The Life-Cycle Dynamics of Wealth Mobility

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Disclaimer: The views below are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York, the Federal Reserve System, the European Central Bank or the Eurosystem.

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Today: Document patterns of relative wealth mobility across life cycle

Made possible by **Norwegian administrative data** on wealth+income 1993–2017

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  - But: as many different histories as individuals
  - Use clustering techniques to find "typical" trajectories responsible for mobility
- Study how our clusters relate to other observable characteristics
  - Life cycle choices and events (Housing, civil status, portfolio composition, etc.)
  - To which extent do individual characteristics at age 30 predict future trajectories?

Main findings

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    - Mobility driven by two groups experiencing a *reversal of fortune* in middle of distribution
    - Pattern of segmented mobility:
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   - Pattern of segmented mobility:
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3. Individual circumstances help to predict trajectories: Human capital is key
   - Parental background: key determinant of Wealthy/Poor
   - Education: key determinant of Risers/Fallers

Norwegian Wealth Data

Data: Norwegian Tax Registry 1993 – 2017 ▸ Context ▸ Details

- No top-coding + Limited misreporting or measurement error (third-party reporting)
  - Focus on wealth (e.g., don't include public pensions)
  - No transaction data (e.g., changing houses or selling stocks)
- We adjust the tax value to reflect market values (Fagereng, Holm, Torstensen, 2023)
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Sample selection: Norwegian residents 1993–2017 (no immigrants after 25/2011, no emigrants)

- Focus on birth cohort born between 1960 and 1965 (first observed in early 30s)
  - 292,222 individuals in this sample (279,002 after balancing)

Ranks and Histories

- Compute within cohort ranks as

$$y_{i,t} = 100 \times F_w\left(w_{i,t} \middle| t, i \in BC(i)\right)$$

  - Computed separately for each year and each cohort

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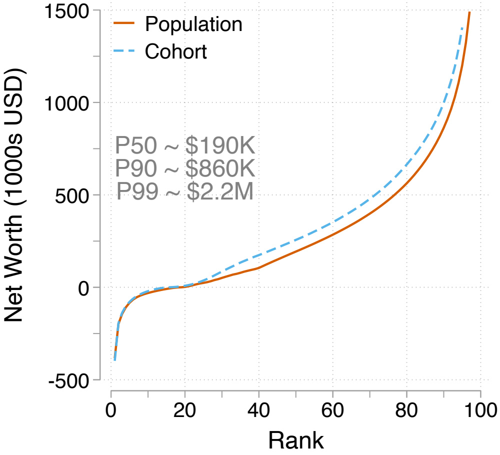
- Trajectories: Histories of ranks

$$\mathbf{Y}_i = \left(y_{i,1993}, y_{i,1994}, \ldots, y_{i,2016}, y_{i,2017} \right) \in [0, 100]^{25}$$

We are interested in the distribution of the trajectories $\mathbf{Y}_i$

Ranks vs Wealth Levels

Net Worth CDF (2014)



- Substantial wealth inequality in Norway
- Meaningful differences in wealth levels across ranks
- e.g. at the median, 10 ranks ≈ 60k USD

BC vs Pop Ranks

- US: p90≈$620K, p99≈$3.5M (SZZ, 2022)

Intra-Generational Wealth Mobility

- Linear rank-rank persistence: $y_{i,t} = \alpha_t + \rho_t y_{i,0} + u_{i,t}$

▸ Shorrocks

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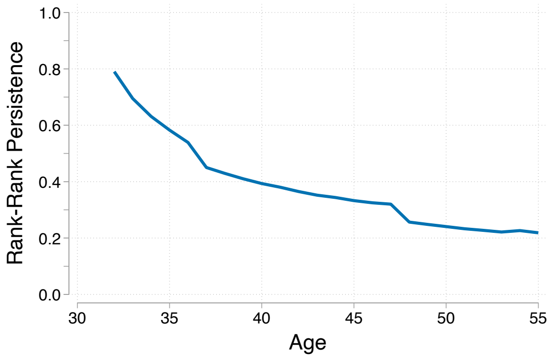

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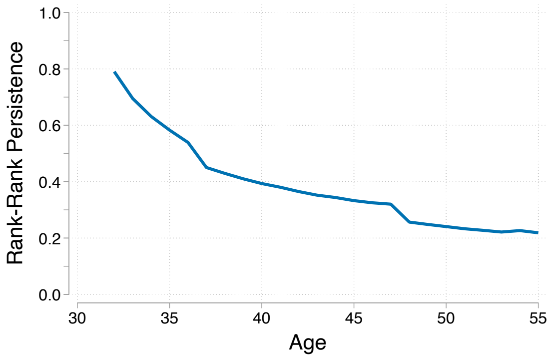

- Declining intra-generational persistence $\longrightarrow$ Increased (cumulative) mobility
- By age 55 only 25% of individuals remain in age 30 quintile (13% in decile)
- How broad-based is mobility? What (who) drives patterns?
- Persistence collapses heterogeneous trajectories

Clustering Wealth Histories

Grouping Individuals Into Typical Histories

Goal: Identify patterns in (ex-post) life cycle paths without restricting to a single statistic

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Method: Agglomerative Hierarchical Clustering to group rank histories

- Start with $G = N$ groups (one for each individual)

- Recursively merge groups by selecting *similar* pairs: $\underset{g,g' \in G,\, g \neq g'}{\operatorname{argmin}} \; d(g, g')$.

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Result: Hierarchy of (nested) partitions ranging from $G = N$ to $G = 1$.

- Choose $G^{\star}$ explaining over 50% variation in histories

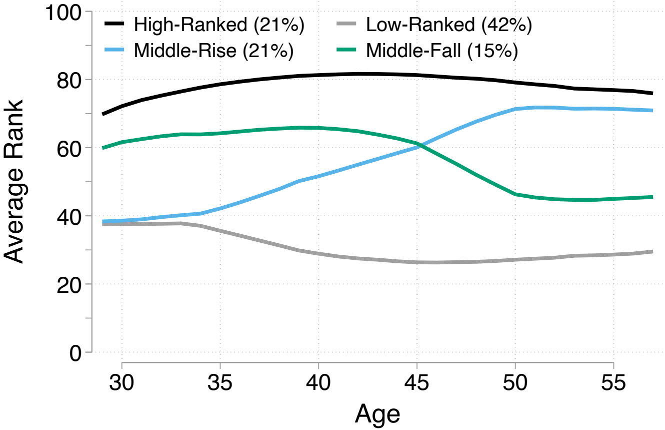
▸ Dendrogram

- Asymptotically consistent as we observe longer trajectories, even for fixed N

(Borysov, Hannig, Marron, 2014; Egashira, Yata, Aoshima, 2024)

Typical Rank Histories

Cohort Ranks



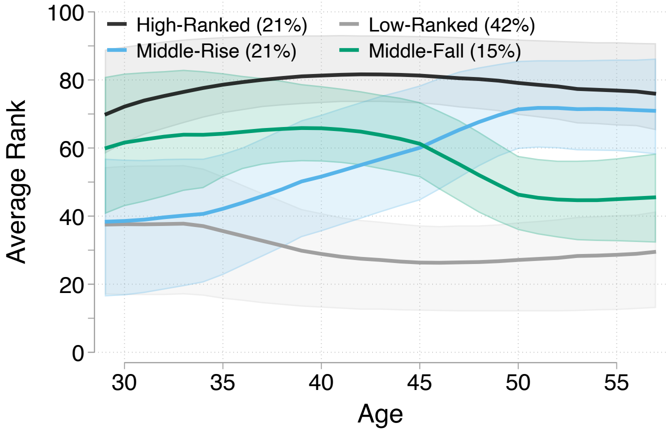
Four largest groups

- Wealthy/High Ranked: always at top of the distribution
- Poor/Low Ranked: always at the bottom of the distribution
- Middle class: one group of Risers and one group of Fallers

▸ Alt. Clustering ▸ Rnd Clustering

Typical Rank Histories

Cohort Ranks, interquartile range

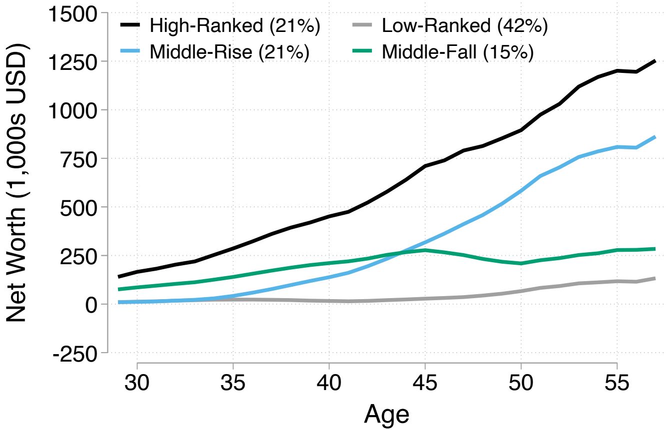


Segmented mobility

- Individuals move within segments of the distribution
- The mean trajectory of a group hides rank swaps within
  - Subclusters reveal patterns
- Segments overlap:
  Middle 60% Top & Bottom 40%

Wealth Histories Across Segments of the Distribution

Net Worth ($1000s)



Significant diff. in wealth profiles

- Top: Maintaining rank means level growth (8-10%)
- Bottom: Stay very low
- Risers: Grow on avg. 18%/y
- Fallers: ahead in 30s + low growth (5%) + Great Recession

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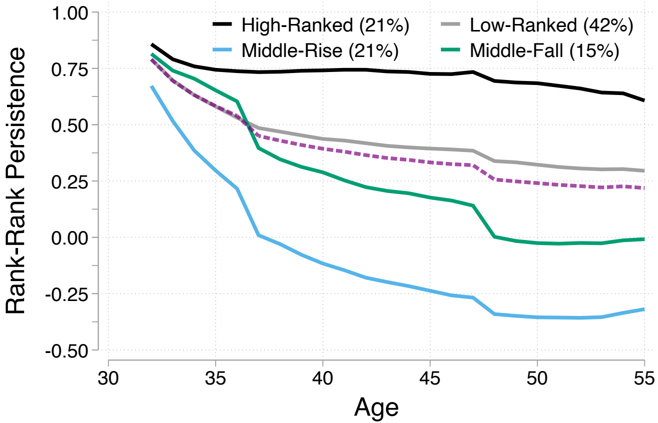

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- Risers: Reversal of fortune within 1 decade
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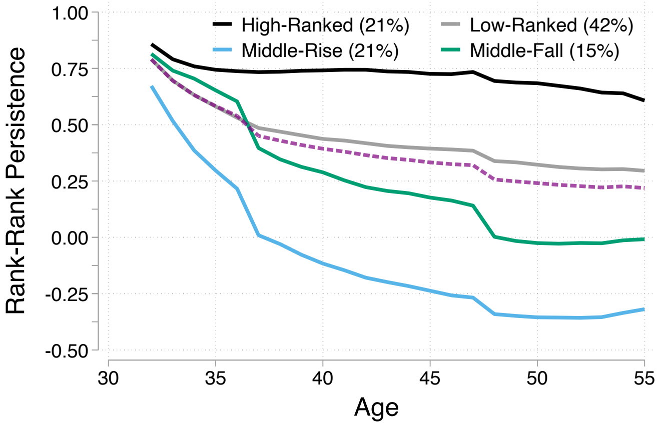

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- Mobility in the middle drives population mobility patterns. Risers are key.

Heterogeneity Across and Within Groups

Link Tax Registry to Income and Demographic Data

▸ Group Characteristics

- Both income levels and composition of portfolio play a role.
- Self-emp. and business ownership relevant for High-Ranked and Fallers. Not Risers.

