Demographic Change, Household Structure and Income Inequality

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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%!)
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:

Outline

1. Why Germany?
2. Equivalence-weighting
3. Methodology
   - Subgroup Decomposition
   - Re-weighting procedure
4. Empirical Strategy
5. Results
6. BJ-Results
7. Conclusions
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1. Why Germany?
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

- Gini coefficient ($I^{\text{Gini}}$)
- Poverty headcount ($P^0$)
- Richness headcount ($R^0$)
- Household size (GSOEP)
- Household size (Micro Census)
- only West (without Berlin)
- only East (with Berlin)

Source: German Micro Census and GSOEP, own calculations.
Confidence intervals (95 per cent) based on 500 bootstrap replications.
2. Equivalence-weighting
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: 0.5 0.3 0.3 1 0.5 1

Equivalence weighted income distribution
Household Structure and Income Inequality

Income:  
- $X/2$  
- $-\$-

Equivalence scale:  
- $1$  
- $0.3$  
- $0.3$

Equivalent weight:  
- $1$  
- $X$

Equivalence weighted income distribution
Use of per capita incomes can increase the effect

Income:
- X/2
- 1
- 1
- 1

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

Equivalence weighted income distribution
3. Methodology
3.1 Subgroup Inequality Decomposition

- Shorrocks (1980, 1984); **Mookherjee/Shorrocks (1982)**
Methodology
Subgroup Decomposition

Mean logarithmic deviation

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

\[
l_0 = \frac{1}{n} \cdot \sum_{i=1}^{n} \ln \left( \frac{\bar{y}}{y_i} \right) \\
= \sum_{k=1}^{K} v_k \cdot l_{0k} + \sum_{k=1}^{K} v_k \cdot \ln \left( \frac{\bar{y}}{\bar{y}_k} \right)
\]

- $y_i$: equivalent individual income
- $\bar{y}$: population mean income
- $v_k$: proportion of population subgroup $k$
- $l_{0k}/\bar{y}_k$: inequality/mean income of subgroup $k$
decomposition of inequality change between periods $t$ and $t+1$ (see Mookherjee/Shorrocks, 1982)

$$
\Delta l_0 \approx \sum_{k=1}^{K} \bar{v}_k \cdot \Delta l_{0k} + \sum_{k=1}^{K} \bar{l}_{0k} \cdot \Delta v_k
$$

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

- $\lambda_k = \bar{y}_k / \bar{y}$: 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 $t+1$
Methodology

Subgroup Decomposition

Decomposition II

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

- **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 \( \Delta I_0 \)
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:

\[
f(y, t_y = 2007, t_x = 1991) = \int f(y|x, t_y = 2007) dF(x|t_x = 1991) = \int f(y|x, t_y = 2007) \psi_x(x) dF(x|t_x = 2007)
\]  

(5a) \hspace{1cm} (5b)

- re-weighting function:

\[
\psi_x(x) \equiv \frac{dF(x|t_x = 1991)}{dF(x|t_x = 2007)}
\]

(6)

- counterfactual density can be estimated by weighted kernel methods
4. Empirical Strategy
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 | $v_{k,1991}$ | $\Delta v_k$ | $y_{k,1991}$ | $\Delta y_{k,1991}^{\text{post}}$ | $\Delta y_{k,1991}^{\text{pre}}$ | $p_{k,1991}^{\text{pre}}$ | $p_{k,1991}^{\text{post}}$ | $R_{k,1991}^{\text{pre}}$ | $R_{k,1991}^{\text{post}}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 1 | 1 | no | 0 | 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 |
| 1 | 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 |
| 1 | 1 | yes | 1 | 0.01 | 0.004 | 13,726.20 | -1,003.54 | 0.112 | -0.032 | 0.218 | 0.191 | 0.323 | 0.046 | 0.035 | -0.03 |
| 2 | 2 | no | 0 | 0.093 | 0.04 | 16,110.03 | 3,103.29 | 0.102 | 0.034 | 0.912 | 0.133 | 0.174 | -0.030 | 0.039 | 0.03 |
| 2 | 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 |
| 2 | 2 | no | 2 | 0.094 | 0.00 | 25,701.18 | 3,201.73 | 0.087 | 0.029 | 0.128 | 0.056 | 0.021 | -0.001 | 0.157 | 0.065 |
| 2 | 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 | 0.21 |
| 2 | 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 |
| 2 | 2 | yes | 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 |
| 3 | ≥3 | no | 0 | 0.006 | 0.002 | 18,816.32 | 1,782.19 | 0.105 | 0.040 | 0.500 | 0.125 | 0.115 | 0.026 | 0.056 | 0.026 |
| 3 | ≥3 | no | 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 |
| 3 | ≥3 | yes | 0 | 0.056 | 0.012 | 18,302.44 | 811.29 | 0.066 | 0.003 | 0.102 | 0.031 | 0.063 | -0.006 | 0.044 | -0.011 |
| 3 | ≥3 | yes | 1 | 0.005 | 0.000 | 106.66 | 162.88 | 0.002 | 0.004 | 0.016 | 0.003 | 0.005 | 0.002 | 0.002 | 0.003 |
5. Results
### Results

