Income Mobility

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1. Introduction

2. Mobility Concepts

2.1 Mobility's Multiple Dimensions

2.2 Is Income Mobility Socially Desirable?

2.3 Income Mobility and Social Welfare

- The social welfare function (SWF) used in the multi-period context is a straightforward generalization of the one-period case discussed by Atkinson (1970).
- Overall social welfare, W, is the expected value (average) of the utility-of-income functions of individuals.
- In the two-period case, the utility-of-income function is $U(x, y)$, and weighted by the joint probability density $f(x, y)$. That is,

$$W = \int_0^{a_y} \int_0^{a_x} U(x, y) f(x, y) dx dy \tag{1}$$

where $U(x, y)$ is differentiable and a_x and a_y are the maximum incomes in periods 1 and 2.

3. Mobility Measurement

3.1 Describing Mobility

- Borrowing notation from Atkinson (1981a), suppose that there are n income ranges, with the relative number of observations in group k in period-1 is m_1^k for $k = 1, \ldots, n$, and correspondingly in period 2.
- The marginal (discrete) distribution in period-1 is summarized by the vector $m_1 = (m_1^1, m_1^2, \ldots, m^n - 1)$ and correspondingly for period-2. Hence,

$$m_1^k = m_2^k A. \tag{2}$$

Table 1: Decile Transition Matrices: USA, (a) 1979–1988 and (b) 1989–1998 (Percentages)

	Destination group									
Origin group	1	2	3	4	5	6	7	8	9	10
1979					**1988**					
1	44.3	18.3	12.4	9.2	7.1	3.0	1.8	2.0	0.7	1.3
2	18.1	25.3	21.0	11.7	7.5	5.4	4.7	3.2	1.9	1.1
3	10.6	18.2	15.3	16.8	11.6	9.0	8.8	4.9	3.1	1.7
4	7.2	8.9	14.0	14.0	14.7	15.7	12.0	5.6	6.0	2.1
5	6.1	9.2	10.9	12.8	13.3	16.9	12.3	7.5	7.7	3.4
6	4.1	5.2	8.8	10.3	11.8	10.0	14.2	16.9	12.6	6.2
7	3.5	6.5	6.9	8.6	10.4	13.4	13.3	16.8	13.4	7.2
8	3.1	4.6	3.2	7.7	12.3	9.5	12.6	15.7	17.7	13.6
9	1.2	2.2	4.8	6.3	6.9	10.2	12.2	14.7	18.0	23.5
10	2.1	1.5	2.8	2.5	4.2	7.0	8.5	12.8	18.6	40.0

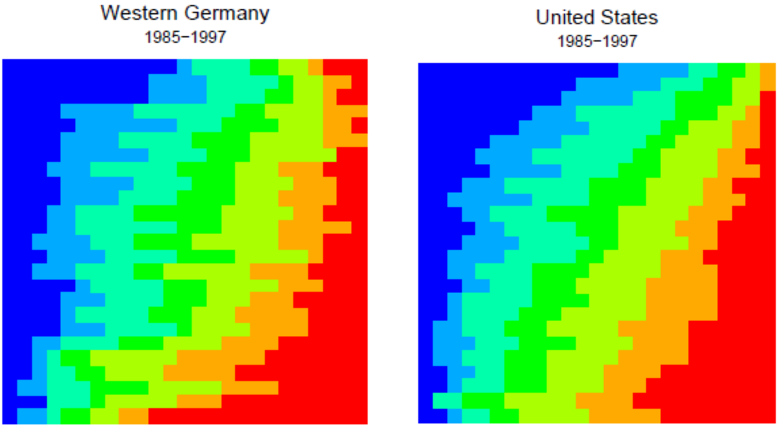
Note: Income refers to equivalized real annual family disposable income, distributed among all individuals (adults and children). The decile groups are ordered from poorest (1) to richest (10).
Source: Hungerford (2011, Tables 2 and 3), based on PSID data.

Table 1: Decile Transition Matrices: USA, (a) 1979–1988 and (b) 1989–1998 (Percentages), Cont.

	Destination group									
Origin group	1	2	3	4	5	6	7	8	9	10
1989					**1998**					
1	41.9	21.6	13.7	7.0	4.6	3.7	2.7	2.2	1.9	0.7
2	20.4	22.5	15.4	11.6	11.0	8.1	4.0	4.0	1.7	1.2
3	12.5	20.8	17.1	16.4	10.9	10.3	5.2	3.2	1.7	1.9
4	6.9	11.6	15.5	16.9	14.5	11.4	10.1	7.7	2.3	3.1
5	4.8	6.2	12.2	13.8	16.0	14.2	12.4	7.1	7.5	5.8
6	3.2	3.7	9.1	11.6	16.0	14.4	15.7	11.7	7.7	6.9
7	3.2	4.5	7.6	9.3	8.7	12.2	16.3	15.6	16.8	5.8
8	3.0	4.7	5.2	5.4	7.9	12.1	17.2	17.0	19.3	8.3
9	2.5	3.1	4.0	4.9	7.5	7.1	10.7	18.2	21.8	20.3
10	1.7	1.0	0.4	3.2	3.0	6.3	6.0	13.1	19.3	46.1

Note: Income refers to equivalized real annual family disposable income, distributed among all individuals (adults and children). The decile groups are ordered from poorest (1) to richest (10).
Source: Hungerford (2011, Tables 2 and 3), based on PSID data.

Figure 1: Transition colour plot examples



Source: Van Kerm (2011).

