

# The Life-Cycle Dynamics of Wealth Mobility

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- Intergenerational “social” wealth mobility key as context for large wealth inequality
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**Today:** Flexibly and non-parametrically characterize lifetime wealth mobility

Possible with **Norwegian administrative data** on wealth 1993–2017

# This paper

1. Study individuals as they transition across the wealth distribution over their lives
  - Study individuals' relative and absolute mobility (within-cohort wealth ranks + wealth levels)
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1. Study individuals as they transition across the wealth distribution over their lives
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  - But: as many different wealth histories as individuals
  - Use clustering techniques to find “typical” trajectories responsible for mobility
2. Study how “typical” trajectories relate to other observable characteristics
  - Lifetime choices and events (portfolio composition, income, etc.)
  - Role of heterogeneity in income, savings, and returns
  - To which extent do individual characteristics at age 30 predict future trajectories?



# Contributions

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 mobility 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 labor markets
  - K-Means (Bonhome, Lamadon, Manresa; Gregory, Menzio, Wiczer), Sequence Analysis (Humphries), Hidden Markov (Ahn, Hobijn, Şahin), Finite Mixture

# Norwegian Wealth Data

# Data: Norwegian Tax Registry 1993 – 2017

- 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 → limited info. on returns)
- We adjust the tax value of real estate to market values (Fagereng, Holm, Torstensen, 2023)
- We focus on wealth at the individual level (additional results for household wealth)
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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)

# Key Variables

- **Wealth:** Net worth = assets-debt → **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

# Ranks and Histories

- Compute within cohort ranks as

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

- Computed separately for each year and each cohort

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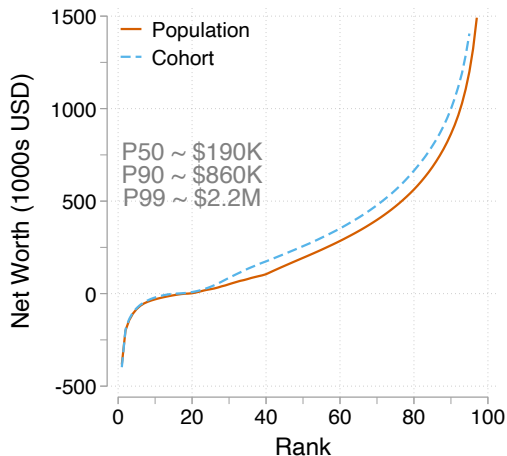
- Computed separately for each year and each cohort
- **Trajectories:** Histories of ranks

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

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

# Ranks vs Wealth Levels

## Net Worth Inverse CDF (2014)



- Substantial wealth inequality in Norway

► Context

- Relative mobility in rank  $\implies$  absolute mobility in wealth level

- e.g. at the median, 10 ranks  $\approx$  60k USD

► BC vs Pop Ranks

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

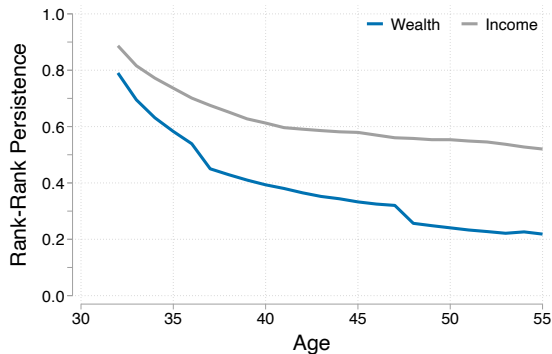


# Intra-Generational Wealth Mobility

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

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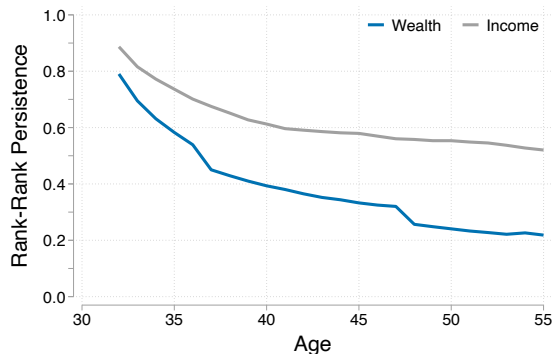
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- Declining intra-generational persistence  
→ Increased (cumulative) mobility
- Rank-rank persistence:  
 $\rho_t = 0.22$  by age 55 (Income  $\rho_t = 0.52$ )

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- Rank-rank persistence:  
 $\rho_t = 0.22$  by age 55 (Income  $\rho_t = 0.52$ )
- How broad-based is mobility?  
What (who) drives patterns?
- Persistence measures collapse heterogeneous trajectories

# Clustering Wealth Histories

# Grouping Individuals Into Typical Histories

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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:  $\operatorname{argmin}_{g, g' \in G, g \neq g'} d(g, g')$ .

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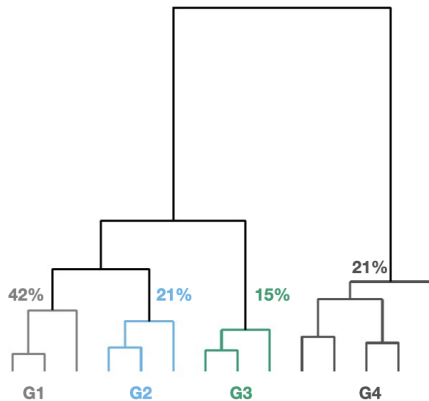
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**Result:** Hierarchy of partitions ranging from  $G = N$  to  $G = 1$ .

