	0.191	0.323	0.046	0.035	-0.030
				(0.001)	(0.002)	(517.46)	(543.96)	(0.011)	(0.014)	(0.020)	(0.046)	(0.030)	(0.037)	(0.013)	(0.013)
5	2	no	0	0.093	0.040	16,110.03	3,103.29	0.102	0.034	0.912	0.133	0.174	-0.030	0.034	0.030
				(0.003)	(0.005)	(370.28)	(509.75)	(0.011)	(0.014)	(0.047)	(0.062)	(0.012)	(0.017)	(0.007)	(0.008)
6	2	no	1	0.072	0.014	20,820.02	3,177.36	0.104	0.072	0.228	0.191	0.069	0.011	0.079	0.042
				(0.003)	(0.003)	(418.13)	(1.006).93	(0.008)	(0.025)	(0.020)	(0.037)	(0.008)	(0.014)	(0.012)	(0.016)
7	2	no	2	0.094	0.000	25,701.18	3,201.73	0.087	0.029	0.128	0.056	0.021	-0.001	0.157	0.065
				(0.003)	(0.004)	(418.21)	(527.45)	(0.007)	(0.009)	(0.009)	(0.014)	(0.004)	(0.007)	(0.011)	(0.017)
8	2	yes	0	0.005	0.012	12,826.74	187.29	0.063	0.065	0.813	0.119	0.372	0.137	0.000	0.021
				(0.001)	(0.001)	(601.46)	(857.11)	(0.013)	(0.020)	(0.189)	(0.215)	(0.056)	(0.066)	(0.000)	(0.008)
9	2	yes	1	0.137	-0.041	15,573.69	2,257.36	0.070	0.023	0.157	0.096	0.139	0.004	0.012	0.032
				(0.003)	(0.004)	(146.15)	(245.92)	(0.003)	(0.006)	(0.009)	(0.017)	(0.009)	(0.014)	(0.003)	(0.007)
10	2	yes	$\geq$2	0.185	-0.039	18,723.81	3,474.51	0.070	0.034	0.111	0.068	0.046	-0.001	0.045	0.045
				(0.003)	(0.005)	(157.71)	(346.61)	(0.003)	(0.006)	(0.005)	(0.010)	(0.003)	(0.006)	(0.005)	(0.008)
11	$\geq$3	no	0	0.006	0.002	18,819.59	-3,352.69	0.125	0.007	1.159	-0.403	0.279	0.064	0.103	-0.072
				(0.001)	(0.001)	(1506.98)	(1718.37)	(0.015)	(0.023)	(0.148)	(0.159)	(0.066)	(0.079)	(0.052)	(0.053)
12	$\geq$ 3	no	1	0.031	-0.003	19,508.20	359.316	0.079	0.055	0.264	0.088	0.090	0.044	0.031	0.019
				(0.002)	(0.003)	(507.53)	(908.68)	(0.009)	(0.023)	(0.026)	(0.045)	(0.016)	(0.023)	(0.010)	(0.015)
13	$\geq$3	no	$\geq$2	0.113	-0.031	22,502.53	1,171.95	0.054	0.033	0.091	0.051	0.015	0.011	0.069	0.035
				(0.003)	(0.004)	(217.405)	(388.02)	(0.002)	(0.005)	(0.003)	(0.009)	(0.002)	(0.005)	(0.006)	(0.011)
14	$\geq$3	yes	0	0.000	0.003	11,030.41	157.85	0.020	0.018	0.839	-0.407	0.549	0.096	0.000	0.000
				(0.000)	(0.000)	(1.165).37	(1.386).60	(0.007)	(0.017)	(0.323)	(0.322)	(0.262)	(0.275)	(0.000)	(0.000)
15	$\geq$3	yes	1	0.015	0.004	16,383.19	-544.04	0.110	0.007	0.271	0.072	0.184	0.173	0.067	-0.052
				(0.001)	(0.002)	(596.22)	(758.52)	(0.012)	(0.013)	(0.028)	(0.039)	(0.027)	(0.046)	(0.016)	(0.016)
16	$\geq$3	yes	$\geq$2	0.065	-0.012	18,302.44	811.29	0.066	0.003	0.102	0.031	0.063	-0.006	0.044	-0.011
				(0.002)	(0.003)	(216.89)	(358.60)	(0.003)	(0.005)	(0.004)	(0.009)	(0.007)	(0.014)	(0.007)	(0.009)
Total	–	–	–	1.000	0.000	18,816.32	1,782.19	0.105	0.040	0.500	0.125	0.115	0.026	0.056	0.026
				(0.000)	(0.000)	(106.66)	(162.88)	(0.002)	(0.004)	(0.010)	(0.016)	(0.003)	(0.005)	(0.002)	(0.003)