Figure 2: Scatterplot Example

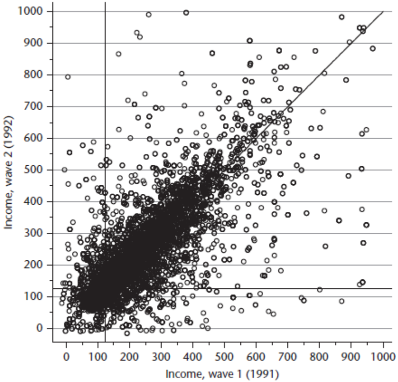


Figure 1.2. Scatter plot of 1991 and 1992 incomes

Notes: Sample of individuals (adults and children) present at BHPS waves 1 (1991) and 2 (1992) with incomes less than £1,000 per week. Each circle represents the incomes for the two years for each individual. The definition of income is given in the text (the adjustment for differences in household size and composition uses the Modified OECD equivalence scale). Incomes are expressed in pounds per week (January 2008 prices). The dark horizontal and vertical lines correspond to an income equal to 60% of contemporary median income (£123 per week for wave 1; £126 per week for wave 2).

Source: Jenkins (2011a, Figure 1.2).

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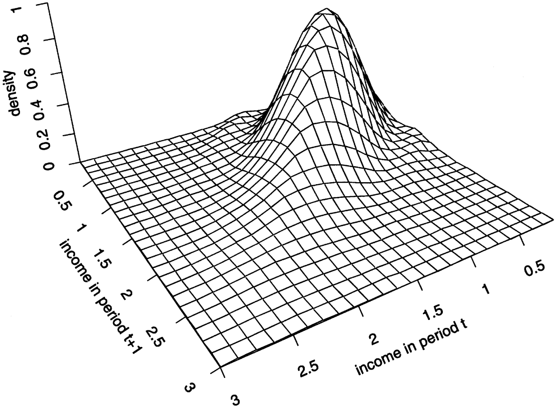
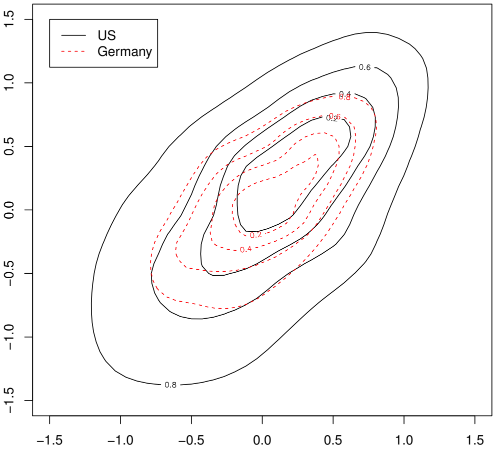
Figure 3: Bivariate Density Plot Example



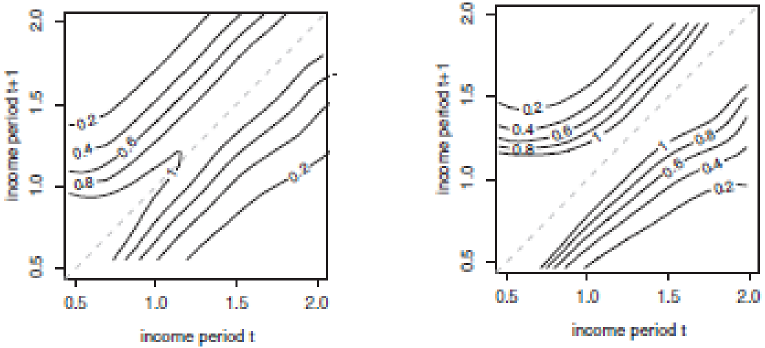
Note: The charts shows a ‘typical’ kernel density estimate for incomes in two consecutive periods.
Source: Schluter (1998, Figure 1).

Figure 4: Contour Plot Example



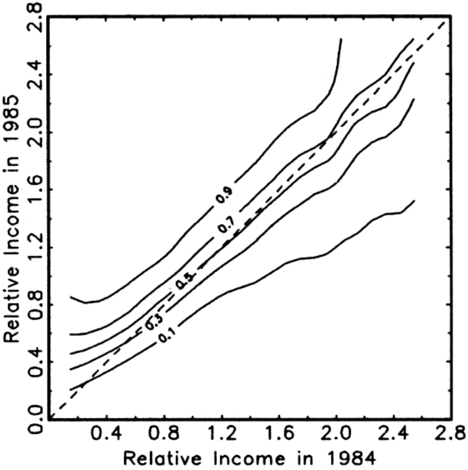
Note: The chart shows the kernel-smoothed joint density of income in 1984 and 1993 for the USA and West Germany, where income is post-tax post-transfer family income equivalised by the PSID equivalence scale, and income for each year is expressed as a deviation from the year-specific mean.
Source: Gottschalk and Spolaore (2002, Figure 1), redrawn by the authors.

Figure 5: Conditional Density Plot Example



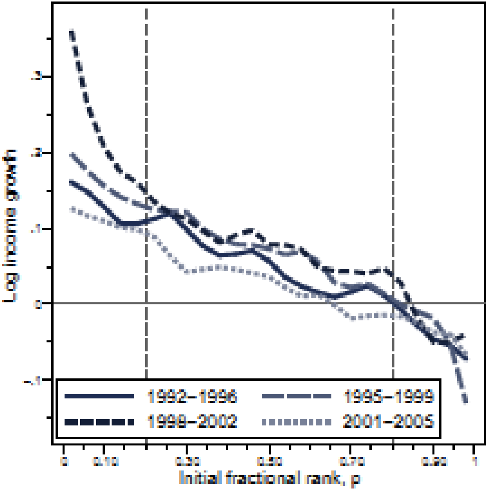
Note: Year t refers to 1987; year $t+1$ refers to 1988. The top chart refers to the USA; the bottom chart to Western Germany.
Source: Schluter and Van de gaer (2011, Figure 2).

Figure 6: Non-Parametric Transition Probability Plot Example



Note: Relative income in each year equal to income divided by the 1984 median income.
Source: Trede (1998, Figure 1).