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Use Hierarchy of Clusters for Subgroups

▸ Subgroup Trajectories

- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)
- High- and Low-Ranked differ in levels within segments

Towards Determinants of Trajectories

Hereditary Advantage: Wealth vs Human Capital

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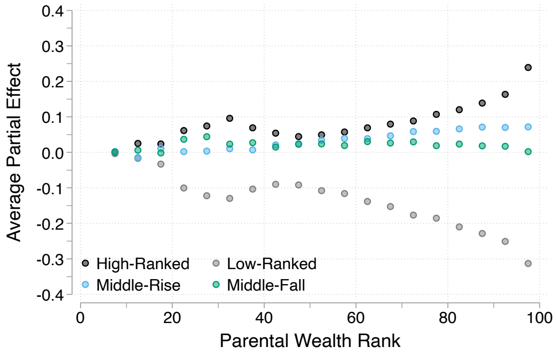
Predictors explain at most 6% of cross-group variation (same as rank-rank inter-gen reg) ▸ Results

Non-Linear Effects of Parental Wealth and Education

PW CIs ED CIs ED Field

Parental Wealth



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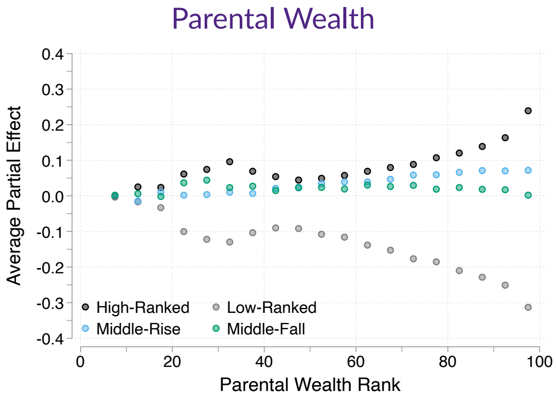

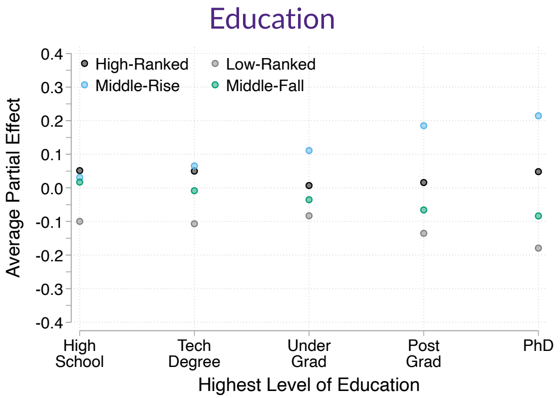

- Parental wealth's explanatory power: High for top/bottom, limited for middle groups
- Education tells risers/fallers apart: Equalizing effect but doesn't overcome initial cond.

Heterogeneity + Robustness + Intergenerational Mobility

- Robust to controlling for individuals' initial wealth rank + parent portfolio (1993)
  - $\downarrow$ Effect sizes by 25-40% (+ explained variation)
  - $\uparrow$ Overall variation explained $(\times 4)$
  - Driven by own initial wealth $\Rightarrow$ consistent w/ segmentation!

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  - Education and Parental Wealth explain risers and fallers within segments

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▸ High Ranked ▸ Low Ranked ▸ Middle Rise ▸ Middle Fall

- Decreasing intergenerational mobility:
  - Correlation between parents' and own wealth ranks increases over age
  - Reversal of fortune increases inter-generational persistence ▸ details

Conclusions

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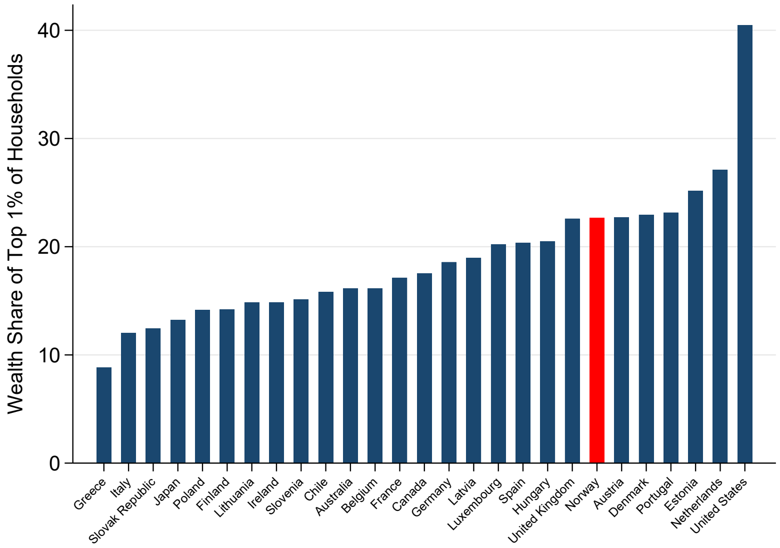
- Document intra- and inter-generational wealth mobility over the life cycle
- Uncover typical trajectories of individuals through the wealth distribution
  - Find important evidence of reversals in fortune over a quarter century
- Mobility driven my reversal of fortune for selected groups in the middle of the distribution
- Intergenerational background an important predictor of whole history
- Education is key for movements through the wealth distribution

▸ Connections and Contribution to Literature

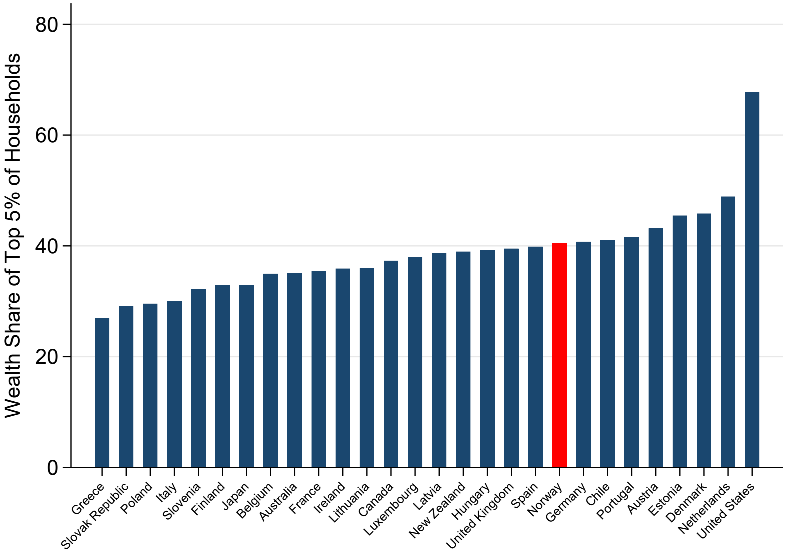
Extra

Norway in Context

Back

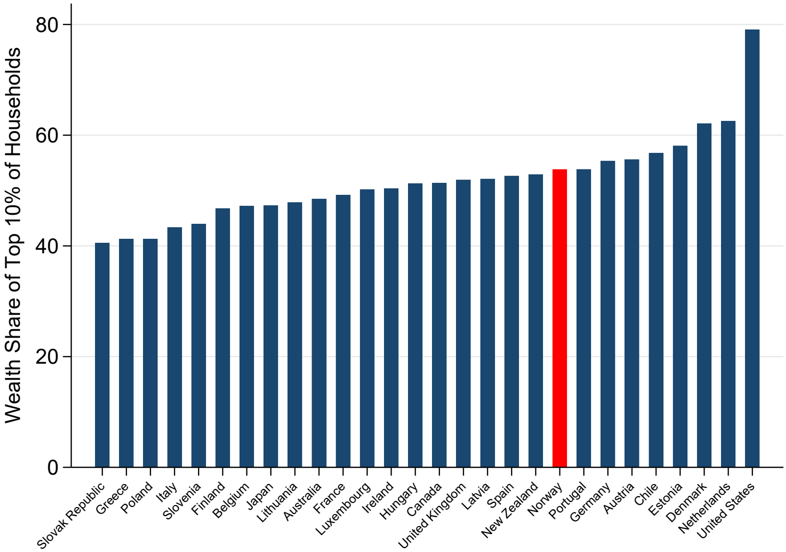


Norway in Context: Top 5% Share ◂ Back



Norway in Context: Top 10% Share

◂ Back

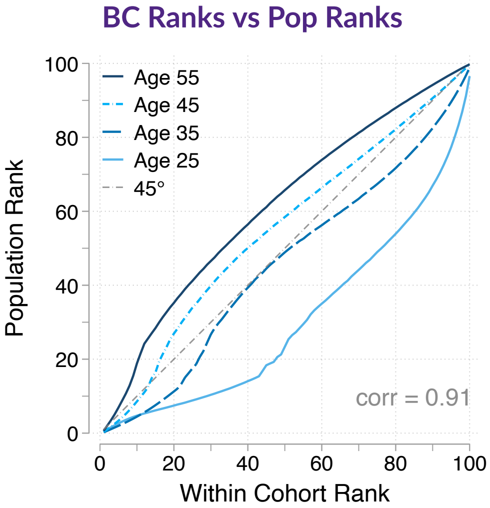


Key Variables ◂ back

- **Wealth:** Net worth = assets-debt $\longrightarrow$ **Primary Variable**
- **Assets & Debt:** Total assets and debt, and major asset categories
  - Domestic, foreign, property, vehicles, "safe," publicly and privately traded
  - Leverage, some assets are net positions
- **Income:** Including gifts/bequests, transfers, asset income, & earnings
- **Demographics:** Age, sex, education, civil status, place-of-birth
- **Lineage:** Match individuals to their parents and siblings

Birth Cohort Ranks vs Population Ranks

back



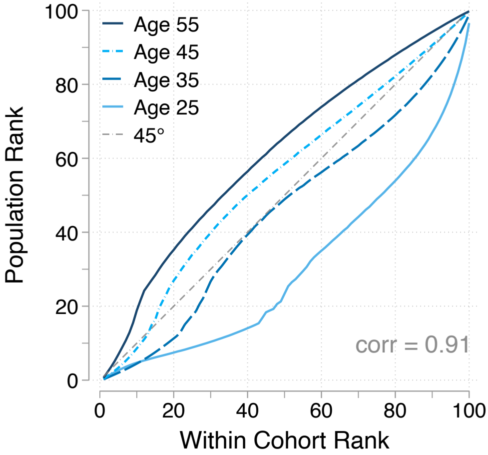
- Changes in wealth levels at each rank as the cohort ages
- 75 percent of age 25 individuals are below the median
- 35 percent of age 55 individuals are below the median

Household Ranks

Birth Cohort Individual Ranks vs Household Ranks

back

BC Ranks vs Pop Ranks



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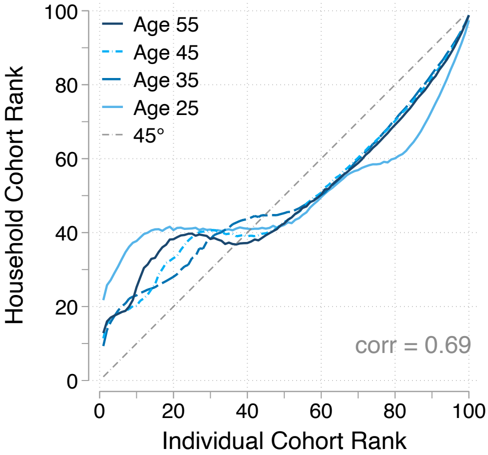

Shorrocks Mobility Index ◂ back

- Linear rank-rank persistence: $y_{i,t} = \alpha_t + \rho_t y_{i,0} + u_{i,t}$
- Shorrocks Index: Share that remains in initial quintile of dist. (trace of transition matrix)

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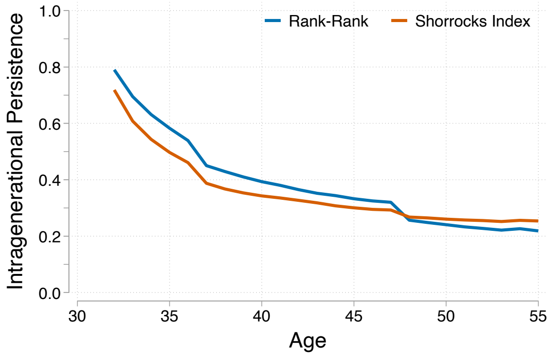

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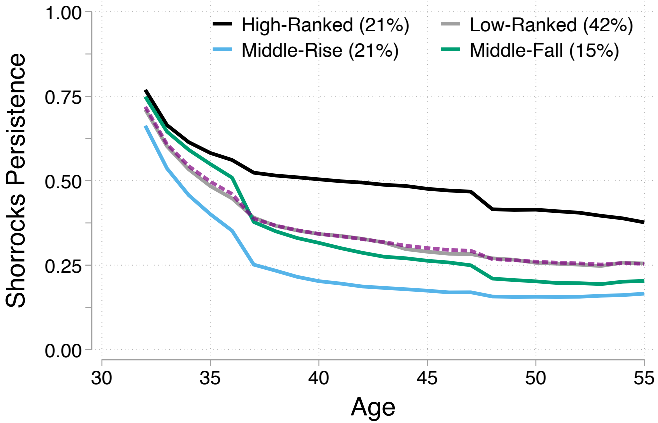
- By age 55 only 25% of individuals remain in age 30 quintile (13% in decile)
- Same patterns as rank persistence