- Global result with nested clusters (feasible in large datasets)
- Asymptotically consistent as we observe longer trajectories, even for fixed  $N$   
(Borysov, Hannig, Marron, 2014; Egashira, Yata, Aoshima, 2024)

# Two Levels of Clustering

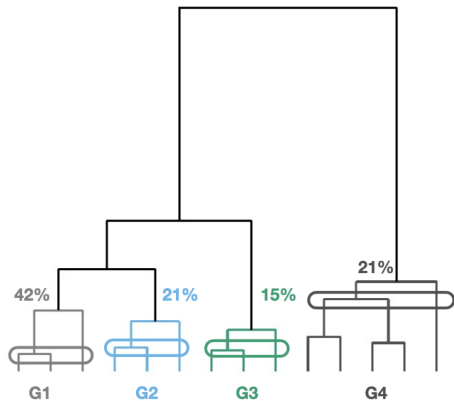
## Clustering Tree



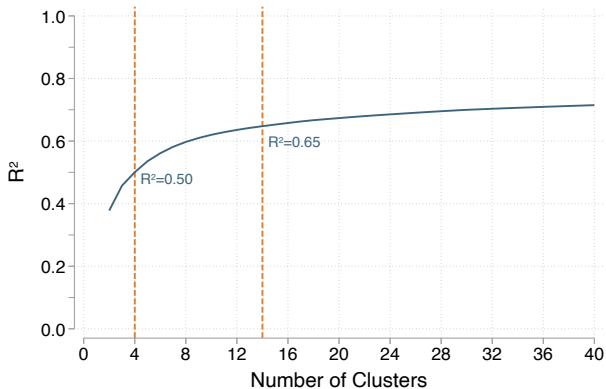


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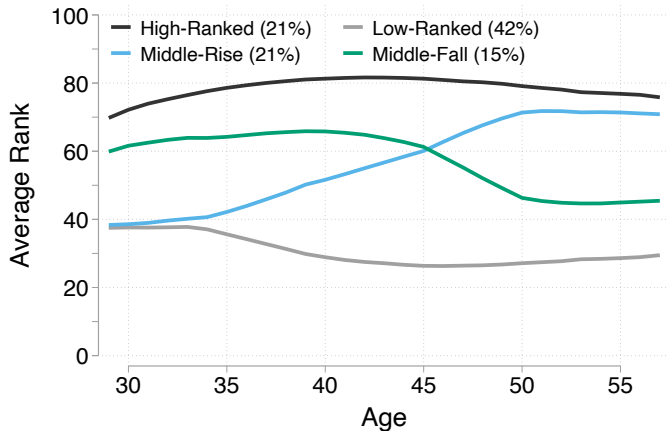


## Variation Explained



# Typical Rank Histories

## Cohort Ranks

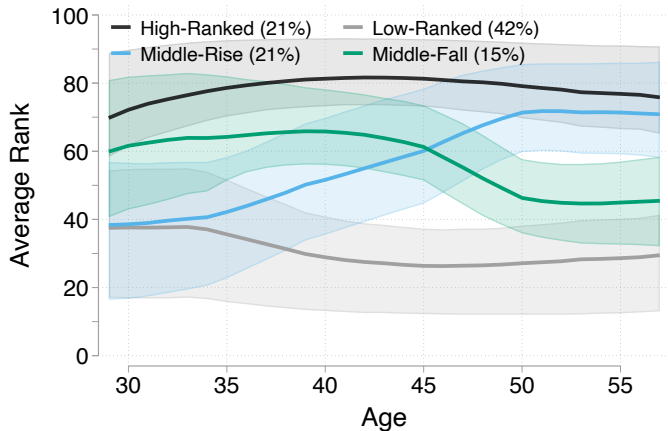


## Four largest groups

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

# Typical Rank Histories

## Cohort Ranks, interquartile range



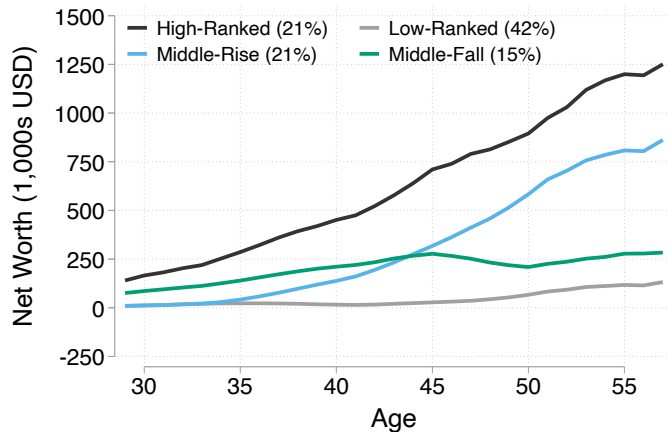
## Segmented mobility

- 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%

► Subclusters

# Wealth Histories Across Segments of the Distribution

Net Worth (\$1000s)



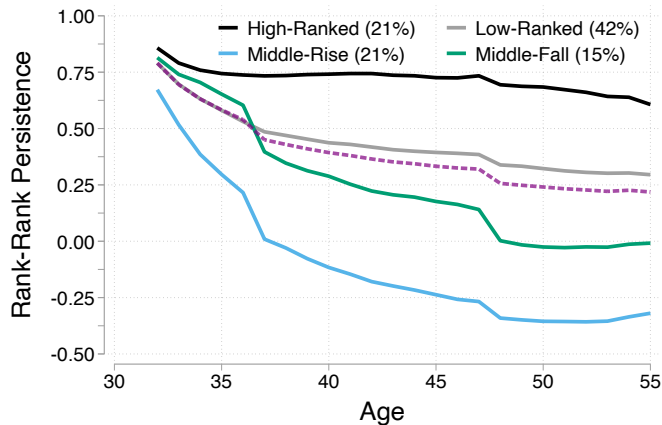
Significant diff. in wealth profiles

- **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

► Absolute Mobility

# Intra-Generational Mobility

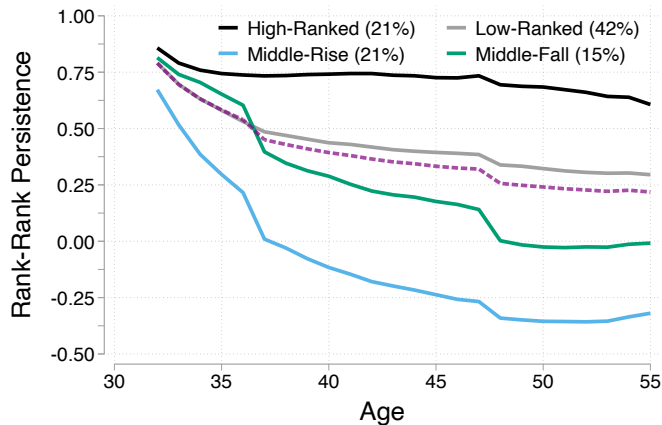
Linear rank-rank persistence:  $y_{i,t}^k = \alpha_t + \rho_t^{g(i)} y_{i,0}^k + u_{i,t}$