5. Results

Inequality decomposition 1991–2007

income	region	I_0^{1991}	I_0^{2007}	ΔI_0	A	B	C	D	$\frac{B+C}{\Delta I_0}$
household structure and employment status									
pre fisc	Germany	0.500	0.625	25.027	15.973	11.800	7.596	-10.148	77.500
		(0.010)	(0.011)	(3.542)	(2.274)	(1.211)	(0.973)	(1.716)	(8.150)
	West	0.480	0.558	16.284	15.892	7.982	5.542	-12.870	83.052
		(0.012)	(0.012)	(4.042)	(2.658)	(1.210)	(1.048)	(1.836)	(16.407)
	East	0.514	0.872	69.567	15.711	28.931	23.860	-0.584	75.885
		(0.022)	(0.024)	(8.524)	(3.743)	(3.154)	(3.097)	(3.691)	(5.311)
post fisc	Germany	0.105	0.144	37.755	28.917	5.354	3.024	0.560	22.189
		(0.002)	(0.004)	(4.463)	(3.991)	(0.682)	(0.586)	(1.415)	(2.851)
	West	0.104	0.149	42.990	35.679	4.689	2.145	0.564	15.896
		(0.003)	(0.004)	(5.268)	(4.635)	(0.694)	(0.656)	(1.508)	(2.248)
	East	0.070	0.097	38.801	44.055	-0.731	7.239	-16.178	16.773
		(0.002)	(0.003)	(6.022)	(4.886)	(1.639)	(1.938)	(2.479)	(8.656)

Inequality decomposition 1991–2007

$\frac{B+C}{\Delta I_0}$ for different equivalence scales $ES = (\theta_1 + \theta_2 \cdot N_A + \theta_3 \cdot N_C)^\gamma$:

	$\theta_1 = \theta_2 = 0.5$						$\theta_1 = 0;\ \theta_2 = 1$					
	$\theta_3 = 0.3$		$\theta_3 = 0.5$		$\theta_3 = 1$		$\theta_3 = 0.3$		$\theta_3 = 0.5$		$\theta_3 = 1$	
income	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$	$\gamma = 0.5$	$\gamma = 1$
	household structure and employment status											
pre fisc	79.143	77.500	79.319	78.139	78.931	76.762	78.497	77.941	78.698	78.591	78.307	77.322
	(6.336)	(5.798)	(6.391)	(5.972)	(6.315)	(5.740)	(6.064)	(5.618)	(6.084)	(5.747)	(6.080)	(5.594)
post fisc	23.259	22.189	23.353	22.853	22.797	20.054	21.658	24.296	22.264	26.476	20.751	21.075
	(2.285)	(2.482)	(2.570)	(3.212)	(2.027)	(1.925)	(2.145)	(2.888)	(2.373)	(3.498)	(1.958)	(2.471)