Figure 7: Individual income growth and mobility profiles



Source: Jenkins and Van Kerm (2011).

3.2 Mobility Dominance

- Welfare comparisons of differences in mobility for bivariate distributions f and f^* are based the difference

$$\Delta W = \int_0^{a_y} \int_0^{a_x} U(x, y) \Delta f(x, y) dxdy \tag{3}$$

where $\Delta f(x, y) = f - f^*$ is the difference in bivariate densities and the same $U(.)$ is used for the social evaluation of each distribution. Cf. equation (3).

3.3 Mobility Indices

- We refer to these features at several points in what follows.
- We now turn to consider the most commonly-used ‘statistical’ or ‘intuitive’ measures of (im)mobility are the Pearson (product moment) correlation, r, between the log of incomes at two time points or its close sibling Beta (β), the slope coefficient from a leastsquares linear regression of log(period-2 income) on log(period-1 income):

$$r = \beta \frac{\sigma_1}{\sigma_2} \tag{4}$$

where σ_1 and σ_2 are the standard deviations of log incomes in periods 1 and 2.

- The Gini correlation between the income distributions in periods 1 and 2 is

$$\Gamma_{12} = \frac{\mathrm{cov}(y_1/\mu_1, F_2)}{\mathrm{cov}(y_1/\mu_1, F_1)} \quad (5)$$

where y_1/μ_1 is period-1 relative income, i.e. income divided by the period-specific mean income, F_1 and F_2 are the fractional ranks in the two periods, and cov(.) means covariance.

- Since $1 - \Gamma_{12}$ is a directional measure of mobility ($\Gamma_{12} \neq \Gamma_{21}$ in general), the overall Gini Mobility index is defined as a weighted average of the two possible directional measures, where the weights depend on the inequalities in each marginal distribution, measured using the Gini coefficient (G).
- That is,

$$\text{Gini Mobility Index } = \frac{G_1(1-\Gamma_{12}) + G_2(1-\Gamma_{21})}{G_1 + G_2}. \tag{6}$$

- Fields and Ok (1999b) provide the most well-known aggregate measure of directional income growth in this tradition. They show that directional measures of individual income growth that satisfy the properties of scale invariance, subgroup decomposability, and multiplicative path separability must take the form

$$D1 = c\left[\frac{1}{N}\sum_{i=1}^{N}(\log(y_i) - \log(x_i))\right] \qquad (7)$$

where c is a normalizing constant which may be set equal to one, and N is the population size.

- (Demuynck and Van de gaer, 2012, 750) prove that the measure satisfying their axioms is of the form:

$$S = \frac{1}{N^{\delta}} \sum_{i=1}^{N} (i^{\delta} - (i-1)^{\delta})\tilde{d}_i, \text{with } \delta \geq 1. \tag{8}$$

- Shorrocks (1978a) defines a measure of income rigidity, $R(T)$, equal to the ratio of inequality among T-averaged incomes ('longer-term' inequality) to the weighted average of single-year inequality values:

$$R(T) = \frac{I[Y(T)]}{\sum_{k=1}^{k=T} w_k I[Y^k]}. \tag{9}$$

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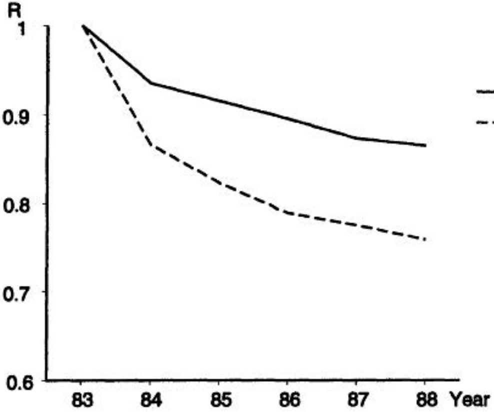
Figure 8: Income Rigidity (Longer-Term Inequality Expressed as a Fraction of Total Inequality) Falls as the Time Period is Lengthened



Note: Income is post-tax post-transfer income. The Shorrocks rigidity index R is computed using the Theil index of inequality. 'Germany' refers to the federal states of Western Germany.
Source: Burkhauser and Poupore (1997, Figure 2).

- The class of mobility indices for the two-period case is then defined as (Chakravarty et al., 1985, 8):

$$C = \frac{1 - I[Y(T)]}{1 - I[Y^1]} - 1. \tag{10}$$

where I is a relative inequality index equal to one minus an index of relative equality (as is the case with the Atkinson (1970) class of inequality indices).

- To fix ideas, suppose that the dynamics of income for each individual can be described using the canonical random effects model

$$\log y_{it} = u_i + v_{it} \tag{11}$$

where y_{it} now refers to the income for person i in year t.

- Thus total inequality as measured by variance of log incomes is equal to the sum of the variance of ‘permanent’ individual differences plus the variance of ‘transitory’ shocks:

$$\sigma_1^2 = \sigma_u^2 + \sigma_v^2. \tag{12}$$

where y_{it} now refers to the income for person i in year t.