- **Top:** Immobile over 25y
- **Bottom:** Track population movements *within segment*
- **Risers:** Reversal of fortune within 1 decade
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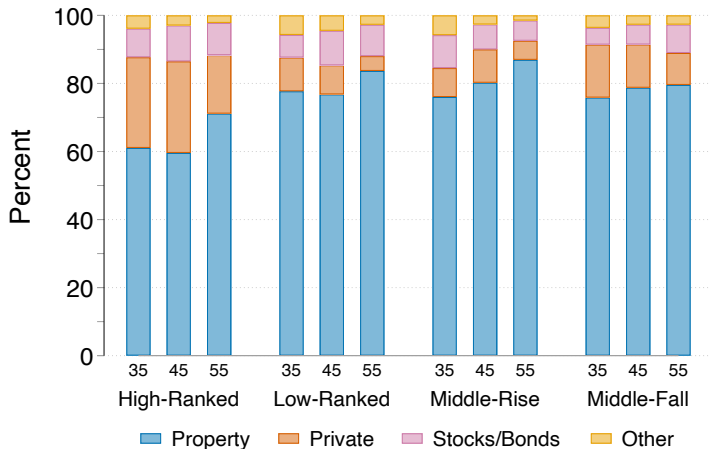


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- Mobility in the middle drives population mobility patterns. Risers are key.

# Drivers of Wealth Accumulation

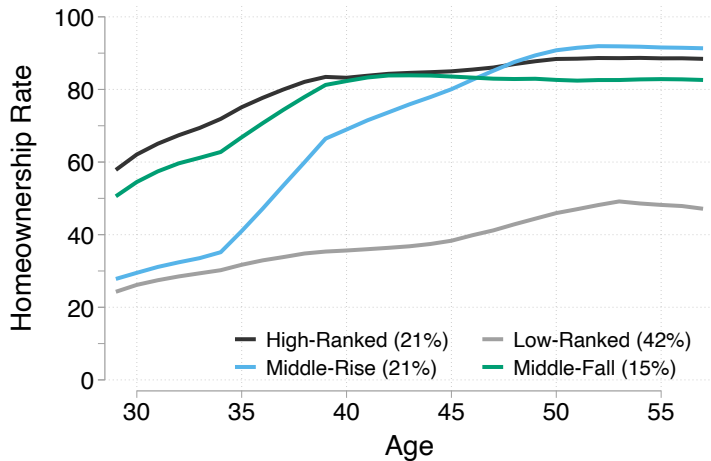
## Portfolio composition by group and age: Mostly housing



- No large differences in portfolio composition. More private business wealth at the top



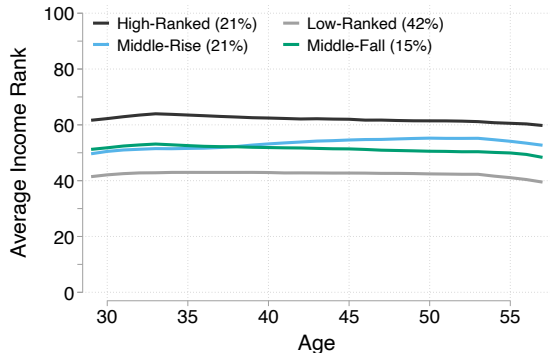
# Homeownership Rates by Cluster



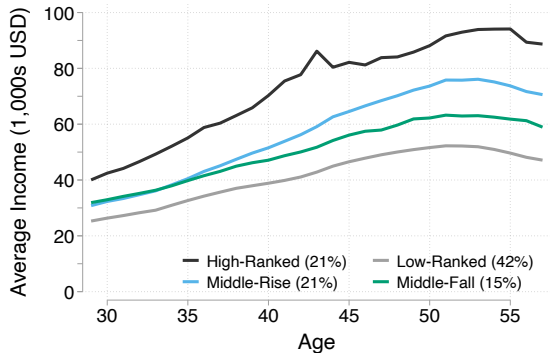
- Risers: Catching up in homeownership.

# Income Histories Across Segments of the Distribution

## Income Cohort Ranks



## Income (\$1000s)

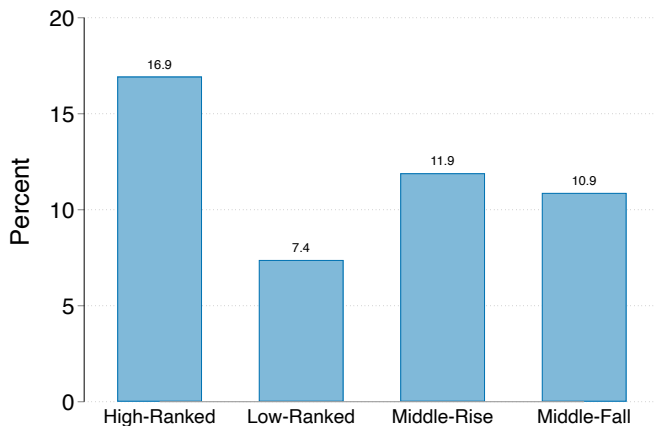


- Distribution of income across clusters compressed relative to wealth
- Similar patterns for HH income; Risers same inc. as high ranked on average

► Median Income

► HH Inc. CS

## Limited role of lifetime Inheritances and Gifts by age 50



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

# Theory: Grouping wealth trajectories within the buffer-stock model

Standard model w/ permanent skill differences ( $l$ ) and homothetic preferences ( $u(\cdot), v(\cdot)$ )

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Clearly, not what we find in the data!