Re-weighting results 1991-2007

	pre fisc			post fisc		
measure	Δ^{act}	Δ^{rew}	$\frac{\Delta^{act}-\Delta^{rew}}{\Delta^{act}}$	Δ^{act}	Δ^{rew}	$\frac{\Delta^{act}-\Delta^{rew}}{\Delta^{act}}$
I_{Gini}	18.39	9.16	50.21	16.14	12.45	22.85
	(1.44)	(1.26)	(3.21)	(1.65)	(1.53)	(2.54)
I_0	25.03	4.97	80.14	37.76	28.82	23.67
	(3.59)	(2.92)	(9.42)	(4.46)	(3.91)	(2.54)
I_1	39.97	20.69	48.24	54.24	43.11	20.51
	(5.45)	(4.24)	(3.90)	(10.34)	(8.47)	(2.75)
I_2	107.12	66.74	37.70	187.16	148.65	20.58
	(37.28)	(26.45)	(4.11)	(81.27)	(65.29)	(3.14)
	post fisc incomes					
	poverty			richness		
P_0/R_0	22.60	10.65	52.87	46.62	40.26	13.64
	(5.11)	(4.52)	(13.06)	(7.20)	(7.24)	(4.58)
P_1/R_3	36.36	21.08	42.03	65.75	56.79	13.63
	(7.74)	(6.95)	(9.28)	(9.69)	(9.54)	(2.93)
P_2/R_1	47.24	29.44	37.68	76.06	65.90	13.36
	(11.48)	(10.22)	(10.65)	(11.54)	(11.36)	(2.85)

Summary and discussion

- proportion of "demographic effect" much larger for pre fisc incomes
- tax-benefit system seems to compensate for changing household structure at bottom of distribution
- however, no causal relationship: tax-benefit system itself might have enforced demographic trends
- results of subgroup decomposition in line with those of a counterfactual re-weighting analysis (without further controls!)

6. Biewen / Juhasz

Approach

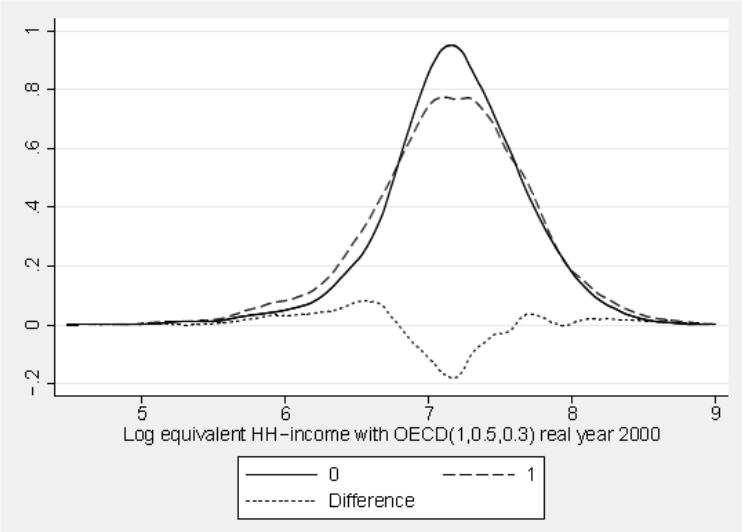
- Re-weighting à la Hyslop/Maré controlling for various characteristics
  - advantage: several distributional statistics can be computed
  - advantage: can control for other characteristics
  - disadvantage: path-dependence
- GSOEP 1999+2000 vs. 2005+2006 (pooled data!)
- only look at post fisc (disposable) income

Results

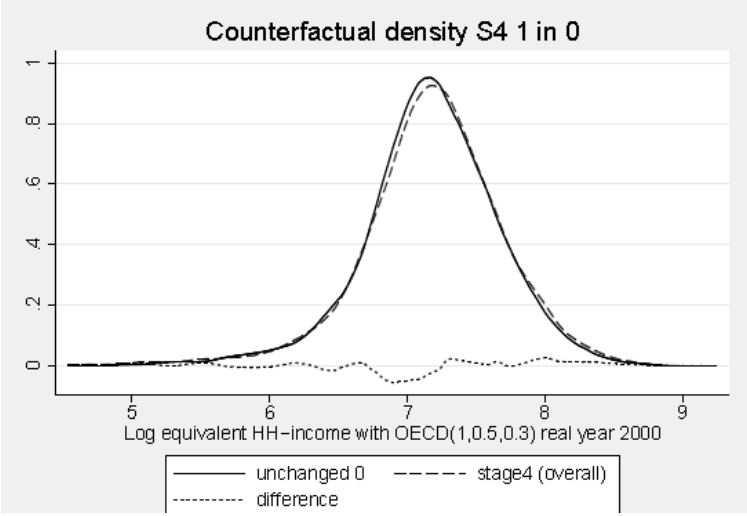
- increase in inequality can be explained by
  - changes in employment outcomes and market returns
  - and changes in the tax system.
- Changes in household structures and other household characteristics seem to have played a much smaller role.
- However: several issues with the analysis! (data, method, weights, policy modelling ...)