Intra-Generational Shorrocks Mobility Index back



- Top: Higher persistence than population
- Fallers: Lower persistence than population

Decreasing Inter-Generational Mobility

back

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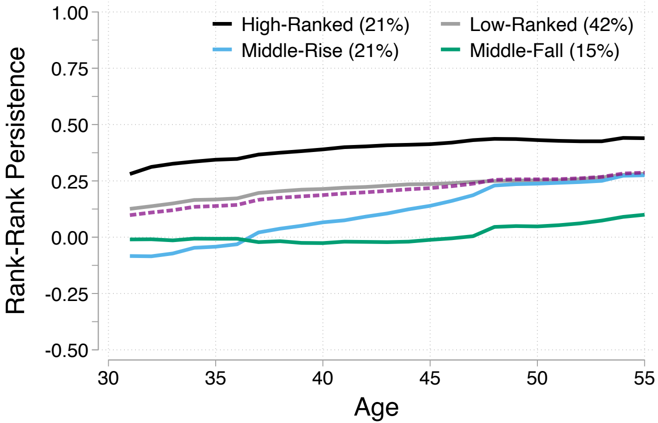

- Persistence rises for all groups
- Level differences are parallel

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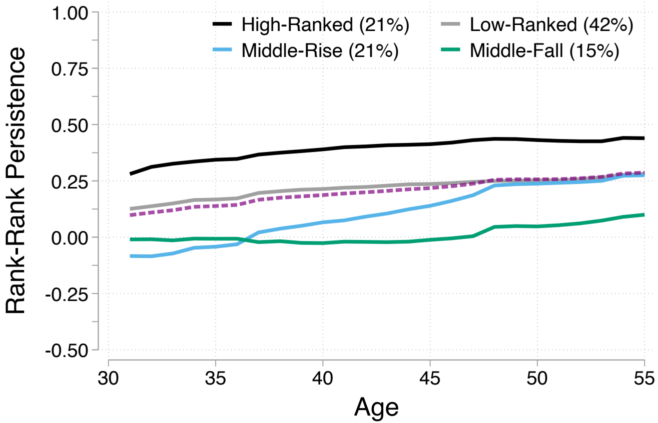

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  Except for risers!
- Risers' mobility trends from get-go
- Reversal of fortune increases inter-generational persistence

Shorrocks

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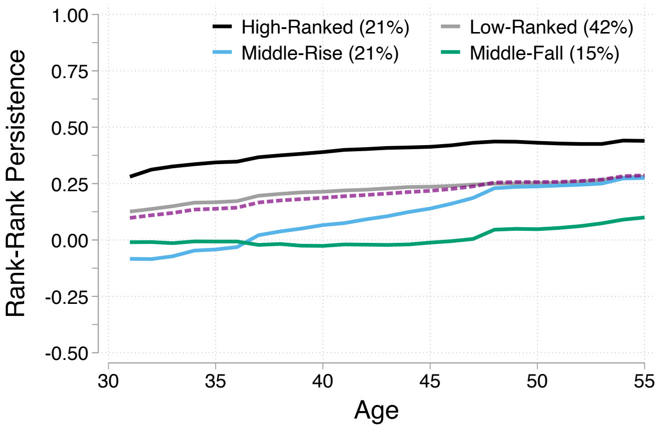

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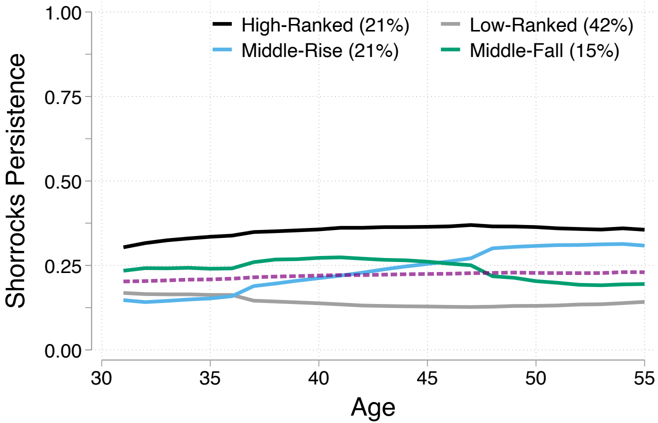
Shorrocks

- Clustering of trajectories captures persistent differences in mobility

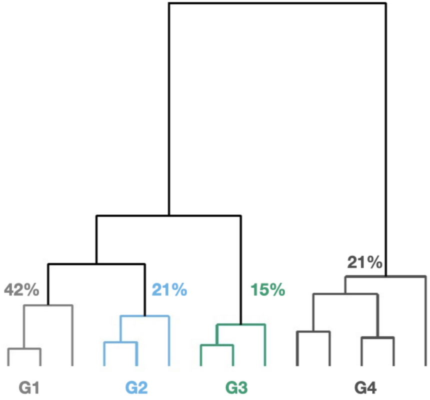
Inter-Generational Shorrocks Mobility Index ◂ back



- Risers have clear upwards persistence trend
- Flat patterns for other groups

Two Levels of Clustering ◂ back

Clustering Tree



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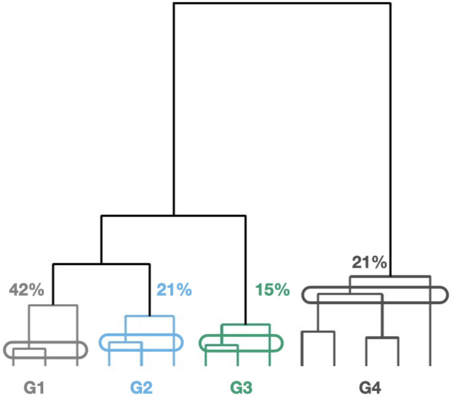
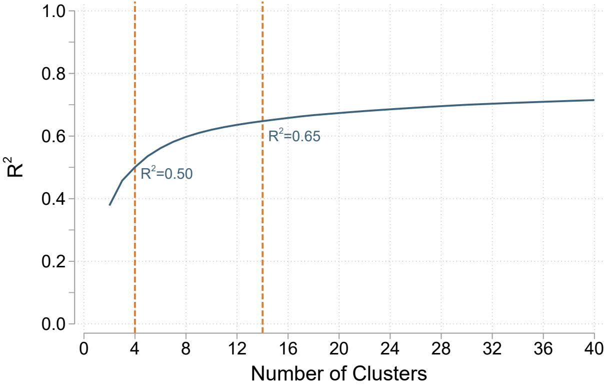


Variation Explained

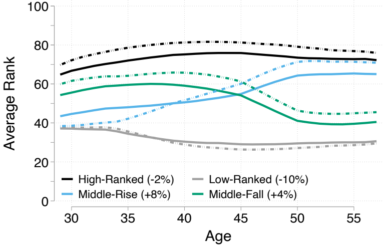


Characteristics of Main Clusters

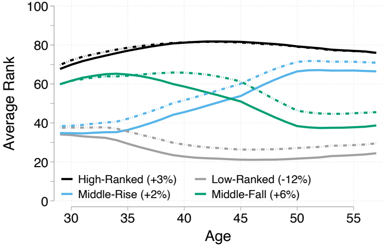
Alternative Clustering

Back

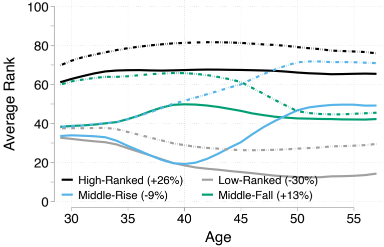
Household Cohort Ranks



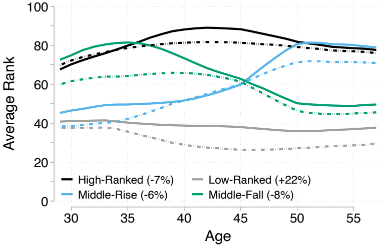
K Means on Ind. Cohort Ranks



Log Net Worth



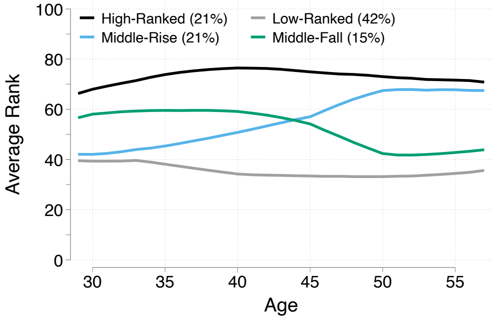
"Lorenz" Ordinates



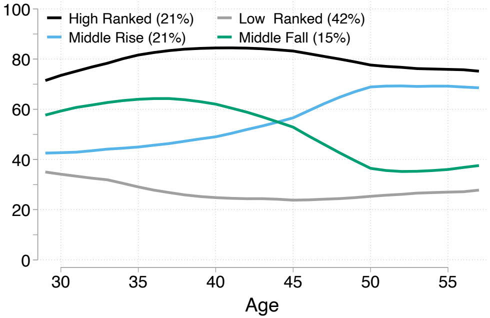
Household Wealth Ranks

Back

Household Cohort Ranks (Ind. CI)

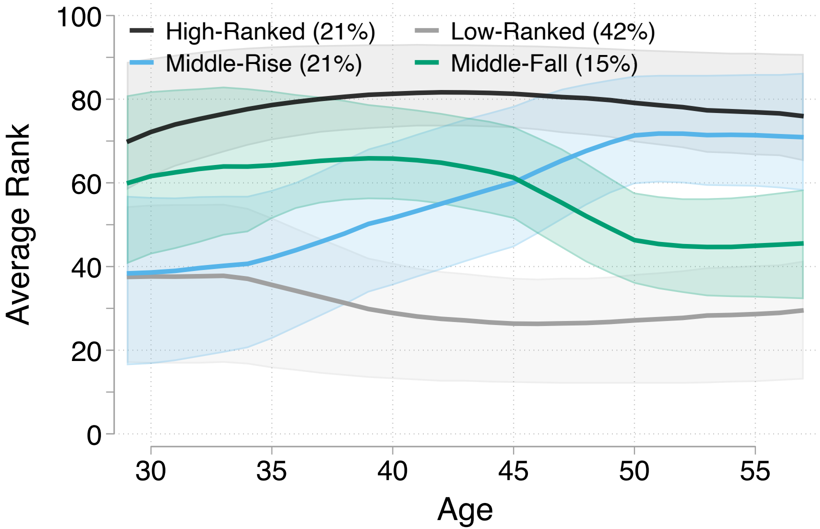


Household Cohort Ranks (HH. CI)