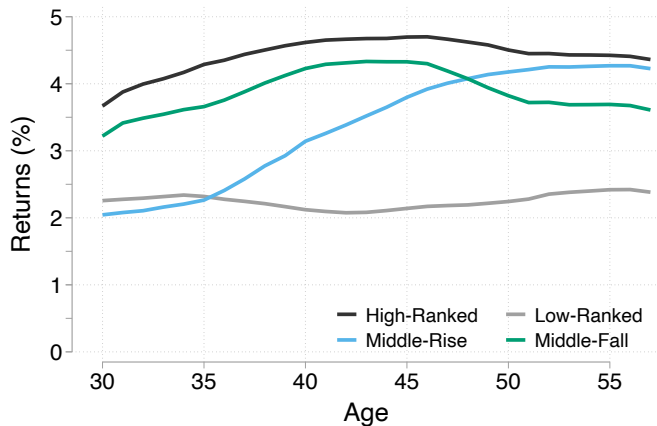
# Counterfactual wealth trajectories

**Goal:** Get a handle on role of income, returns, and savings rate

1. Income: observed
2. Construct returns implied by portfolio differences (Fagereng, Guiso, Malacrino, Pistaferri 2020)
3. Active vs Passive saving rates (Fagereng, Holm, Moll, Natvik 2019)

We can use the budget constraint to simulate counterfactual wealth paths by group!

# Implied portfolio returns by groups

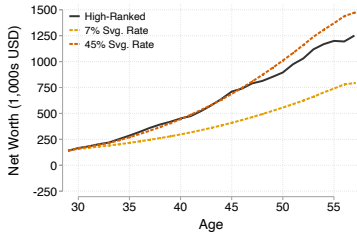


Assumption: No return heterogeneity within asset class across groups

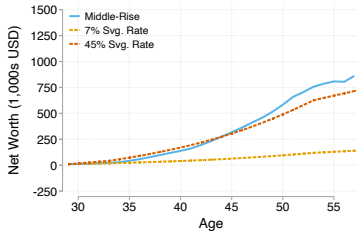


# Wealth counterfactuals: More than income heterogeneity

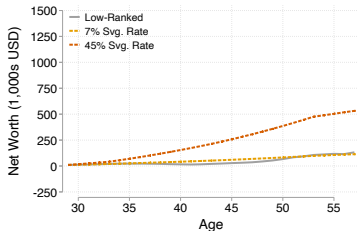
## High-ranked



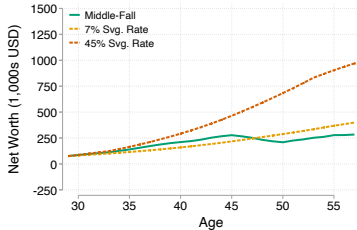
## Middle-Rise



## Low-ranked



## Middle-Fall



# Towards Determinants of Trajectories

# Hereditary Advantage: Wealth vs Human Capital

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- $\beta_{q(i)}^j$ : Indicators for 1993 parental wealth (cohort rank by ventile)

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► Sex APE

► Location APE

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

► Results

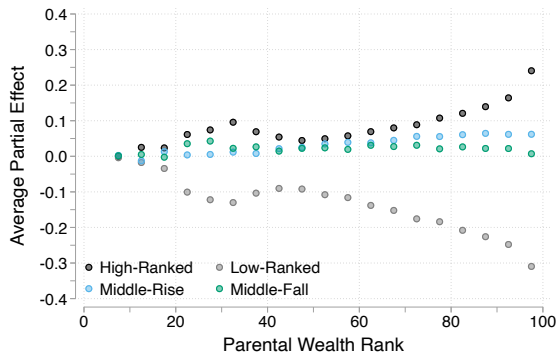
# Non-Linear Effects of Parental Wealth and Education

PW CIs

ED CIs

ED Field

## Parental Wealth



- Parental wealth's explanatory power: High for top/bottom, limited for middle groups



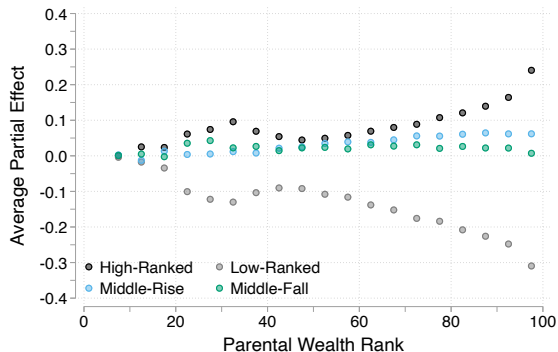
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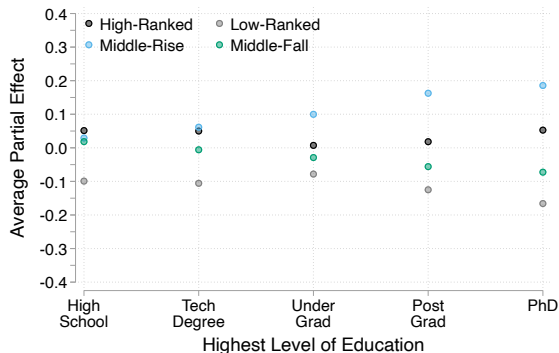
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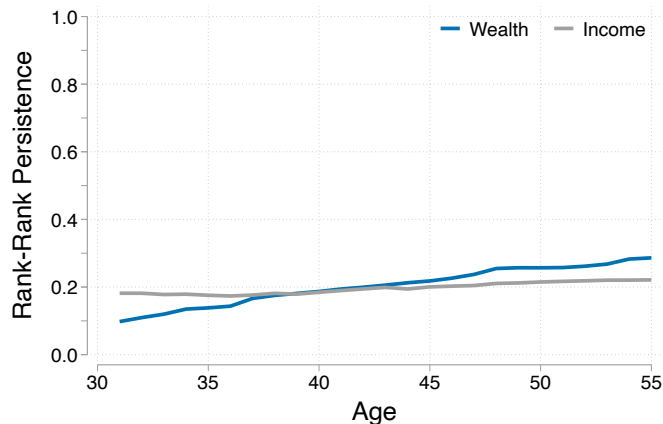


- Parental wealth's explanatory power: High for top/bottom, limited for middle groups
- Education tells risers/fallers apart: Equalizing effect but doesn't overcome initial cond.