Inequality decomposition 1991–2007

<table>
<thead>
<tr>
<th>income region</th>
<th>$l_0^{1991}$</th>
<th>$l_0^{2007}$</th>
<th>$\Delta l_0$</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>$B+C \over \Delta l_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>household structure and employment status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>pre fisc</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>0.500</td>
<td>0.625</td>
<td>25.027</td>
<td>15.973</td>
<td>11.800</td>
<td>7.596</td>
<td>-10.148</td>
<td>77.500</td>
</tr>
<tr>
<td>West</td>
<td>0.480</td>
<td>0.558</td>
<td>16.284</td>
<td>15.892</td>
<td>7.982</td>
<td>5.542</td>
<td>-12.870</td>
<td>83.052</td>
</tr>
<tr>
<td>East</td>
<td>0.514</td>
<td>0.872</td>
<td>69.567</td>
<td>15.711</td>
<td>28.931</td>
<td>23.860</td>
<td>-0.584</td>
<td>75.885</td>
</tr>
<tr>
<td><strong>post fisc</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>0.105</td>
<td>0.144</td>
<td>37.755</td>
<td>28.917</td>
<td>5.354</td>
<td>3.024</td>
<td>0.560</td>
<td>22.189</td>
</tr>
<tr>
<td>West</td>
<td>0.104</td>
<td>0.149</td>
<td>42.990</td>
<td>35.679</td>
<td>4.689</td>
<td>2.145</td>
<td>0.564</td>
<td>15.896</td>
</tr>
<tr>
<td>East</td>
<td>0.070</td>
<td>0.097</td>
<td>38.801</td>
<td>44.055</td>
<td>-0.731</td>
<td>7.239</td>
<td>-16.178</td>
<td>16.773</td>
</tr>
</tbody>
</table>

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Household Structure and Income Inequality  
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Inequality decomposition 1991–2007

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

<table>
<thead>
<tr>
<th></th>
<th>(\theta_1 = \theta_2 = 0.5)</th>
<th>(\theta_1 = 0; \theta_2 = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\theta_3 = 0.3)</td>
<td>(\theta_3 = 0.5)</td>
</tr>
<tr>
<td>income</td>
<td>(\gamma = 0.5)</td>
<td>(\gamma = 1)</td>
</tr>
<tr>
<td>pre fisc</td>
<td>79.143 (6.336)</td>
<td>77.500 (5.798)</td>
</tr>
</tbody>
</table>
### Results

#### Re-weighting results 1991-2007

<table>
<thead>
<tr>
<th>Measure</th>
<th>( \Delta^{act} )</th>
<th>( \Delta^{rew} )</th>
<th>( \frac{\Delta^{act} - \Delta^{rew}}{\Delta^{act}} )</th>
<th>( \Delta^{act} )</th>
<th>( \Delta^{rew} )</th>
<th>( \frac{\Delta^{act} - \Delta^{rew}}{\Delta^{act}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( l_{Gini} )</td>
<td>18.39</td>
<td>9.16</td>
<td>50.21</td>
<td>16.14</td>
<td>12.45</td>
<td>22.85</td>
</tr>
<tr>
<td></td>
<td>(1.44)</td>
<td>(1.26)</td>
<td>(3.21)</td>
<td>(1.65)</td>
<td>(1.53)</td>
<td>(2.54)</td>
</tr>
<tr>
<td>( l_0 )</td>
<td>25.03</td>
<td>4.97</td>
<td>80.14</td>
<td>37.76</td>
<td>28.82</td>
<td>23.67</td>
</tr>
<tr>
<td></td>
<td>(3.59)</td>
<td>(2.92)</td>
<td>(9.42)</td>
<td>(4.46)</td>
<td>(3.91)</td>
<td>(2.54)</td>
</tr>
<tr>
<td>( l_1 )</td>
<td>39.97</td>
<td>20.69</td>
<td>48.24</td>
<td>54.24</td>
<td>43.11</td>
<td>20.51</td>
</tr>
<tr>
<td></td>
<td>(5.45)</td>
<td>(4.24)</td>
<td>(3.90)</td>
<td>(10.34)</td>
<td>(8.47)</td>
<td>(2.75)</td>
</tr>
<tr>
<td>( l_2 )</td>
<td>107.12</td>
<td>66.74</td>
<td>37.70</td>
<td>187.16</td>
<td>148.65</td>
<td>20.58</td>
</tr>
<tr>
<td></td>
<td>(37.28)</td>
<td>(26.45)</td>
<td>(4.11)</td>
<td>(81.27)</td>
<td>(65.29)</td>
<td>(3.14)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Poverty</th>
<th>Richness</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_0 / R_0 )</td>
<td>22.60</td>
</tr>
<tr>
<td></td>
<td>(5.11)</td>
</tr>
<tr>
<td>( P_1 / R_3 )</td>
<td>36.36</td>
</tr>
<tr>
<td></td>
<td>(7.74)</td>
</tr>
<tr>
<td>( P_2 / R_1 )</td>
<td>47.24</td>
</tr>
<tr>
<td></td>
<td>(11.48)</td>
</tr>
</tbody>
</table>
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 ...)
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).
### Table 4 – Exact decomposition of inequality increase