Distribution of Trajectories by Cluster

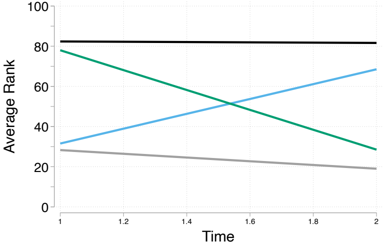
Back



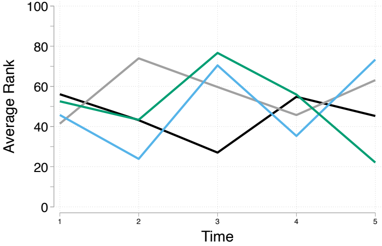
Clustering Random Ranks

Back

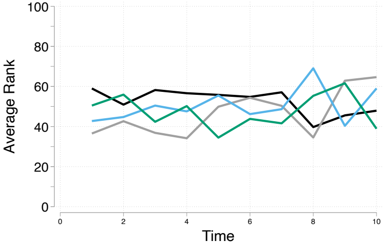
2 Periods



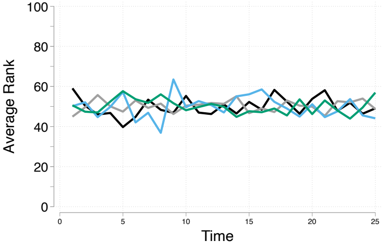
5 Periods



10 Periods



25 Periods

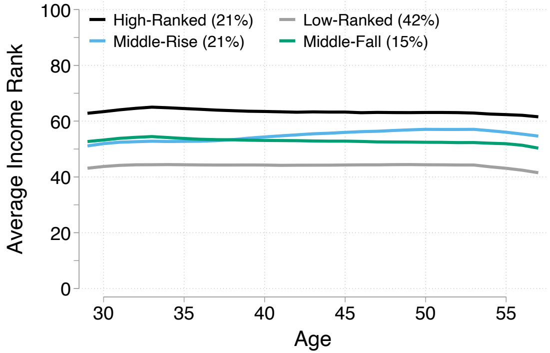


Heterogeneity Across and Within Groups

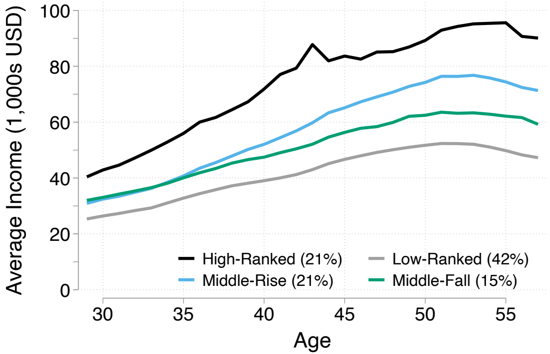
Income Histories Across Segments of the Distribution

back

Income Cohort Ranks



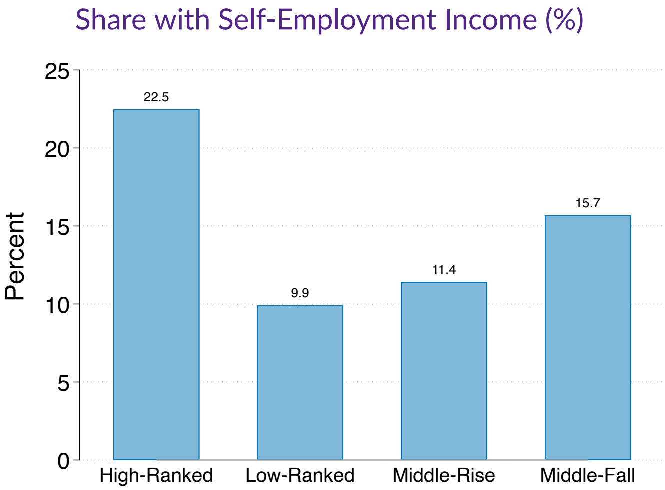
Income ($1000s)



- Distribution of income across clusters compressed relative to wealth Median Income
- Similar patterns for HH income; Risers same inc. as high ranked on average HH Inc. CS

Self-Employment Rates, Age 45

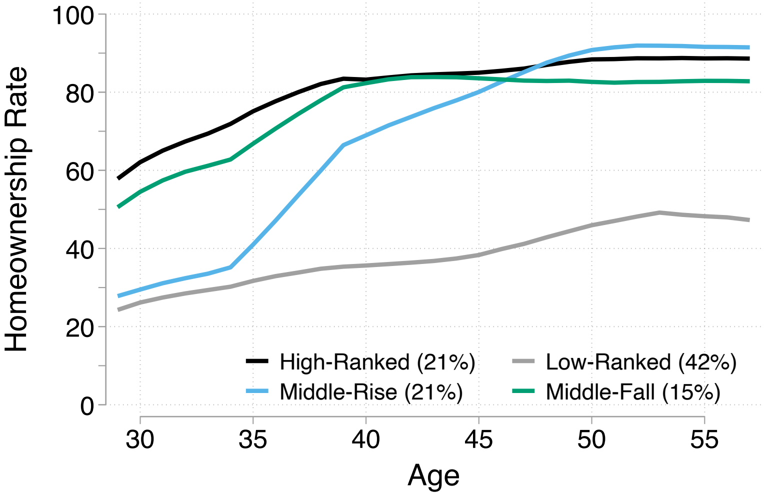
back



Income shares

Homeownership Rates by Cluster

back



Asset Portfolios

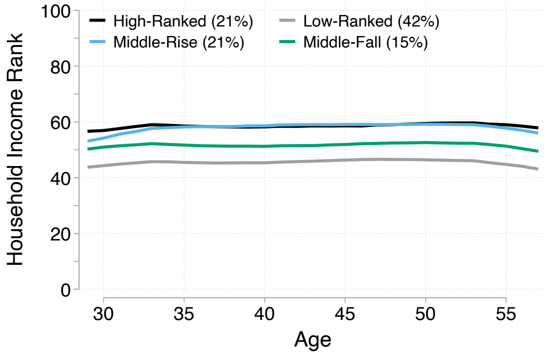
Taking stock: four largest clusters

back

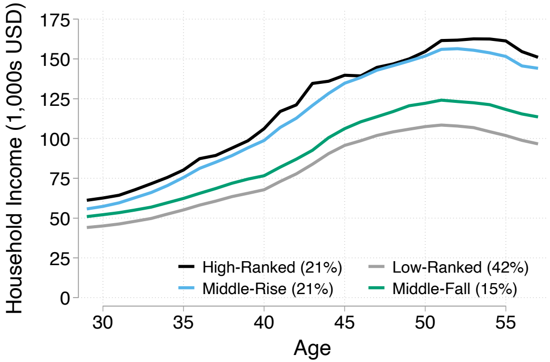
- High-Ranked
  - Stable at the top
  - Accumulate wealth fast
  - Homeowners, likely to own businesses
  - Largest labour market income
- Middle-Risers
  - Start out low
  - Accumulate wealth fast
  - Income similar to Wealthy
  - Become homeowners along the way
- Middle-Fallers
  - Start out relatively well off
  - Relatively lower labour market income
  - Likely to be self-employed
  - Usually own assets
- Low-Ranked
  - Stuck at the bottom
  - Little rise at the end
  - Lowest incomes
  - Non-homeowners

Household Income ◂ Back

Household Income Cohort Ranks

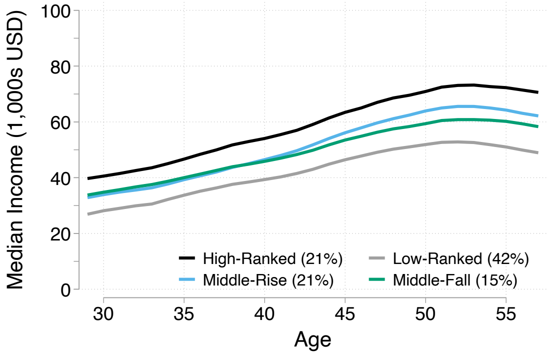


Household Income ($1000s)

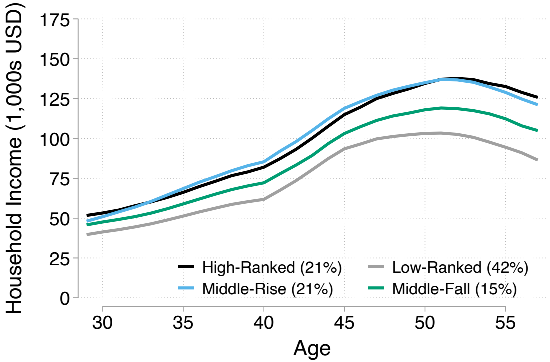


Median Income Histories ◂ Back

Median Income

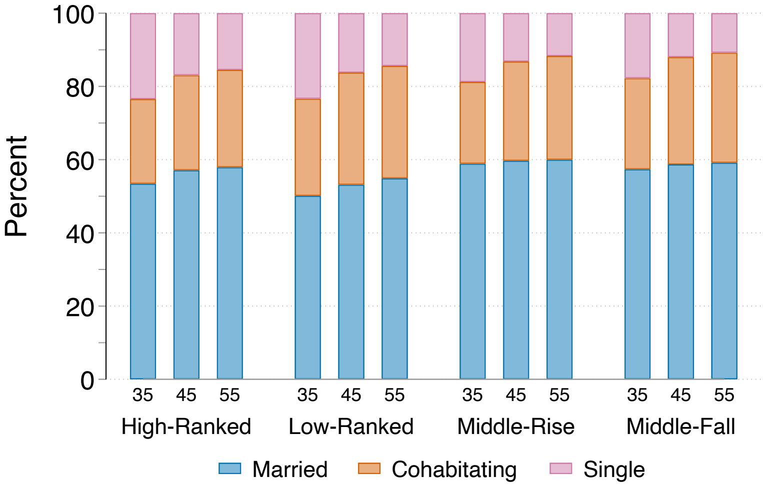


Household Median Income ($1000s)



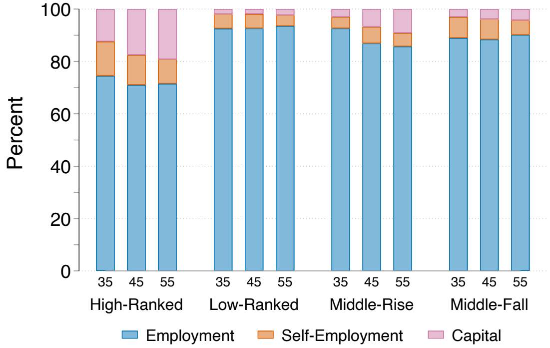
Civil Status

Back



Portfolio and Income Composition [Back]

Income Sources

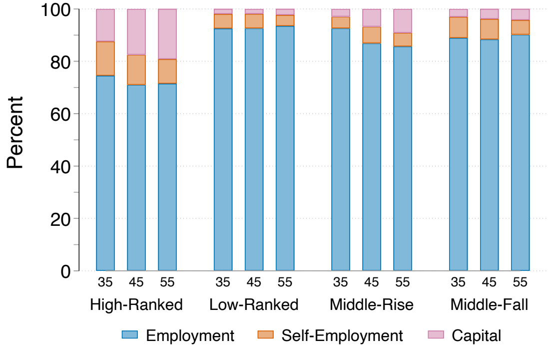


- Income differences in Self-Employment and Capital

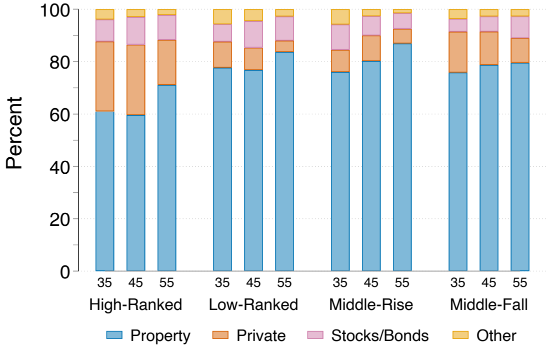
[SE] [Transfers] [Gifts]

Portfolio and Income Composition ◂ Back

Income Sources



Asset Portfolio



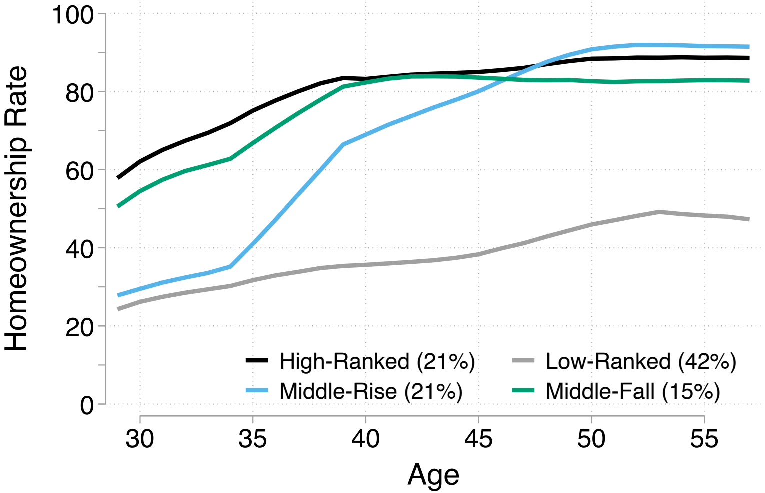
- Income differences in Self-Employment and Capital