# Back to Intergenerational Mobility

# Decreasing Inter-Generational Mobility

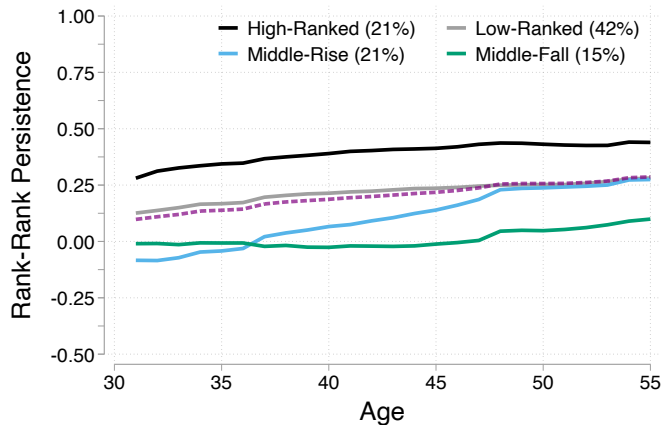
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- Compute measure of mobility with respect to wealth of parents at age  $\sim 55$
- Mobility slightly dropping over life cycle
- People become more like their parents as they age

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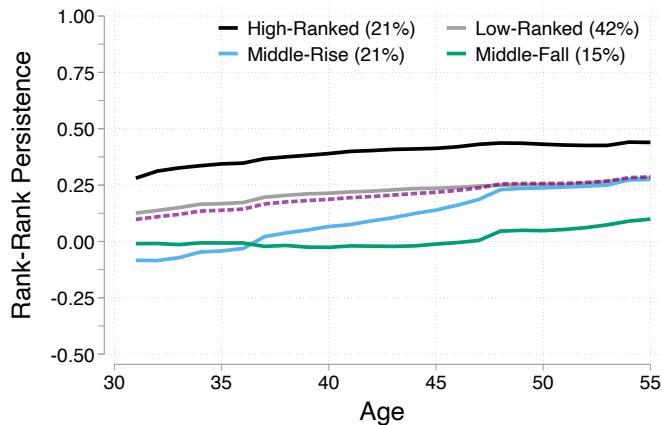
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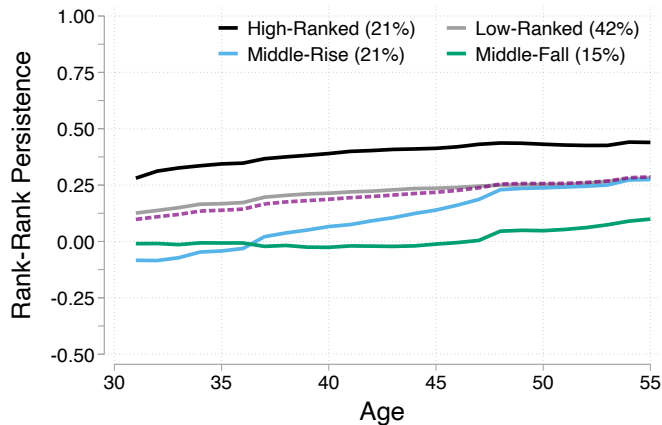
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- Clustering of trajectories captures persistent differences in mobility

# Conclusions

# Conclusions

**Contribution:** Flexibly and non-parametrically characterize lifetime wealth mobility

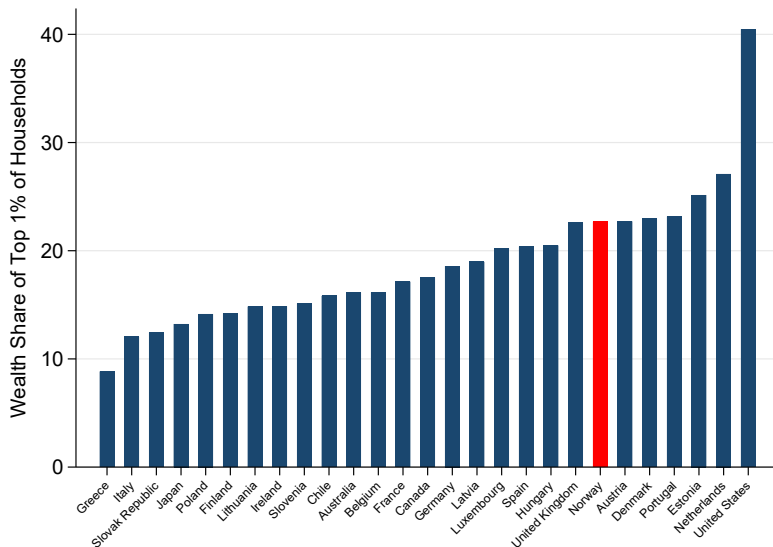
## Key takeaways:

1. Find evidence of substantial changes in wealth ranks over a quarter century
2. Mobility driven by selected groups in the middle of the distribution
3. Persistent differences in saving behavior across groups beyond income
4. Parental background and education predict distinct wealth trajectories