- Income volatility in a given year t, V_t , is commonly measured by the standard deviation (sd)) of the distribution of individual changes in log income between one year and an earlier year.

$$V_t = \text{sd}[\log(y_{it} + \tau) - \log(y_{it})]. \quad (13)$$

- The final step is to consider versions of these measures that would enable comparisons across populations of different size. Specifically, their per capita measure of absolute measure of absolute income movement is:

$$D2 = \frac{1}{N}\sum_{i=1}^{N}|y_i - x_i|. \quad (14)$$

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- This leads to the per-capita relative movement index: given by

$$D3 = \frac{1}{N} \sum_{i=1}^{N} |\log(y_i) - \log(x_i)|. \qquad (15)$$

4. Intragenerational Mobility: Evidence

4.1 Data and Issues of Empirical Implementation

4.2 Intragenerational Income Mobility in the USA: Levels and Trends

Table 2: Differences in cumulative density: USA, 1979–1988 versus 1989–1998

	Destination group									
Origin group	1	2	3	4	5	6	7	8	9	10
1	0.2	–0.1	–0.2	0.0	0.3	0.2	0.1	0.1	–0.1	0.0
2	0.0	0.0	0.4	0.6	0.5	0.2	0.2	0.1	0.0	0.0
3	–0.2	–0.5	–0.2	0.0	0.0	–0.5	–0.1	–0.1	0.0	0.0
4	–0.2	–0.7	–0.6	–0.6	–0.7	–0.7	–0.2	–0.3	0.1	0.0
5	0.0	–0.3	–0.3	–0.5	–0.7	–0.5	0.0	–0.1	0.4	0.0
6	0.1	–0.1	–0.1	–0.4	–1.1	–1.3	–0.9	–0.5	0.4	0.0
7	0.1	0.2	0.0	–0.3	–0.8	–0.9	–0.8	–0.3	0.3	0.0
8	0.1	0.2	–0.2	–0.2	–0.3	–0.7	–1.1	–0.7	–0.3	0.0
9	0.0	–0.1	–0.3	–0.2	–0.4	–0.4	–0.7	–0.6	–0.6	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: The estimates are in percent, rounded to one decimal place, and show in each cell the cumulative discrete density for the 1980s minus the corresponding cumulative discrete density for the 1990s.
Source: Authors' calculations from (Hungerford, 2011, Tables 2 and 3), based on PSID data.

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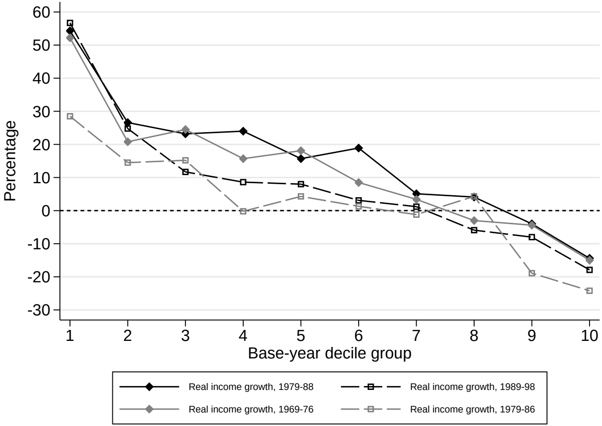
Table 3: Selected mobility indices (%): USA, 1979–1988 versus 1989–1998

Index	1979–88	1989–98
Decile mobility	79.1	77.0
Normalized trace	87.9	85.6
Gini mobility	36.2	34.4
Equalization (Shorrocks, Gini-based)	10.9	11.1
Equalization (Fields, Gini-based)	2.1	8.2
Average of absolute income changes ($D1$)	11,368	13,878
Average of absolute income share changes	0.421	0.459

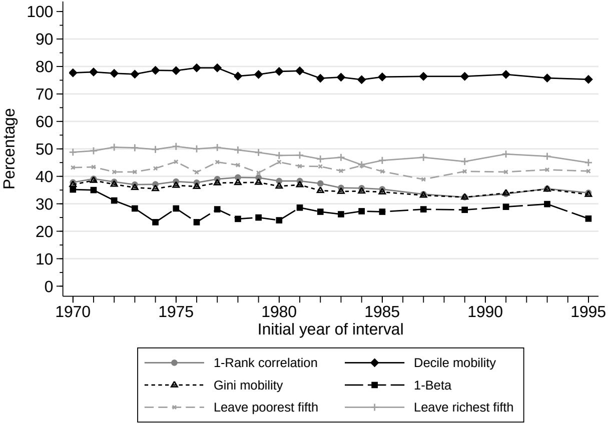
Note: The estimates are in percent, rounded to one decimal place, apart from those in the last two rows (in constant-price dollars). Decile mobility is the proportion of persons changing at least one decile group. The normalized trace is the Shorrocks (1978b) index calculated from the decile transition matrix. The Gini mobility index is the index of Yitzhaki and Wodon (2005). The Equalization indices are those of Shorrocks (1978a) and Fields (2010). On the average of absolute income and income share changes, see Fields and Ok (1996) and Fields (2010). See text for more details.
Source: Authors' calculations from Hungerford (2011, Tables 4 and 8, and p. 97), based on PSID data.

Figure 9: Median Real Income Growth, by Base-Year Decile Group: USA, by Period



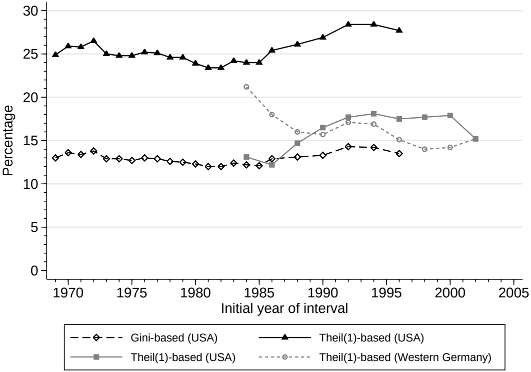
Note: The estimates show median income growth for each base-year decile group over the relevant period.
Source: Hungerford (1993, Table 9) and Hungerford (2011, Tables 5 and 6).