Results II

Overall change in density from 1999/2000 ('period 0') to 2005/2006 ('period 1')



Counterfactual income distribution if only market returns are changed (dashed line) vs. factual distribution (bold line).



Results III

Table 4 – Exact decomposition of inequality increase

	Results of sequential decomposition attributable to										
	Household Structure (1)		Socio-economic attributes (2)		Employment outcomes (3)		Return on attributes (4)		Tax system (5)		Residual
p5010	7.39	(2.82)	5.96	(3.26)	30.48	(8.76)	23.62	(16.49)	24.30	(5.64)	8.25
p7525	6.80	(2.29)	3.42	(2.79)	22.54	(5.33)	14.15	(10.66)	19.08	(3.22)	33.30
p9010	8.93	(2.45)	6.04	(2.96)	30.16	(7.11)	29.61	(13.03)	20.59	(3.77)	4.67
p9050	13.47	(4.92)	6.77	(7.24)	30.80	(12.70)	41.89	(24.98)	10.62	(8.59)	-3.55
Cv	8.20	(2.21)	4.66	(3.04)	16.96	(4.19)	22.76	(7.80)	20.92	(5.24)	26.50
Theil	8.33	(2.24)	5.07	(2.70)	19.92	(4.54)	31.41	(9.80)	19.88	(4.66)	15.36
Mld	3.90	(2.23)	5.81	(2.70)	23.30	(5.43)	28.85	(12.1)	19.64	(4.65)	18.47
Gini	5.31	(2.44)	5.54	(2.79)	23.17	(4.99)	17.71	(10.91)	17.77	(4.71)	30.48
Fgt0	7.72	(2.58)	5.34	(2.73)	26.67	(6.64)	20.23	(12.34)	19.81	(3.97)	20.24
Fgt1	4.03	(2.54)	8.21	(3.79)	30.40	(9.07)	39.38	(17.19)	23.09	(5.01)	-5.11

Source: GSOEP, own calculations. The numbers in parentheses are bootstrap standard errors which correctly take into account the longitudinal sample design and the clustering of individuals in households.

7. Conclusion

Conclusions

- changing household composition associated with widening income gap
- **but:** share of 15% for post fisc incomes only *(for inequality)*
  - much lower than reported by OECD
  - other more important driving forces
  - human capital? bargaining power of unions? $\longrightarrow$ future research
- statements on income distribution must be differentiated
  - important to analyze different reasons for a growing income gap
  - complex interactions between income distribution, demographic trends (household formation), and tax-benefit system

- Detailed policy decomposition: see Bargain et al. (2011)

Thank you for your attention!

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FGT measures

- well-known poverty measure P_α *(Foster et al., 1984)*
- richness measure R_β *(Peichl et al., 2008)*
- decomposable for population subgroups

$$P_\alpha(y;z) = \frac{1}{n} \cdot \sum_{i=1}^{n} \left(\frac{z - y_i}{z} \right)^\alpha \cdot \mathbf{1}_{y_i < z} \tag{7}$$

$$R_\beta(y;\rho) = \frac{1}{n} \cdot \sum_{i=1}^{n} \left[1 - \left(\frac{\rho}{y_i} \right)^\beta \right] \cdot \mathbf{1}_{y_i > \rho} \tag{8}$$

  - z: poverty line, ρ: richness line
  - α: parameter for poverty aversion, β: parameter for sensitiveness to (intense) richness

Decomposition

$$\Delta P_\alpha = \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta P_{\alpha,k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{P}_{\alpha,k} \cdot \Delta v_k}_{B} \tag{9}$$

$$\Delta R_\beta = \underbrace{\sum_{k=1}^{K} \bar{v}_k \cdot \Delta R_{\beta,k}}_{A} + \underbrace{\sum_{k=1}^{K} \bar{R}_{\beta,k} \cdot \Delta v_k}_{B} \tag{10}$$

- A: change in level of group poverty/richness
- B: changes in composition of population
- **prior interest:** relative importance of B relative to ΔP_α and ΔR_β