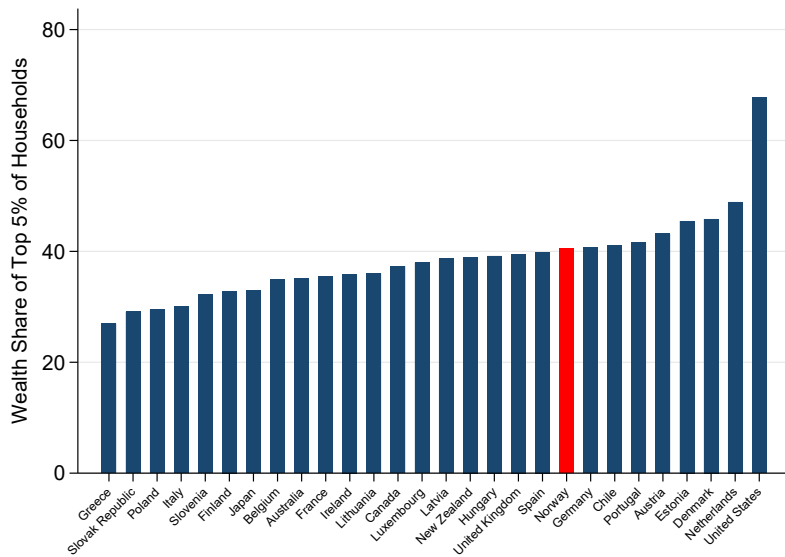


# Details on Wealth Measurement

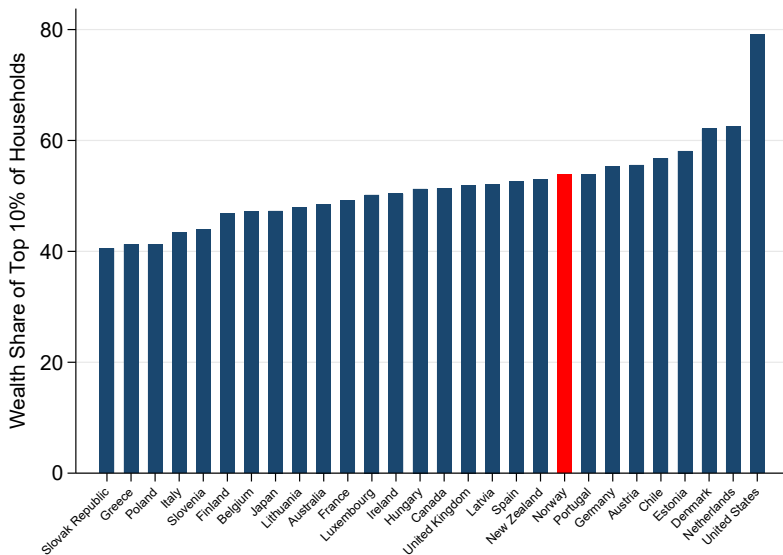
# Norway in Context

[◀ Back](#)

## Norway in Context: Top 5% Share [◀ Back](#)

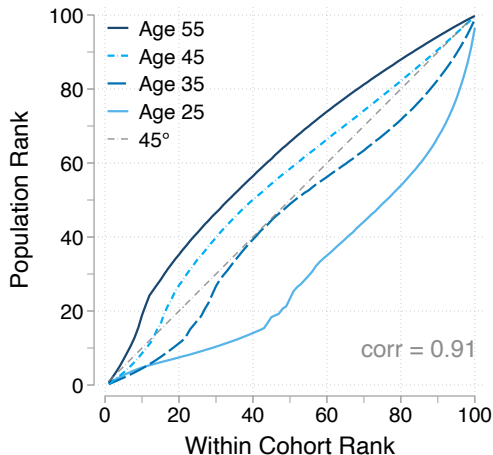


## Norway in Context: Top 10% Share [◀ Back](#)



# Birth Cohort Ranks vs Population Ranks [◀ back](#)

## BC Ranks vs Pop Ranks

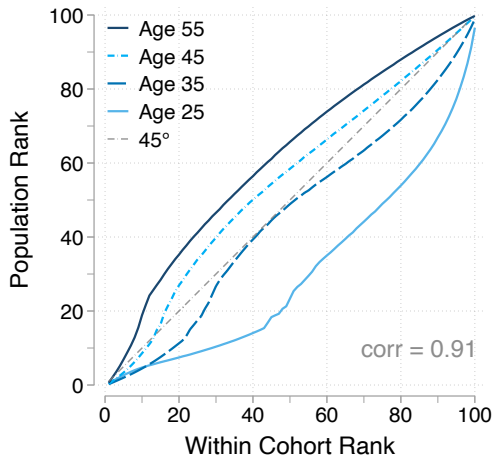


- Changes in wealth levels at each rank as the cohort ages
- 75 percent of age 25 individuals are below the median
- 35 percent of age 55 individuals are below the median

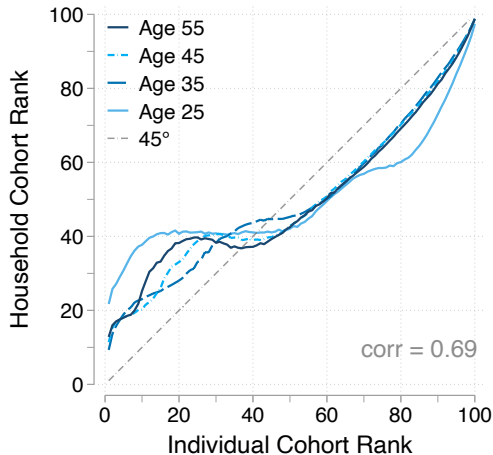
[▶ Household Ranks](#)

# Birth Cohort Individual Ranks vs Household Ranks [◀ back](#)

## BC Ranks vs Pop Ranks



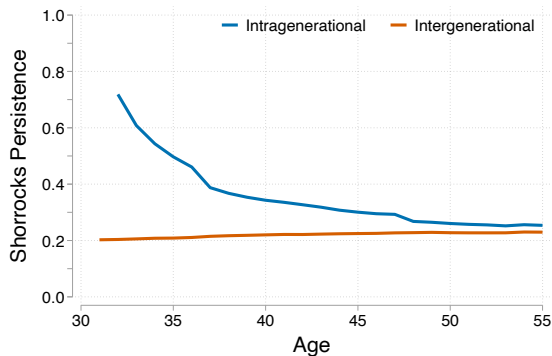
## BC Individual Ranks vs Household Ranks



# Shorrocks Mobility Index

# Shorrocks Mobility Index [◀ back](#)

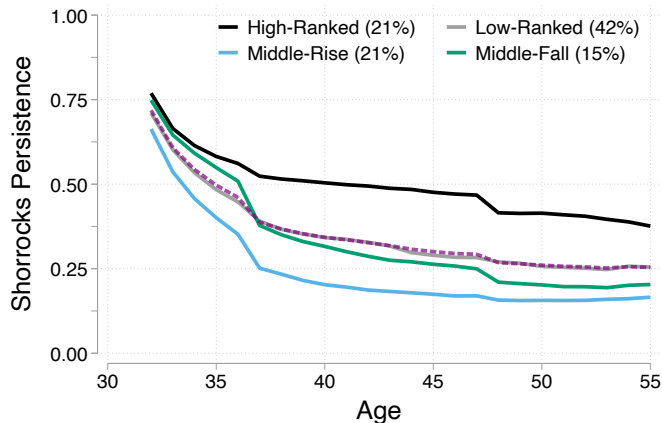
Trace of transition matrix: Divide individuals by quintiles.