Figure 10: Indices of positional income mobility: USA, 1970–1995



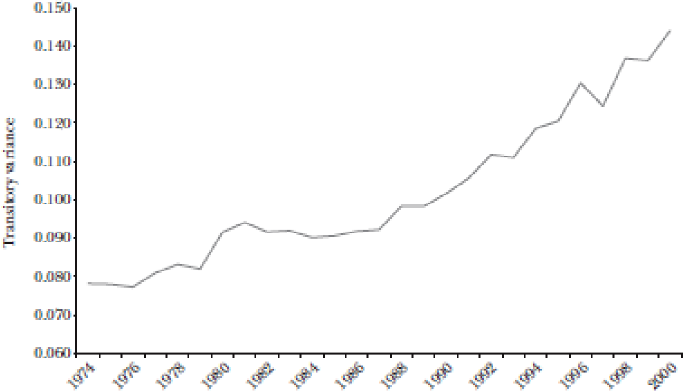
Note: The estimates refer to 11-year intervals, with incomes in base- and final-year averaged over two years. For example, the estimates labelled as 1970 refer to incomes longitudinally-averaged over 1969 and 1970 (base year) and 1979 and 1980 (final year). See text for index definitions.
Source: Bradbury (2011, Tables 2 and 3).

Figure 11: Mobility as longer-term income inequality reduction: USA, 1970–1995



Note: The estimates refer to the Shorrocks equalization measure, $M = 1 - R$, calculated using the Gini and Theil inequality indices. The Bradbury (2011) calculations are based on eleven-year intervals with longer-term average incomes calculated using every second year's income in order to handle the PSID's change to alternate-year interviewing in the late-1990s. The Bayaz-Ozturk et al. (2013) calculations use five-year intervals, with interval base-years two years apart.
Sources: Bradbury (2011, Table 4) for the series shown in black and Bayaz-Ozturk et al. (2013, Table A1) for the series shown in gray. Both use PSID (CNEF) data.

Figure 12: Transitory variance of log annual family income: USA, 1974–2000



Note: Transitory variances computed using the Gottschalk and Moffitt (1994) window-averaging method, with rolling 9-year windows.
Sources: Gottschalk and Moffitt (2009, Figure 5), based on PSID data.

4.3 Is There More Income Mobility in the USA Than in (Western) Germany?

Table 4: Studies comparing household income mobility in the USA and Western Germany (WG)

Study	Time period covered	(Im)mobility measure(s)	Remarks
Burkhauser and Poupore (1997)	1983–88	Shorrocks R	First finding that mobility greater in WG than in USA
Burkhauser et al. (1998)	Year pairs $t, t+\tau$, $\tau = 1, \ldots, 5$, 1983–88	Quintile transition matrices	Slightly more income mobility in WG
Maasoumi and Trede (2001)	1984-89	Maasoumi-Shorrocks R	Greater mobility in WG; statistically significant
Gottschalk and Spolaore (2002)	1983, 1993	SWF-based indices	WG–USA difference depends on index parameters
Schluter and Trede (2003)	Year pairs $t, t+1$ between 1984–92	Shorrocks R	WG's greater mobility arises from greater mobility in low-income ranges
Van Kerm (2004)	1985, 1997	Portfolio of indices	More income movement in USA; otherwise varies by index
Jenkins and Van Kerm (2006)	Year pairs $t, t+5$: USA 1981–93, WG 1985–99	Indices of re-ranking, progressivity	Reranking and pro-poorness of income growth greater in WG

Note: Studies are listed in order of publication year. Each study measures income as equivalized post-tax posttransfer household income (using various equivalence scales), analysis samples are all individuals in households (except Burkhauser et al. (1998), all individuals aged 25–55). Western Germany: the states included in the Federal Republic of Germany before re-unification.
Data Sources: PSID (USA) and SOEP (WG).

Table 4: Studies comparing household income mobility in the USA and Western Germany (WG), Cont.

Study	Time period covered	(Im)mobility measure(s)	Remarks
Schluter and Van de gaer (2011)	Year pairs $t, t+1$ between 1984–92	Index sensitive to upward structural mobility	US 'typically' has more mobility
Allanson (2012)	Year pairs $t, t+5$: USA 1981–96, WG 1985–04	Indices of re-ranking and structural mobility	Reranking and pro-poorness of income growth greater in WG
Demuynck and Van de gaer (2012)	1984–85, 1996–97	Indices of 'inequality-adjusted' income growth	USA–WG ranking depends on weight given low-income-growth individuals
Bayaz-Ozturk et al. (2013)	5-year windows, alternating years, 1984–2006	Shorrocks R, ratio of permanent to total variance, log incomes	More mobility in USA from around 1990 onwards

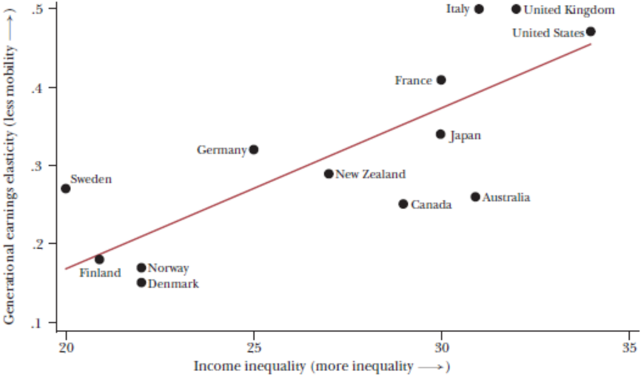
Note: Studies are listed in order of publication year. Each study measures income as equivalized post-tax posttransfer household income (using various equivalence scales), analysis samples are all individuals in households (except Burkhauser et al. (1998), all individuals aged 25–55). Western Germany: the states included in the Federal Republic of Germany before re-unification.
Data Sources: PSID (USA) and SOEP (WG).

4.4 Intragenerational Income Mobility: Selected Other Evidence

4.5 Summary and Conclusions

5. Intergenerational Mobility: Evidence

Figure 13: The Great Gatsby Curve: The Relationship Between Intergenerational Earnings Persistence and Cross-Sectional Income Inequality



Note: Income inequality is measured by the Gini coefficient of disposable household income in 1985 taken from the OECD. Persistence is measured as the Beta of parental and son earnings. Sons are born in early 1960s and outcomes for them are measured in late 1990s. See Corak (2013a,b) for further detail.
Sources: Corak (2013a, Figure 1).