<table>
<thead>
<tr>
<th></th>
<th>Household Structure</th>
<th>Socio-economic attributes</th>
<th>Employment outcomes</th>
<th>Return on attributes</th>
<th>Tax system</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>p5010</td>
<td>7.39 (2.82)</td>
<td>5.96 (3.26)</td>
<td>30.48 (8.76)</td>
<td>23.62 (16.49)</td>
<td>24.30 (5.54)</td>
<td>8.25</td>
</tr>
<tr>
<td>p7525</td>
<td>6.80 (2.29)</td>
<td>3.42 (2.79)</td>
<td>22.54 (5.33)</td>
<td>14.15 (10.66)</td>
<td>19.08 (3.22)</td>
<td>33.30</td>
</tr>
<tr>
<td>p9010</td>
<td>8.93 (2.45)</td>
<td>6.04 (2.96)</td>
<td>30.16 (7.11)</td>
<td>29.61 (13.03)</td>
<td>20.59 (3.77)</td>
<td>4.67</td>
</tr>
<tr>
<td>p9050</td>
<td>13.47 (4.92)</td>
<td>6.77 (7.24)</td>
<td>30.80 (12.70)</td>
<td>41.89 (24.98)</td>
<td>10.62 (8.59)</td>
<td>-3.55</td>
</tr>
<tr>
<td>Cv</td>
<td>8.20 (2.21)</td>
<td>4.66 (3.04)</td>
<td>16.96 (4.19)</td>
<td>22.76 (7.80)</td>
<td>20.92 (5.24)</td>
<td>26.50</td>
</tr>
<tr>
<td>Theil</td>
<td>8.33 (2.24)</td>
<td>5.07 (2.70)</td>
<td>19.92 (4.54)</td>
<td>31.41 (9.80)</td>
<td>19.88 (4.56)</td>
<td>15.36</td>
</tr>
<tr>
<td>MId</td>
<td>3.90 (2.23)</td>
<td>5.81 (2.70)</td>
<td>23.30 (5.43)</td>
<td>28.85 (12.1)</td>
<td>19.64 (4.55)</td>
<td>18.47</td>
</tr>
<tr>
<td>Gini</td>
<td>5.31 (2.44)</td>
<td>5.54 (2.79)</td>
<td>23.17 (4.99)</td>
<td>17.71 (10.91)</td>
<td>17.77 (4.71)</td>
<td>30.48</td>
</tr>
<tr>
<td>Fgt0</td>
<td>7.72 (2.58)</td>
<td>5.34 (2.73)</td>
<td>26.67 (6.64)</td>
<td>20.23 (12.34)</td>
<td>19.81 (3.97)</td>
<td>20.24</td>
</tr>
<tr>
<td>Fgt1</td>
<td>4.03 (2.54)</td>
<td>8.21 (3.79)</td>
<td>30.40 (9.07)</td>
<td>39.38 (17.19)</td>
<td>23.09 (5.01)</td>
<td>-5.11</td>
</tr>
</tbody>
</table>

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? → 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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Appendix

Poverty and Richness

FGT measures

- well-known poverty measure $P_\alpha$ (Foster et al., 1984)
- richness measure $R_\beta$ (Peichl et al., 2008)
- decomposable for population subgroups

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

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

- $z$: poverty line, $\rho$: richness line
- $\alpha$: parameter for poverty aversion, $\beta$: parameter for sensitiveness to (intense) richness
Decomposition

\[
\Delta P_\alpha = \sum_{k=1}^{K} \bar{v}_k \cdot \Delta P_{\alpha,k} + \sum_{k=1}^{K} \bar{P}_{\alpha,k} \cdot \Delta v_k
\]

A

\[
\Delta R_\beta = \sum_{k=1}^{K} \bar{v}_k \cdot \Delta R_{\beta,k} + \sum_{k=1}^{K} \bar{R}_{\beta,k} \cdot \Delta v_k
\]

B

- **A**: change in level of group poverty/richness
- **B**: changes in composition of population
- **prior interest**: relative importance of **B** relative to \( \Delta P_\alpha \) and \( \Delta R_\beta \)