- Declining intra-generational persistence  
→ Increased mobility
- Increasing inter-generational persistence  
→ Decreased mobility

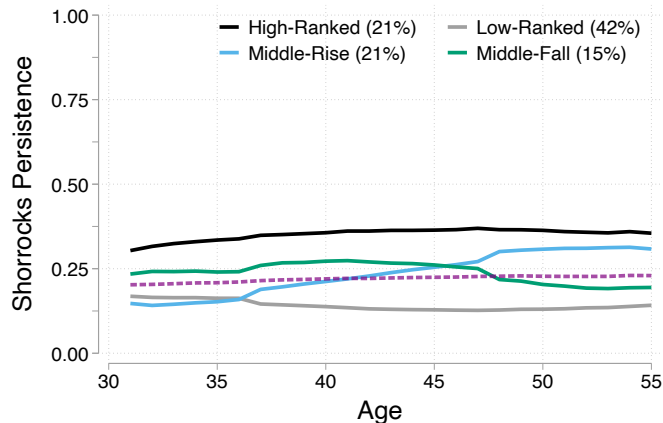


# Intra-Generational Shorrocks Mobility Index [◀ back](#)



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

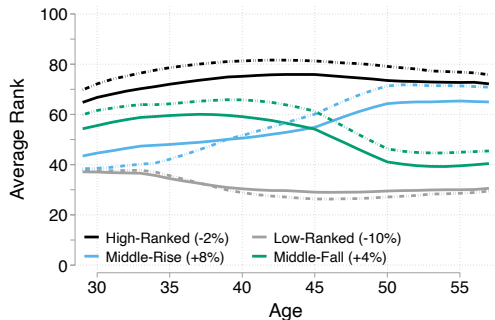
# Inter-Generational Shorrocks Mobility Index [◀ back](#)



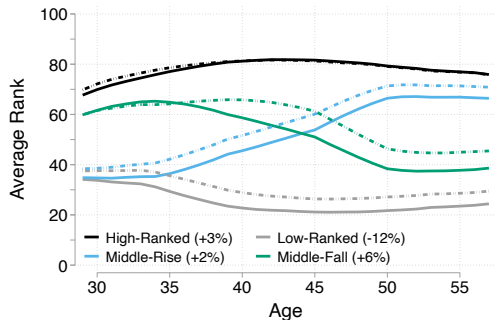
- Risers have clear upwards persistence trend
- Flat patterns for other groups

# Characteristics of Main Clusters

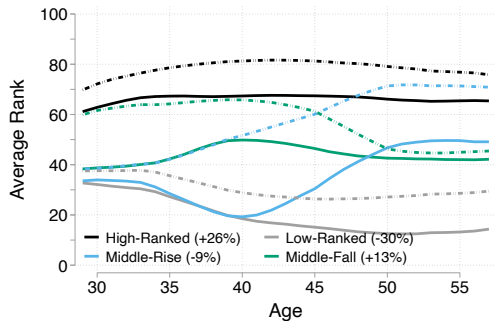
## Household Cohort Ranks



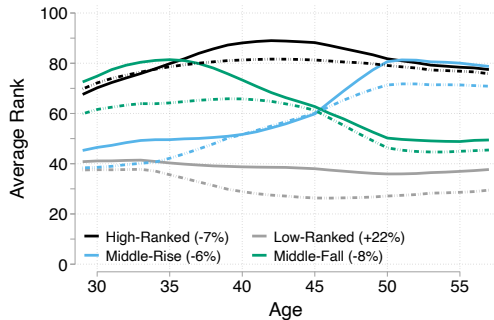
## K Means on Ind. Cohort Ranks



## Log Net Worth



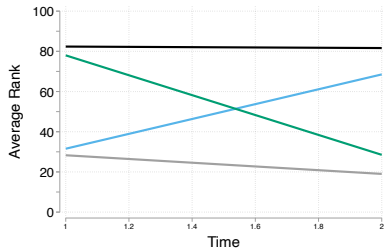
## “Lorenz” Ordinates



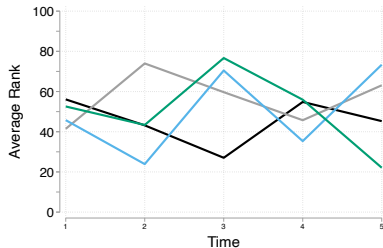
# Clustering Random Ranks

[◀ Back](#)