5.1 Data and Issues of Empirical Implementation

- The GEIV model for the annual income process of an individual in family i in generation $j (= O\text{ffspring}, P\text{arent})$ at age t relates permanent income y and transitory errors v to annual or current income by (Haider and Solon, 2006)

$$y_{ijt} = \lambda_{jt} y_{ij} + v_{ijt} \; j = O, P. \tag{16}$$

- An estimate of the IGE β using annual incomes for both parents and children has the probability limit

$$\text{plim}\hat{\beta} = \frac{\text{Cov}[y_{iOt}, y_{iPt}]}{\text{Var}[y_{iPt}]} \tag{17}$$

$$= \frac{\text{Cov}[y_{iO}, y_{iP}] + \text{Cov}[v_{iOt}, y_{iP}] + \text{Cov}[y_{iO}, y_{iPt}] + \text{Cov}[v_{iOt}, v_{iPt}]}{\text{Cov}[y_{iP}] + \text{Var}[v_{iPt}] + 2\ \text{Cov}[y_{iP}, y_{iPt}]}.$$

- If only parental income is measured with error, we would have

$$\text{plim}\hat{\beta} = \frac{\text{Cov}[y_{Oit}, y_{pi}]}{\sigma^2_{yp}} = \theta_{Ps}\beta, \tag{18}$$

where s is the age at which parental income is measured and

$$\theta_{Ps} = \frac{\text{Cov}[y_{Pis}, y_{Pi}]}{\text{Var}[y_{Pis}]} = \frac{\lambda_{Ps}\sigma^2_{yP}}{\lambda^2_{Ps}\sigma^2_{yP} + \sigma^2_{vP}} \tag{19}$$

is the linear projection coefficient of y_{Pi} on y_{Pis} (Haider and Solon, 2006).

- If only *offspring* income were characterised by the GEIV process, the probability limit of the IGE estimated using annual income would be

$$\text{plim}\hat{\beta} = \frac{\text{Cov}[y_{Oit}, y_{pi}]}{\sigma^2_{yP}} = \lambda_{Ot}\beta. \quad (20)$$

- If both offspring and parental incomes are characterised by the GEIV model, which is plausible, the estimated IGE is (Haider and Solon, 2004; Gouskova et al., 2010)

$$\text{plim}\hat{\beta} = \lambda_{Ot}\theta_{Ps}\beta. \tag{21}$$

- Finally, the Pearson correlation coefficient r has in this case the probability limit

$$\text{plim}\hat{r} = \theta_{Ot}\frac{\sqrt{\lambda_{Ot}^2\sigma_{y0}^2 + \sigma_{v0}^2}}{\sigma_{y0}}\theta_{Ps}\frac{\sqrt{\lambda_{Ps}^2\sigma_{yP}^2 + \sigma_{vP}^2}}{\sigma_{yP}}. \tag{22}$$

- Denoting the two populations by A and B and focusing on Beta, and assuming for simplicity we are measuring both parents and offspring at the same ages, we have

$$\hat{\beta}^A - \hat{\beta}^B \simeq \lambda^A_{Ot}\theta^A_{Ps}\beta^A - \lambda^B_{Ot}\theta^B_{Ps}\beta^B. \qquad (23)$$

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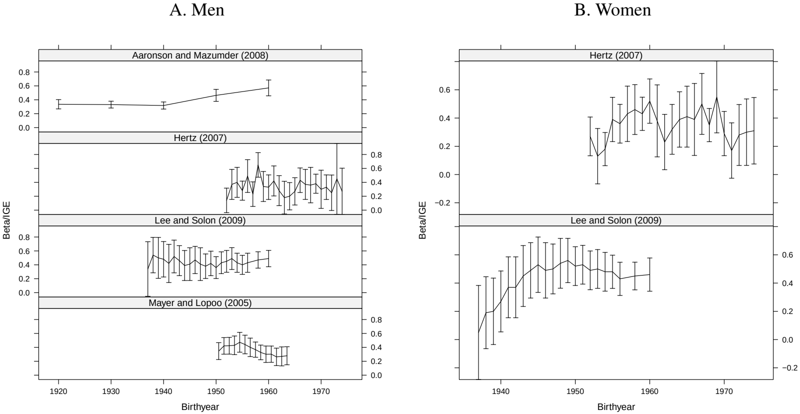
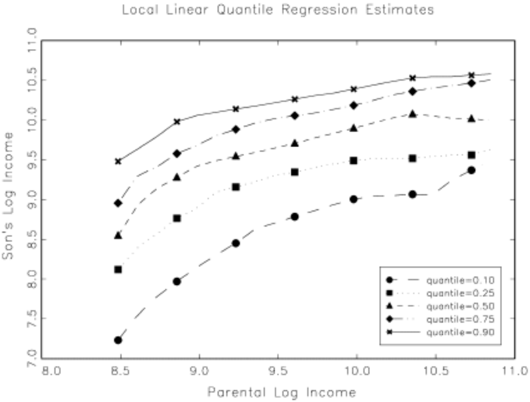
5.2 Intergenerational Persistence in the USA

Figure 14: Trends in US Intergenerational Income Persistence



Note: The estimates in Lee and Solon (2009) are the elasticities for different outcome years at age 40, presented here by subtracting 40 from the outcome year, amd are derived using a three-year average of parental income. Mayer and Lopoo (2005) estimate elasticities for four-year birth cohorts which are centered here, and observe offspring at age 30, and use a seven-year average of parental income (at ages 19–25). Hertz (2007) presents elasticities at age 25 and uses a three-year average of income. His estimates further control for panel attrition. Aaronson and Mazumder (2008) uses two-sample methods applied to (IPUMS) census data, with elasticities applying to 35–44 year olds, here centered at age 40.
Sources: (Aaronson and Mazumder, 2008, Table 1, column 6) Hertz (2007, Table 4), Mayer and Lopoo (2005, Table A1) and Lee and Solon (2009, Table 1).