▸ SE ▸ Transfers ▸ Gifts

- Asset differences across clusters in Private Equity and Property

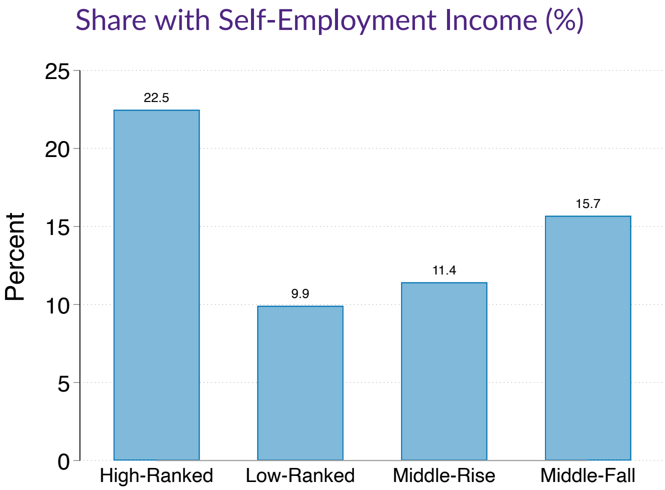
Home-ownership Rates by Cluster

Back



Self-Employment Rates, Age 45

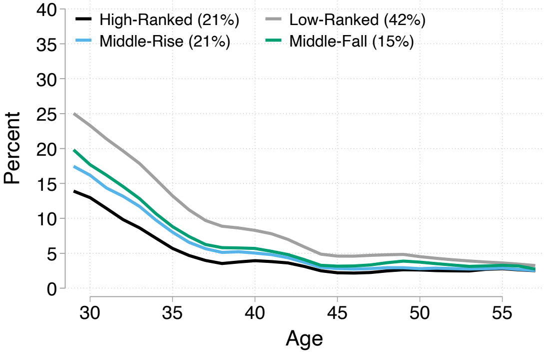
Back



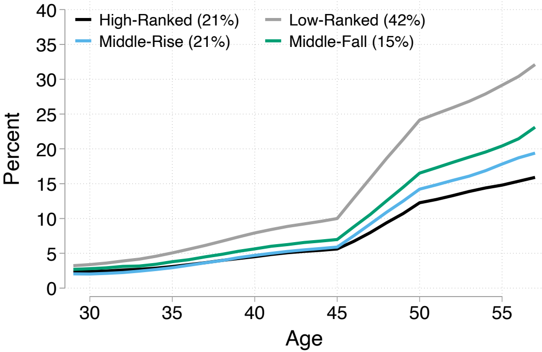
Transfers: Unemployment, Disability, Sick Leave, Nursing

Back

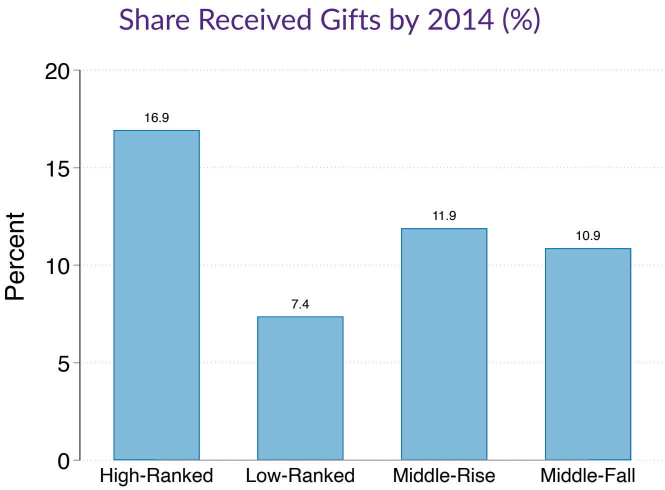
Share with Unemployment Benefits (%)



Share with Health-Related Transfers (%)



Lifetime Inheritances and Gifts ◂ Back

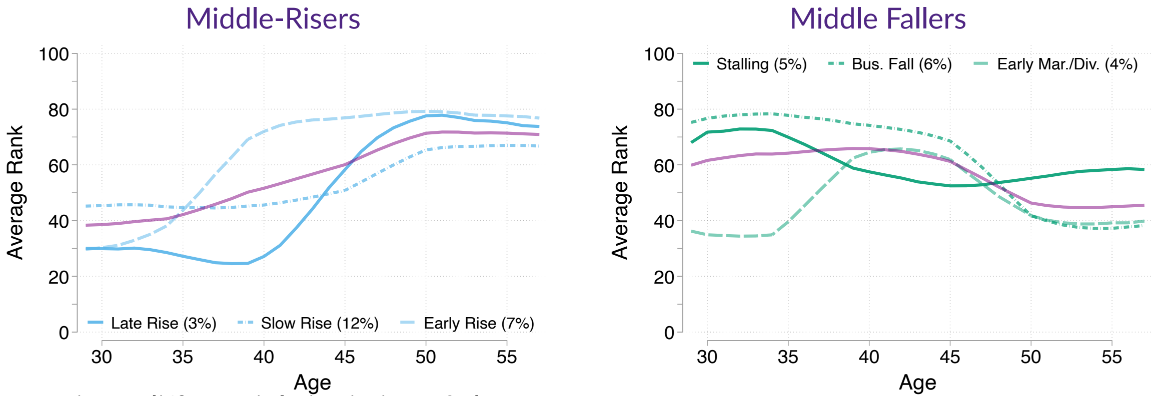


Notes: Total received $>$ NOK 470K ($\approx$ \$47K) before 2014

Characteristics of Sub-Clusters

Heterogeneity in Trajectories

▸ Wealth ▸ Portfolio ▸ Homeownership ▸ Inc. ▸ SE ▸ Edu.



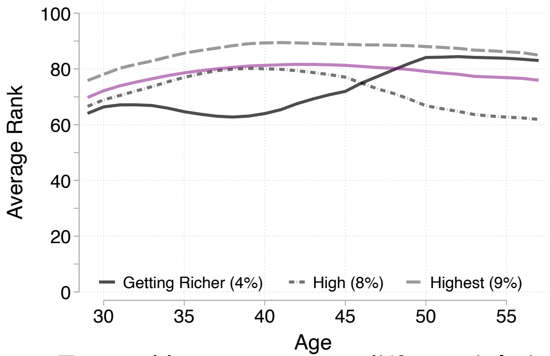
- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)

◂ back

Heterogeneity in Trajectories

Wealth Portfolio Homeownership Inc. SE Edu.

High-Ranked



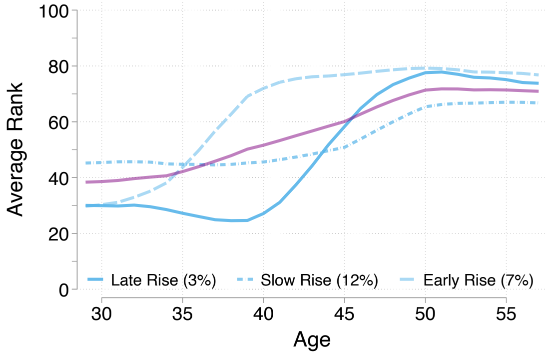
Low-Ranked

- Top and bottom groups differ mainly in avg. levels
- Zeros are quite different from debtors

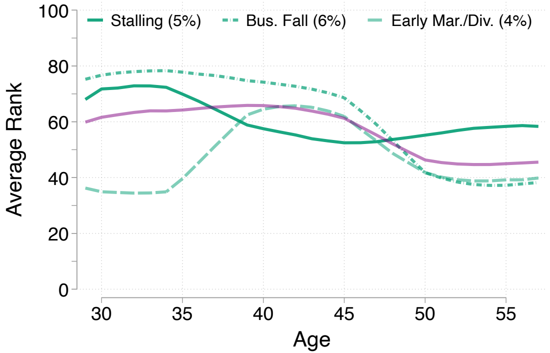
back

Heterogeneity in Trajectories: Levels vs Timing ◂ Back

Middle-Risers



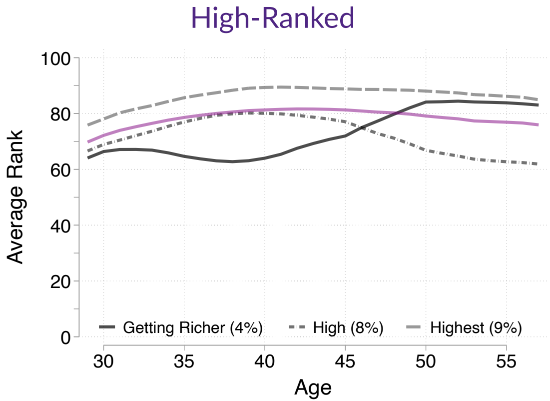
Middle-Fallers

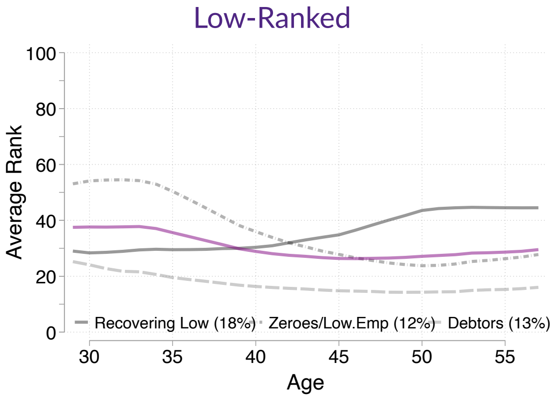


- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)

Heterogeneity in Trajectories: Levels vs Timing

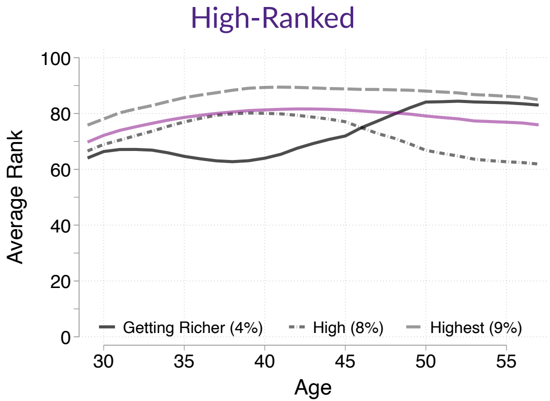
Back

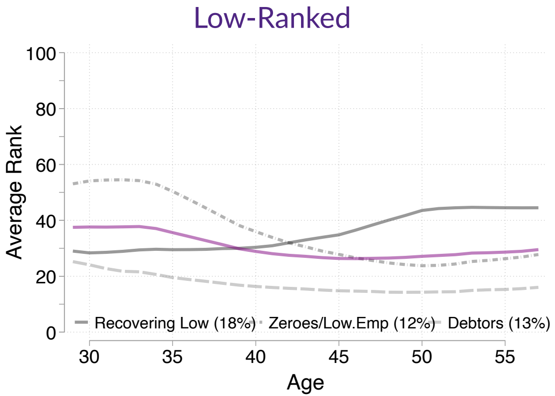




- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)
- Top and bottom groups differ mainly in avg. levels (with a rising sub-group in each)

Heterogeneity in Trajectories: Levels vs Timing ◂ Back



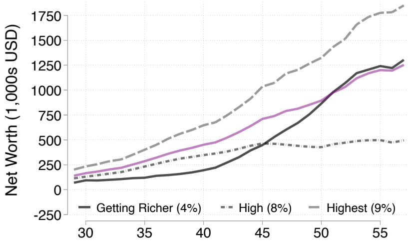


- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)
- Top and bottom groups differ mainly in avg. levels (with a rising sub-group in each)