Figure 15: Intergenerational Income Persistence: Non-Parametric Quantile Regression for US Father-Son Pairs



Note: Estimates based on PSID father-son pairs as prepared by Minicozzi (2003). Sons' income is the average of labour income at ages 28 and 29 and parental income is predicted parental income as defined by Minicozzi (2003).
Sources: Lee et al. (2009, Figure 1).

5.3 Cross-National Comparative Evidence on Intergenerational Associations

Table 5: Intergenerational Decile Transition Matrices for Earnings, Father-Son Pairs, Canada and the USA

A. USA

	Son									
	1	2	3	4	5	6	7	8	9	10
Father										
1	22	18	10	10	11	11	5	5	2	7
2	9	15	16	15	9	9	9	5	9	5
3	9	10	12	17	15	9	9	7	7	5
4	17	9	10	12	3	15	9	11	7	7
5	12	7	12	6	14	9	12	10	12	8
6	7	11	6	10	11	13	13	11	7	11
7	8	7	12	9	11	9	16	13	9	5
8	8	8	8	11	10	7	11	15	13	8
9	4	8	8	5	9	11	7	9	20	19
10	3	8	6	7	7	5	10	16	11	26

Note: The cell entries show, for each decile group origin (referring to fathers), the percentage of sons in each destination decile group. US estimates are based on SIPP matched to social security earnings. Fathers' earnings are averaged across 1979–85 and sons' across 1995-98. Canadian data are based on tax records. Fathers' earnings are averaged across 1978–82 and sons' earnings across 1993–95.
Sources: Mazumder (2005a, Table 2.2) and Corak and Heisz (1999, Table 6).

Table 6: Intergenerational Decile Transition Matrices for Earnings, Father-Son Pairs, Canada and the USA, Cont.

B. Canada

	Son									
	1	2	3	4	5	6	7	8	9	10
Father										
1	16	14	12	11	10	9	8	7	7	7
2	13	13	12	12	11	10	9	8	7	6
3	11	11	12	12	12	11	10	8	8	7
4	10	10	11	11	11	11	11	10	8	7
5	9	10	10	10	11	10	11	11	10	8
6	9	9	10	10	10	11	11	11	10	9
7	8	9	9	9	10	10	11	11	11	11
8	8	8	8	9	9	10	11	12	12	12
9	8	8	8	8	8	10	10	12	13	15
10	8	8	8	8	8	9	10	11	13	18

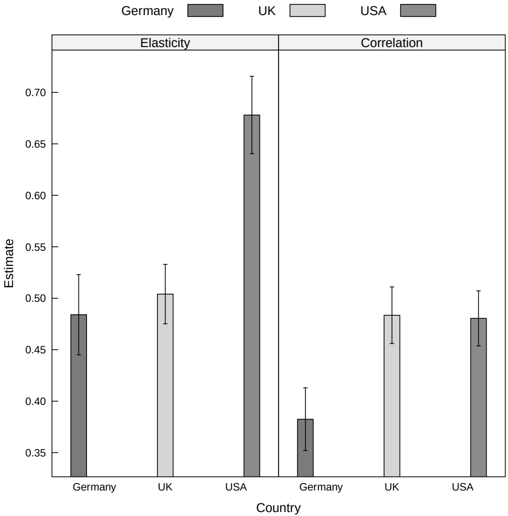
Note: The cell entries show, for each decile group origin (referring to fathers), the percentage of sons in each destination decile group. US estimates are based on SIPP matched to social security earnings. Fathers' earnings are averaged across 1979–85 and sons' across 1995-98. Canadian data are based on tax records. Fathers' earnings are averaged across 1978–82 and sons' earnings across 1993–95.
Sources: Mazumder (2005a, Table 2.2) and Corak and Heisz (1999, Table 6).

Table 7: Intergenerational Earnings Mobility in Canada, Sweden and the USA: Beta, *r*, and the Rank Correlation

Country	Beta		*r*		Rank correlation	
	Estimate	Rank	Estimate	Rank	Estimate	Rank
Canada	0.26	(2)	0.23	(2)	0.24	(1)
Sweden	0.25	(1)	0.21	(1)	0.30	(2)
USA	0.40	(3)	0.26	(3)	0.30	(2)

Note: Canadian estimates rely on tax records. Father's earnings are a five-year average and son's a three-year average 1997–1999 when they were 31–36 years old. Swedish estimates, also based on tax records for earnings, rely for fathers on 20 years of earnings data measured at ages 30–60 and for sons on an 11-year average across ages 30–40. The US estimates stem from the Survey of Income and Program Participation panels using earnings from Social Security records. Fathers earnings are a nine-year average between 1979–1986 when they were 30–60 years old. Sons' earnings are a five-year average between 2003–7 in years they were at least 28 years old.
Sources: Corak et al. (2013, 10–11).

Figure 16: Intergenerational Persistence of Disposable Income: Elasticities Versus Correlations



Sources: Authors' elaborations based on Eberharter (2013, Tables 1, 2).

Table 8: Cumulated Differences in Intergenerational Mobility Tables Across Earnings Decile Groups for Father-Son Pairs in Canada and the USA (USA-CAN)

	Son									
	1	2	3	4	5	6	7	8	9	10
Father										
1	6	10	9	8	9	11	8	6	1	1
2	2	9	11	13	12	14	11	6	3	2
3	1	6	8	16	18	18	15	8	4	2
4	8	11	13	21	16	20	15	10	4	2
5	10	12	15	19	17	19	15	9	7	4
6	9	12	11	15	14	19	17	11	5	4
7	8	9	12	15	15	18	22	18	10	3
8	8	9	11	17	17	17	21	21	13	2
9	4	5	7	9	10	12	12	9	9	2
10	−1	0	0	2	2	0	0	2	−1	0

Note: Cell entries are in percent. See notes to Table 5.
Sources: Authors' derivations using transition matrices shown in Table 5 from Mazumder (2005a) and Corak and Heisz (1999).