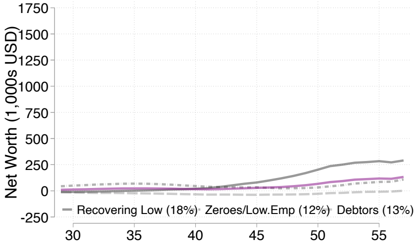
Sub-Clusters: Wealth Levels

Back

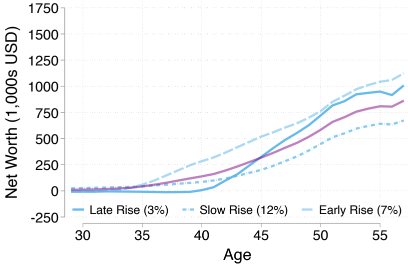
High Ranked



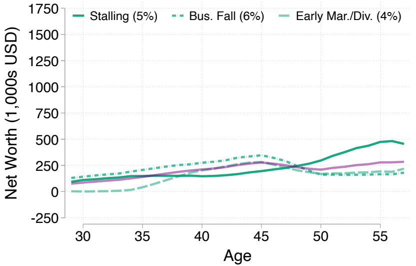
Low Ranked



Middle Risers



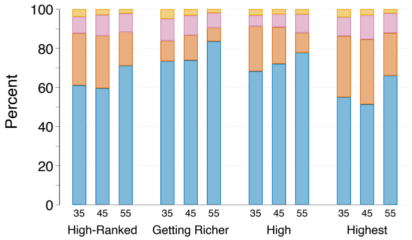
Middle Fallers



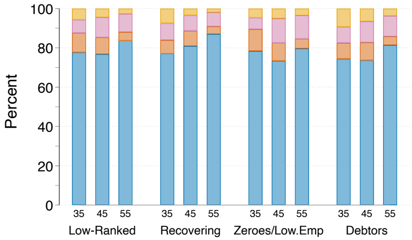
Sub-Clusters: Portfolio

Back

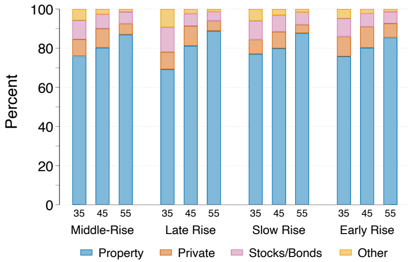
High Ranked



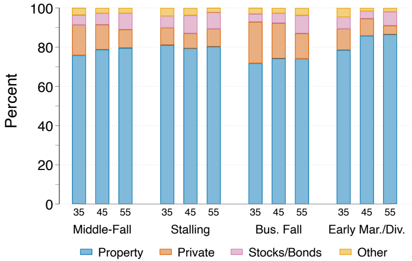
Low Ranked



Middle Risers



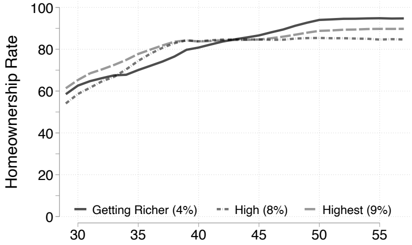
Middle Fallers



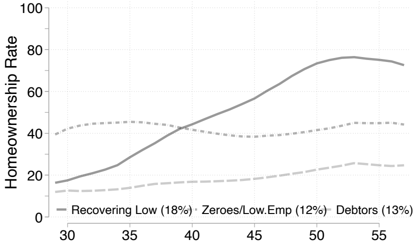
Sub-Clusters: Homeownership

Back

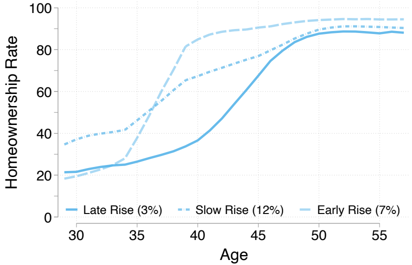
High Ranked



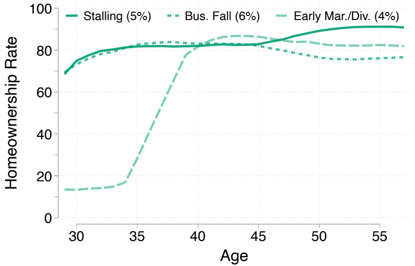
Low Ranked



Middle Risers



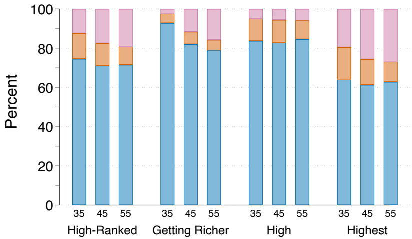
Middle Fallers



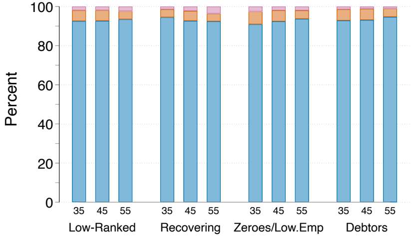
Sub-Clusters: Income Composition

Back

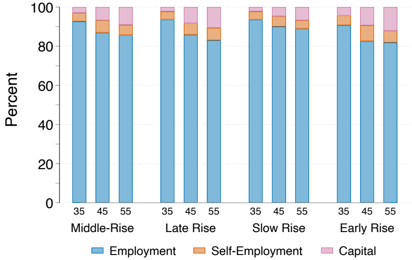
High Ranked



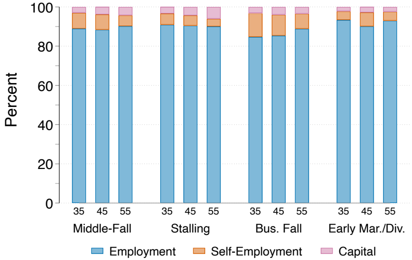
Low Ranked



Middle Risers



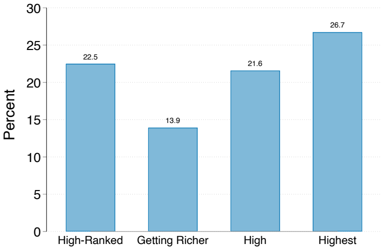
Middle Fallers



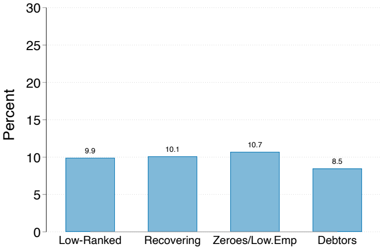
Sub-Clusters: Self-Employment

Back

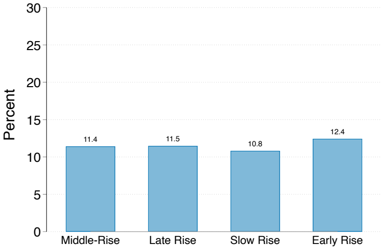
High Ranked



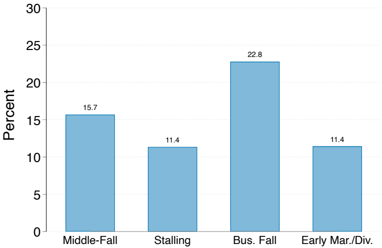
Low Ranked



Middle Risers



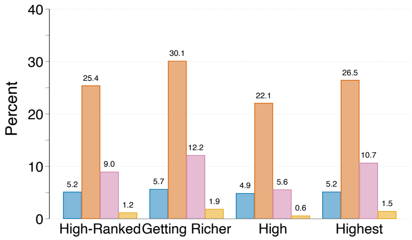
Middle Fallers



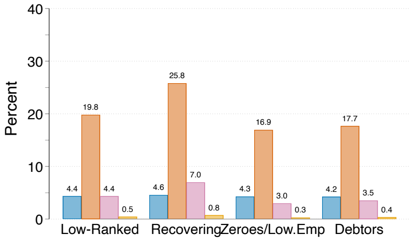
Sub-Clusters: Education

Back

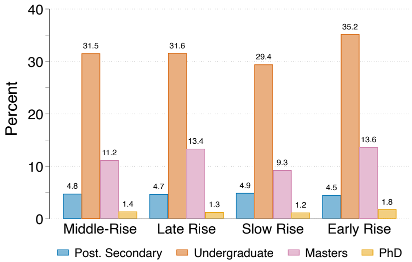
High Ranked



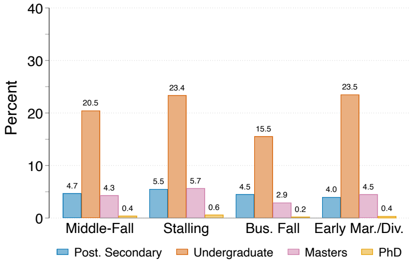
Low Ranked



Middle Risers



Middle Fallers



Shapley-Owen Decomposition

How Important Are Ex-Ante Explanations? Back

Two measures:

1. Distance Weighted Classification Rate $\in [0, 1]$

$$1 - \frac{\sum_{i=1}^{N} \sum_{k=1}^{G} \widehat{Pr}(g = k | X_i) D(g(i), k)}{\sum_{i=1}^{N} \sum_{k=1}^{G} \widehat{Pr}(g = k) D(g(i), k)} \qquad \left(\text{in spirit of} \quad \frac{ESS}{TSS} \right)$$

How Important Are Ex-Ante Explanations? Back

Two measures:

1. Distance Weighted Classification Rate $\in [0, 1]$

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2. Correct Classification Rate $\in [0, 1]$

$$\frac{1}{N}\sum_{i=1}^{N}\sum_{k=1}^{G}\widehat{Pr}\,(g=k\,|\,X_i)\;\mathbb{1}[g(i)=k]$$

How Important Are Ex-Ante Explanations? Back

Two measures:

1. Distance Weighted Classification Rate $\in [0, 1]$

$$1 - \frac{\sum_{i=1}^{N} \sum_{k=1}^{G} \widehat{Pr}(g = k | X_i) D(g(i), k)}{\sum_{i=1}^{N} \sum_{k=1}^{G} \widehat{Pr}(g = k) D(g(i), k)} \qquad \left(\text{in spirit of } \frac{ESS}{TSS} \right)$$

2. Correct Classification Rate $\in [0, 1]$

$$\frac{1}{N} \sum_{i=1}^{N} \sum_{k=1}^{G} \widehat{Pr}\,(g = k \mid X_i)\ \mathbb{1}[g(i) = k]$$

- Report Shapley-Owen decomposition of covariates
  - Order invariant & sums to statistic + Single value per covariate category

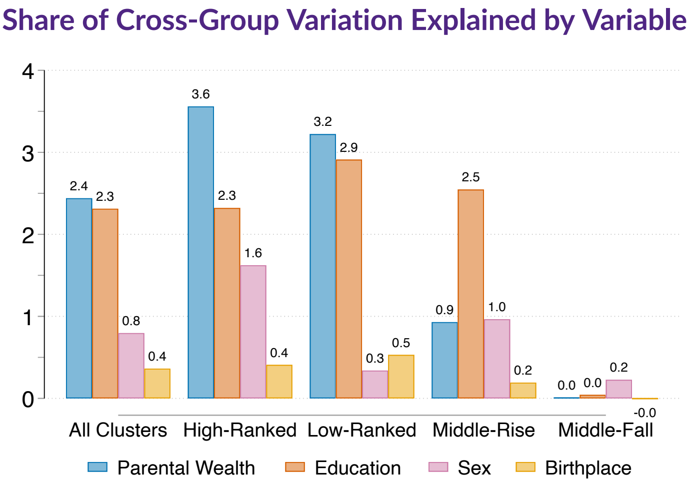
How Important Are Ex-Ante Explanations? Back

Total Contribution*	Partial Contribution			
	Parent	Education	Sex	Birth Place
Share of Distance Variation Explained by Variable (pp)				
5.9	2.4	2.3	0.8	0.4
Share of Individuals Correctly Classified (pp)				
3.1	1.1	1.3	0.6	1.2

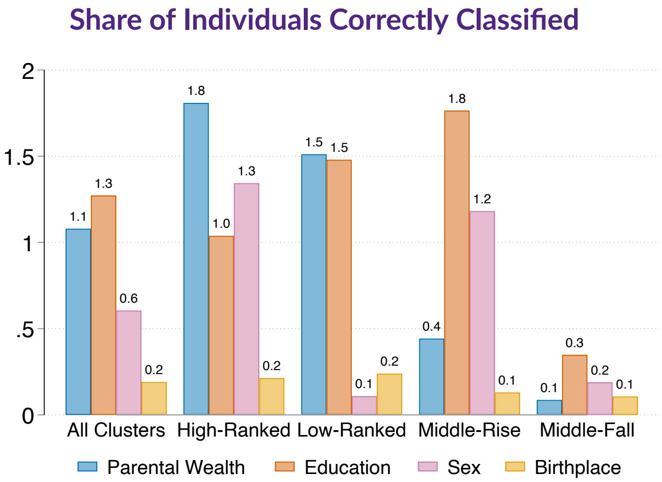
* Contribution relative to random classification using population shares.
Share of individuals correctly classified by random classification 29.3% vs 32.5% with full model.

D by Cluster C by Cluster

How Important Are Ex-Ante Explanations? back



How Important Are Ex-Ante Explanations? back



* Contribution relative to random classification using population shares.

How Important Are Ex-Ante Explanations? Extra controls

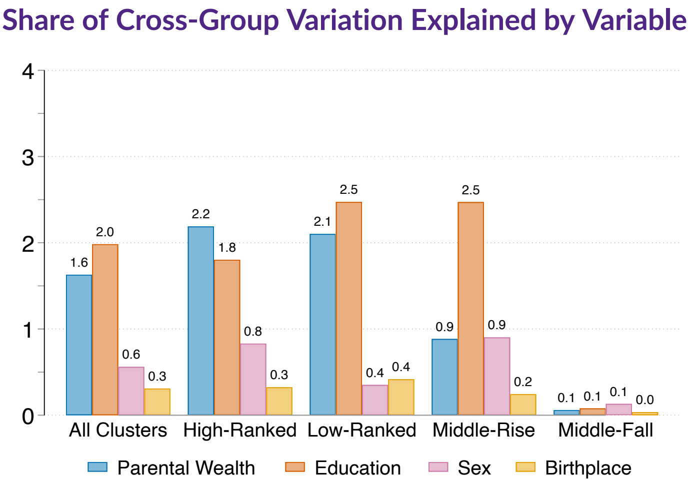
Back

Total Contribution*	Partial Contribution					
	Parent	Education	Sex	Birth Place	Par. Bus.	Own State
Share of Distance Variation Explained by Variable (pp)						
20.0	1.6	2.0	0.6	0.3	0.6	15.0
Share of Individuals Correctly Classified (pp)						
10.6	0.8	1.1	0.4	0.2	0.3	7.9

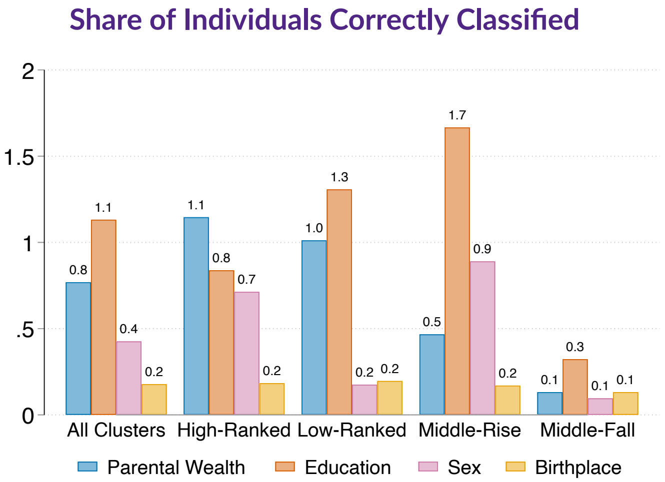
*Contribution relative to random classification using population shares.
Share of individuals correctly classified by random classification 29.3% vs 40.0% with full model.

D by Cluster C by Cluster

How Important Are Ex-Ante Explanations? back



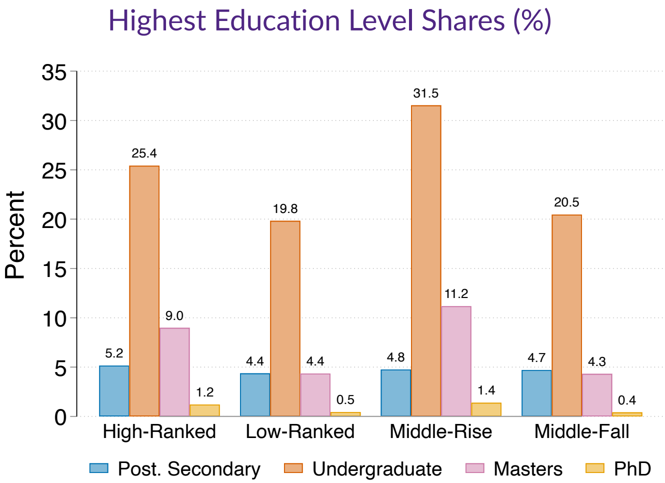
How Important Are Ex-Ante Explanations? ◂ back



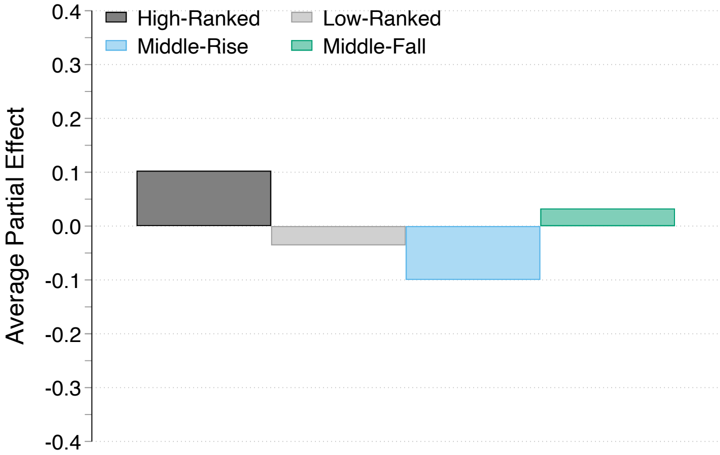
* Contribution relative to random classification using population shares.

Classification Results for Main Clusters

Education: Highest among risers ◂ back

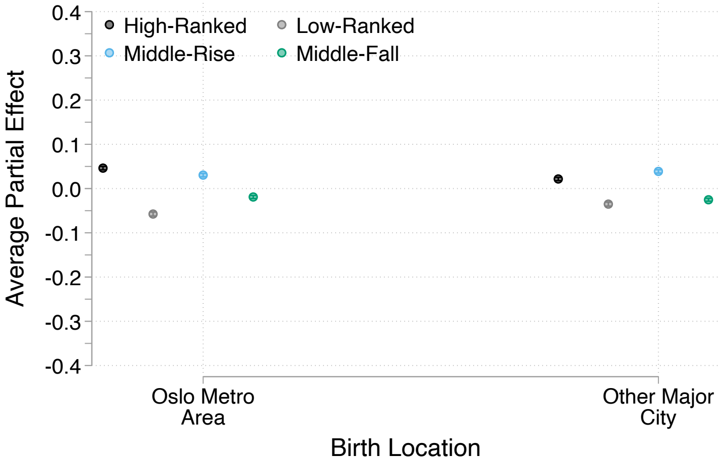


Sex Average Partial Effect ◂ back



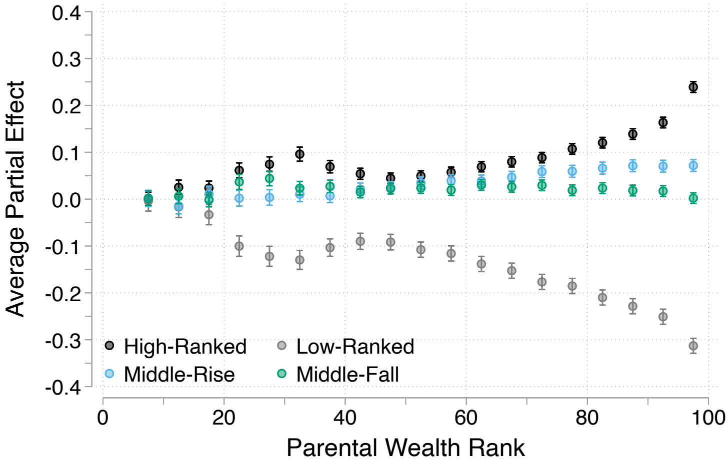
Where Is The Land of Opportunity? Norway

back



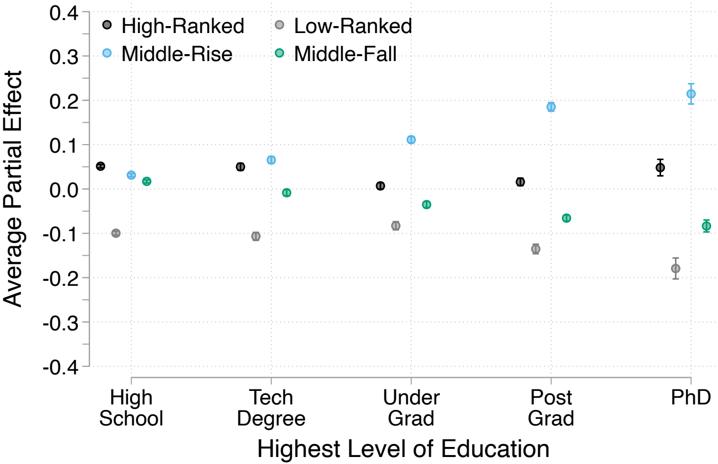
The Non-Linear Effect of Parental Wealth: CI

back



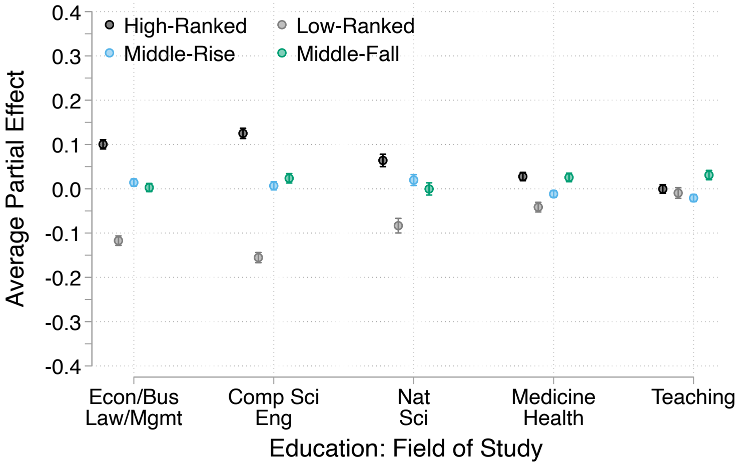
Learn & Rise?: CI

back

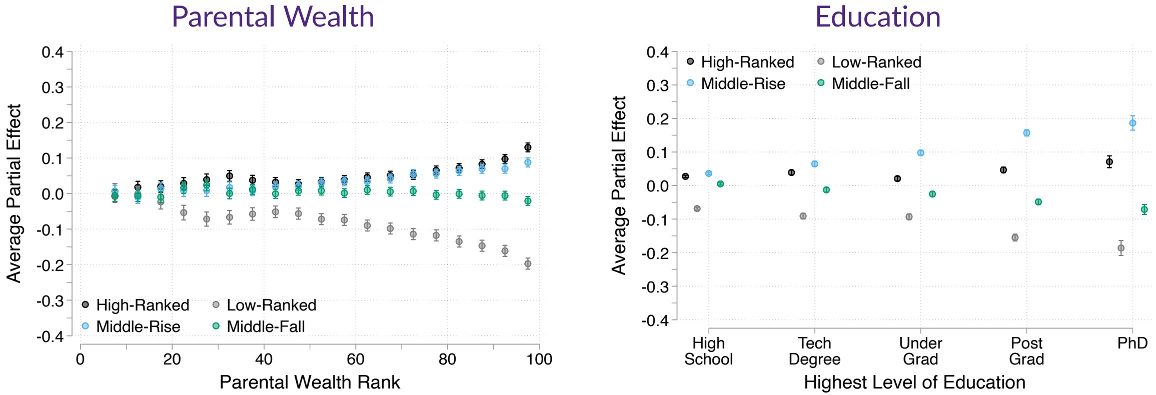


Education: Fields

Back



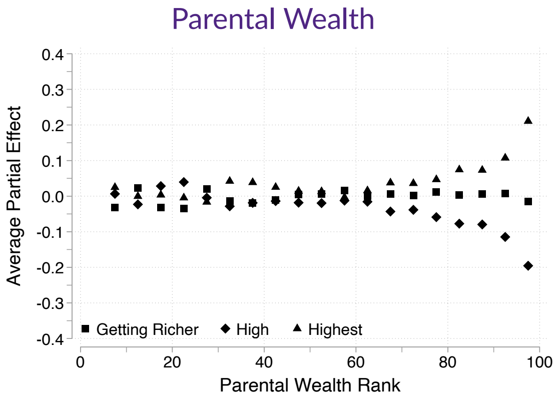
Patterns still present after conditioning on own initial wealth ◂ Back