5.4 Evidence on Sibling Correlations

Table 9: Cumulated Differences in Intergenerational Transition Matrices in Disposable Income Among All Persons for Germany, the UK and the USA

A. USA – Germany

	Offspring				
	1	2	3	4	5
Father					
1	3	5	5	1	0
2	9	11	4	2	0
3	9	18	6	2	0
4	9	18	9	9	0
5	4	13	1	2	0

B. USA – UK

	Offspring				
	1	2	3	4	5
Father					
1	−10	−1	−1	0	0
2	−11	−5	−2	−6	0
3	−11	1	−4	−9	0
4	−8	−3	−12	−10	−1
5	−10	−11	−21	−20	−1

C. UK – Germany

	Offspring				
	1	2	3	4	5
Father					
1	14	6	7	2	0
2	20	16	6	8	0
3	20	18	11	11	0
4	17	20	21	19	1
5	15	24	22	23	1

Note: Cell entries are in percent. See notes to Figure 16.
Sources: Authors' calculations from Eberharter (2013, Table 3).

- The natural logarithm of income in year t, y_{ijt}, for sibling j in family i, for brevity, assumed to be measured as deviations from the population average, is modelled as

$$y_{ijt} = a_i + b_{ij} + v_{ijt}, \tag{24}$$

where a_i is a permanent component common to all siblings in family i, and b_{ij} is a permanent component unique to individual j, which captures individual deviations from the family component.

- The share of the variance of long-run income that can be attributed to family background is

$$\rho = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_b^2}. \tag{25}$$

- Part of what siblings share in a is parental income.
- A useful analytical insight is that (assuming for ease of exposition marginal distributions are in 'steady state') the brother correlation in income can be thought of as the sum of the intergenerational income correlation squared and the correlation of other factors siblings share but that are orthogonal to income:

$$\rho = r^2 + \text{ correlation of other shared factors.} \tag{26}$$

Table 10: Sibling Correlations in Earnings and Income

Brothers

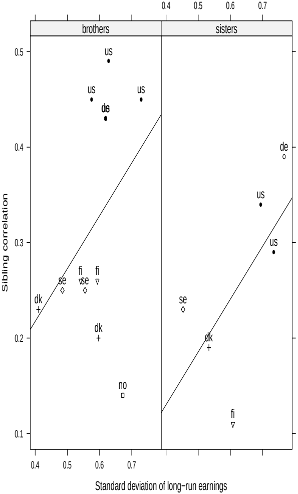
Denmark	0.23	1951–1968	ANOVA	Björklund et al. (2002)
Denmark	0.20	1958-1971	REML	Schnitzlein (2013)
China	0.57	Not reported	REML	Eriksson and Zhang (2012)
Finland	0.26	1953–1965	ANOVA	Björklund et al. (2002)
Finland	0.26	1950–1960	ANOVA	Österbacka (2001)
Finland	0.24	1955–1965	ANOVA	Björklund et al. (2004)
Germany	0.43	1958-1971	REML	Schnitzlein (2013)
Norway	0.14	1950–1970	ANOVA	Björklund et al. (2002)
Norway	0.14	1953–1969	ANOVA	Björklund et al. (2004)
Sweden	0.37	1962–1968	GMM	Björklund et al. (2009)
Sweden	0.25	1953	REML	Björklund et al. (2010)
Sweden	0.25	1948–1965	ANOVA	Björklund et al. (2002)
Sweden	0.22	1962–1968	REML	Björklund et al. (2007a)
Sweden	0.19	1951–1968	ANOVA	Björklund et al. (2004)
USA	0.49	1947–1955	REML	Mazumder (2008)
USA	0.45	1944–1952	REML	Levine and Mazumder (2007)
USA	0.45	1951–1958	ANOVA	Solon et al. (1991)
USA	0.43	1951–1967	ANOVA	Björklund et al. (2002)
USA	0.45	1958-1971	REML	Schnitzlein (2013)

Sisters

Denmark	0.19	1958-1971	REML	Schnitzlein (2013)
Finland	0.13	1950–1960	ANOVA	Österbacka (2001)
Finland	0.11	1955–1965	ANOVA	Björklund et al. (2004)
Germany	0.39	1958-1971	REML	Schnitzlein (2013)
Sweden	0.15	1951–1968	ANOVA	Björklund et al. (2004)
Sweden	0.23	1953	REML	Björklund et al. (2010)
Norway	0.12	1953–1969	ANOVA	Björklund et al. (2004)
USA	0.34	1947–1955	REML	Mazumder (2008)
USA	0.28	1951–1958	ANOVA	Solon et al. (1991)
USA	0.29	1958-1971	REML	Schnitzlein (2013)

Note: Estimates are all based on multi-year averages of earnings or income, adjusted for stage in lifecycle. We have relied in part on the compilation of evidence in Schnitzlein (2013) in constructing this table.
Sources: Schnitzlein (2013) and authors' compilation from sources listed in last column.

Figure 17: Sibling Correlations in Earnings and Income



Note: We have plotted on the horizontal axis the sum of the family and invividual components, which captures the variance of long-run earnings or income. The vertical axis shows the level of the estimated sibling correlation. Also shown in each panel is the least-squares regression line.
Sources: See Table 9.

5.5 Other Approaches to Intergenerational Mobility

5.6 Summary and Conclusions

6. Conclusions