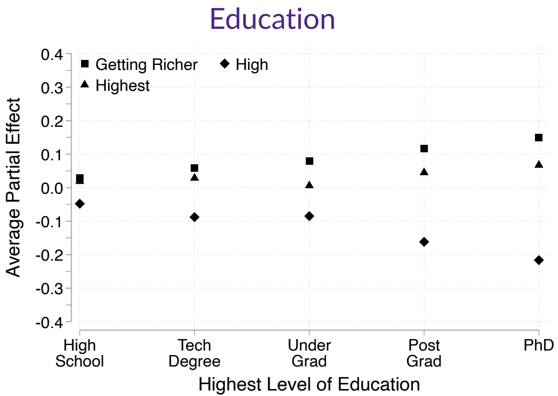


- Robust to controlling for individuals' initial wealth rank + parent portfolio (1993)
  - ↓ Effect sizes by 25-40% (+ explained variation)
  - ↑ Overall variation explained ($\times 4$)

Classification Results for Sub-Clusters

What about heterogeneity within clusters? High-Ranked ◂ Back



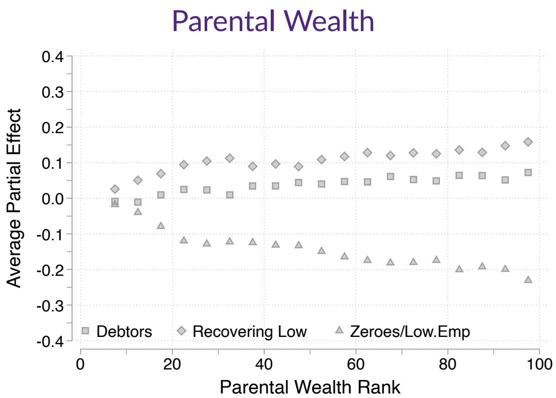


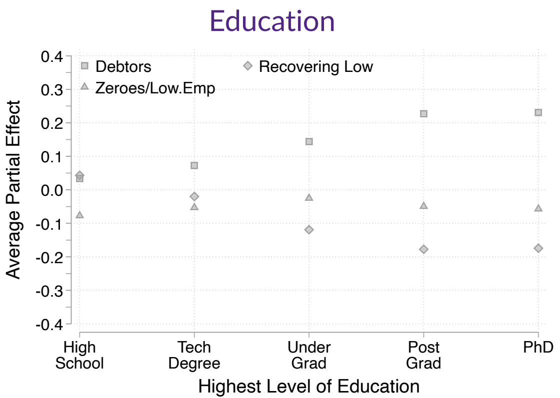
- Even within the groups, movers are hard to predict with parental wealth ▸ PW CI

- Education predicts dynamics within groups (e.g., getting richer vs already wealthy) ▸ ED CI

What about heterogeneity within clusters? Low-Ranked

Back



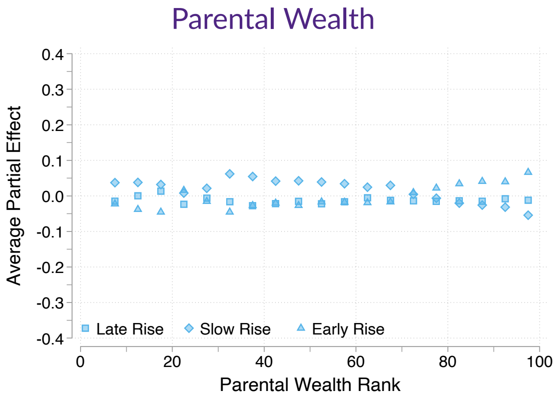


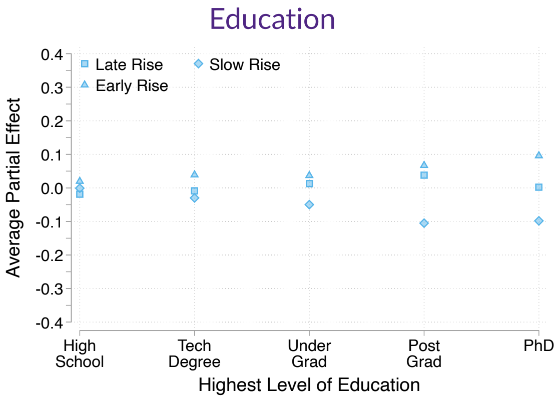
- Among poor, parental wealth does not predict movements
- Education predicts recovery

Middle Rise Middle Fall

What about heterogeneity within clusters? Middle-Risers

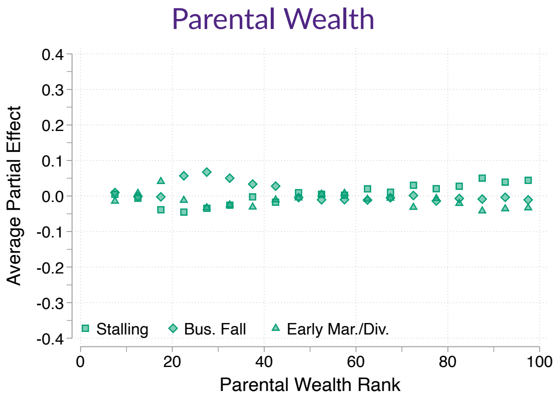
◂ Back

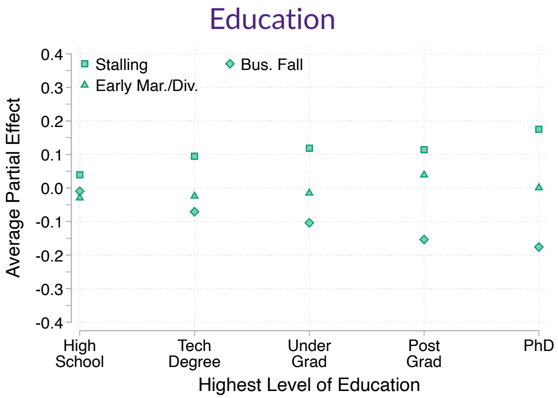




- Within Risers, movers not predicted by parental wealth
- Education predicts timing

What about heterogeneity within clusters? Middle-Fallers
Back





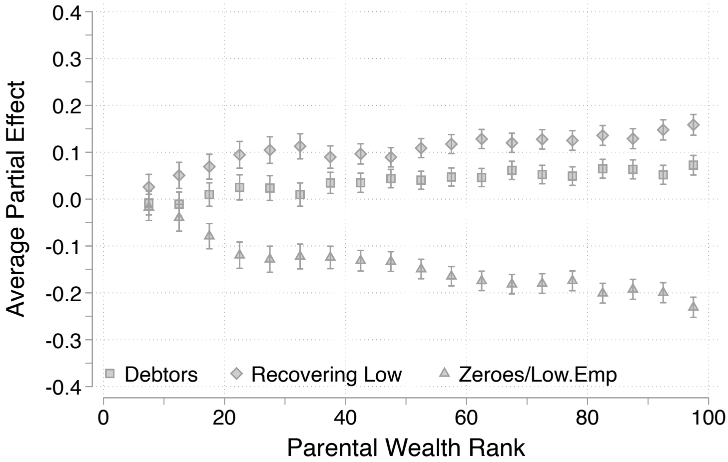
- Similar to Risers, little role for parental wealth
- But Education predicts dynamics

The Non-Linear Effect of Parental Wealth: CI

back

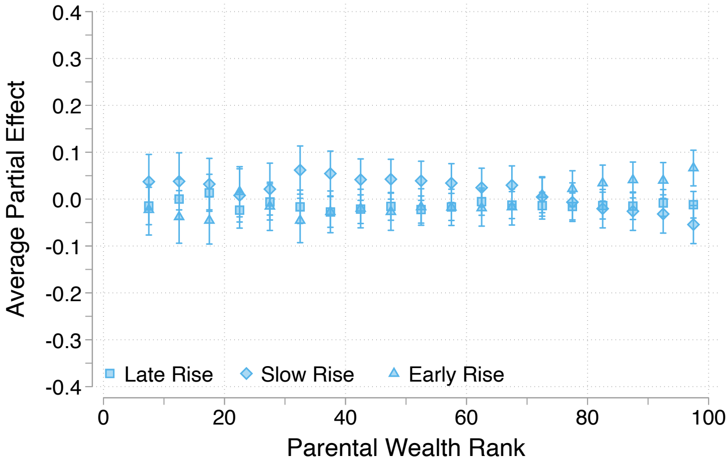
The Non-Linear Effect of Parental Wealth: CI

back



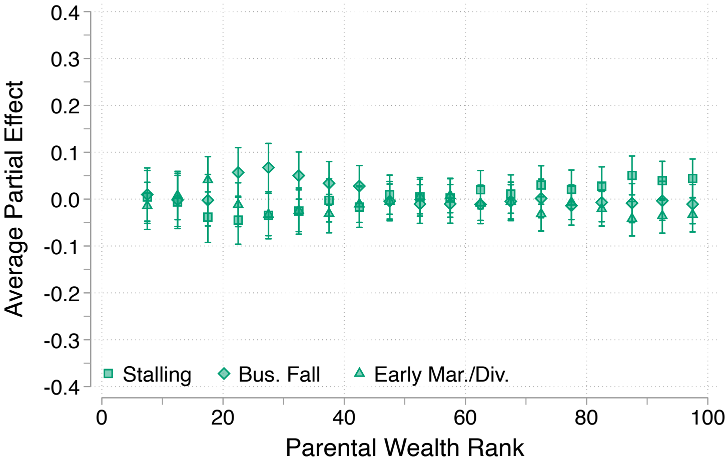
The Non-Linear Effect of Parental Wealth: CI

back



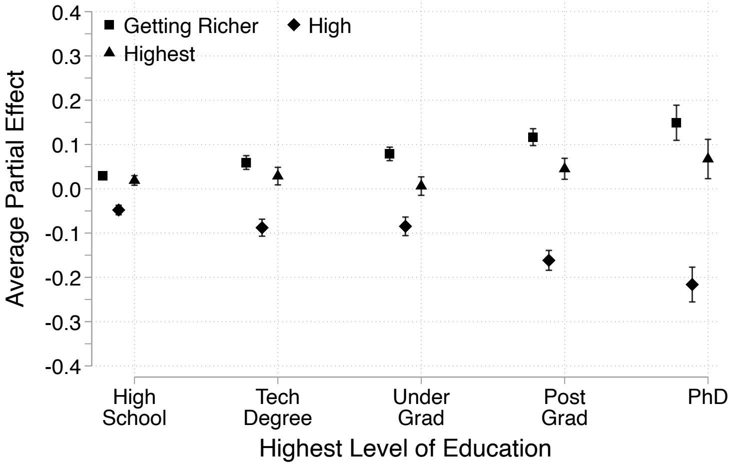
The Non-Linear Effect of Parental Wealth: CI

back



Learn & Rise for Wealthy: CI

◂ back



Contributions

back

1. New evidence on wealth mobility and wealth accumulation: Full life cycle trajectories
   - Add to results for the super wealthy (Gomez; Ozkan, Hubmer, Salgado, Halvorsen), the role of individual factors (Hugget, Ventura, Yaron; Black, Devereux, Landaud, Salvanes), and short-run mobilty and race (Hurst, Luoh, Stafford, Gale).
2. New facts documenting the distribution of changes in wealth ranks
   - Extensive literature on income (Guvenen, Ozkan, Karahan, Song; Guvenen, Pistaferri, Violante; Arellano, Blundell, Bonhomme; De Nardi, Fella, Paz-Pardo)
3. Inter-generational links to full life cycle wealth dynamics
   - Complements "snapshot" links in income (Solon; Aaronson, Mazumder; Chetty, Hendren, Kline, Saez, Turner; Chetty, Grusky, Hendren, Hell, Manduca, Narang) & wealth (Charles, Hurst; Boserup, Kopczuk, Kreiner; Fagereng, Guiso, Malacrino, Pistaferri; Fagereng, Mogstad, Rønning)
4. Dimension reduction methods in economics & applications to labour markets
   - K-Means (Bonhome, Lamadon, Manresa; Gregory, Menzio, Wiczer),
     Sequence Analysis (Humphries), Hidden Markov (Ahn, Hobijn, Şahin), Finite Mixture