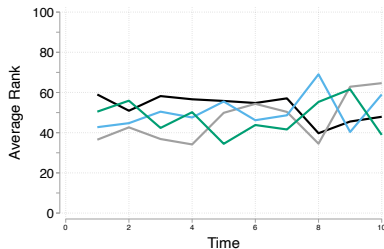
## 2 Periods



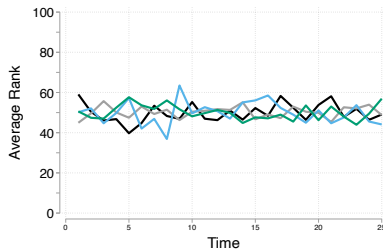
## 5 Periods



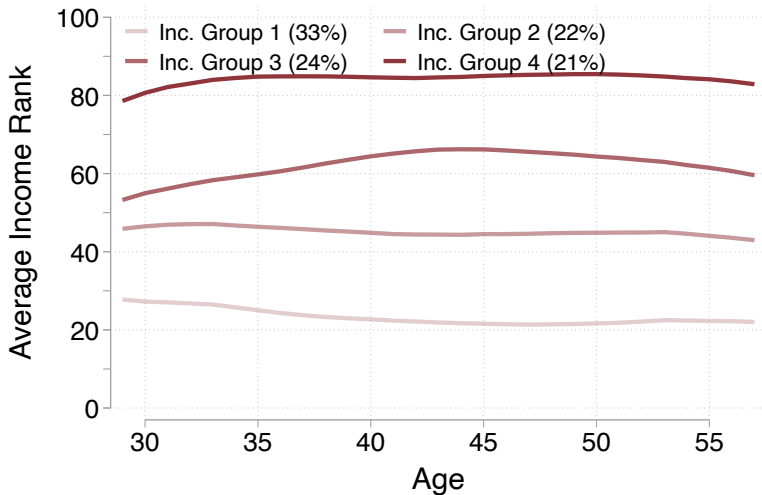
## 10 Periods



## 25 Periods

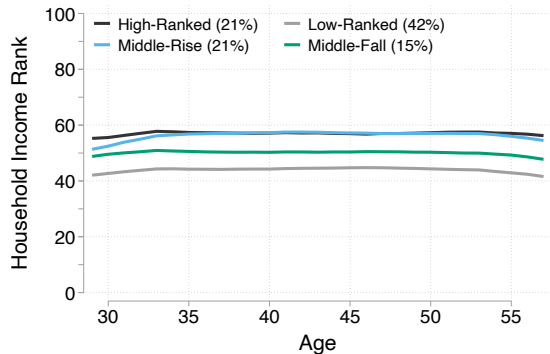


# Clustering on Income

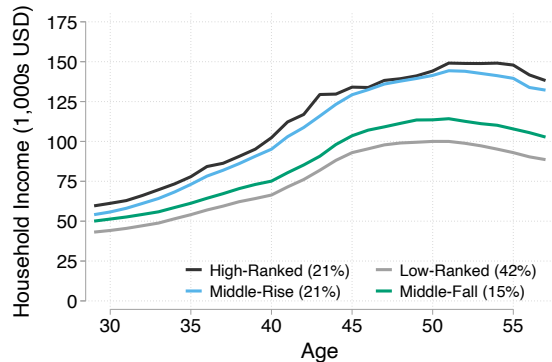
[← Back](#)

# Household Income [◀ Back](#)

## Household Income Cohort Ranks



## Household Income (\$1000s)

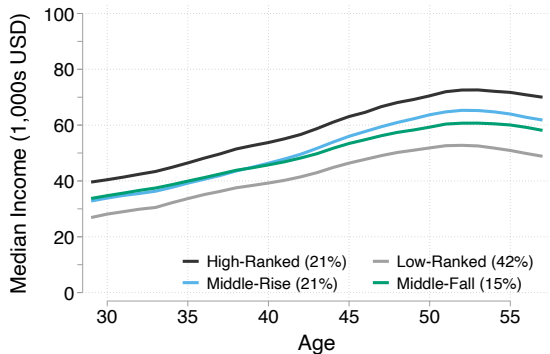




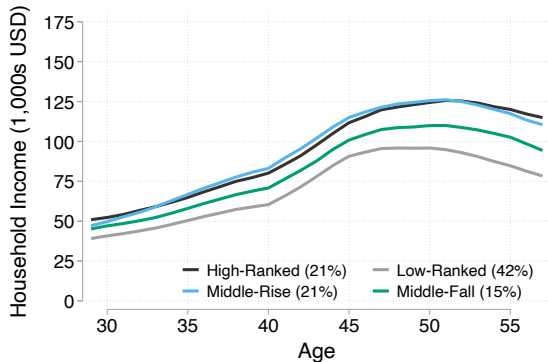
# Median Income Histories

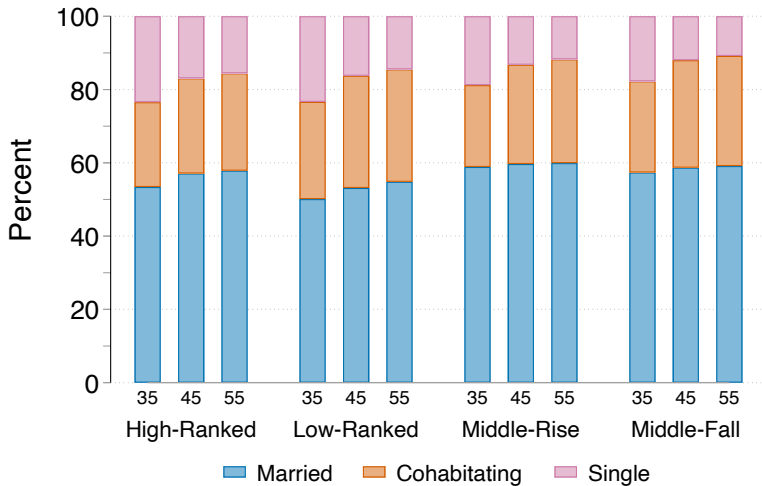
[◀ Back](#)

## Median Income



## Household Median Income (\$1000s)

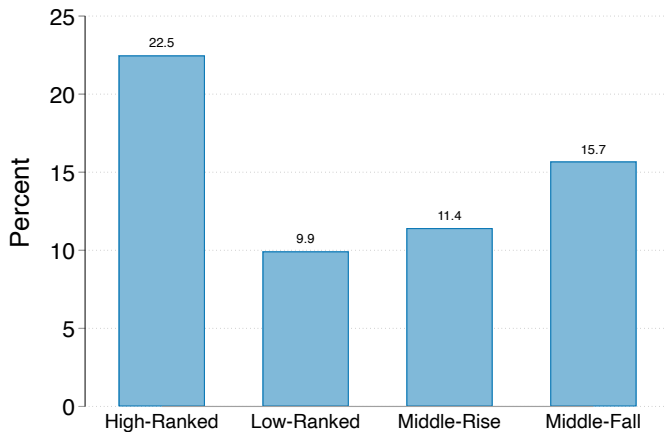




# Self-Employment Rates, Age 45

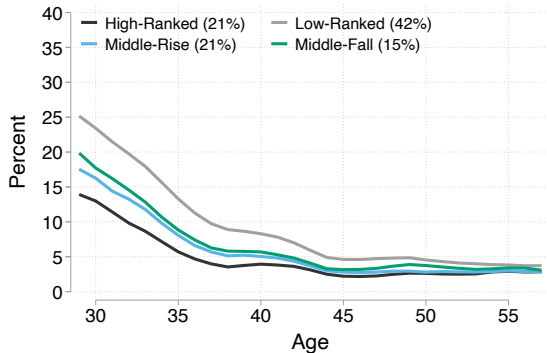
[◀ Back](#)

## Share with Self-Employment Income (%)

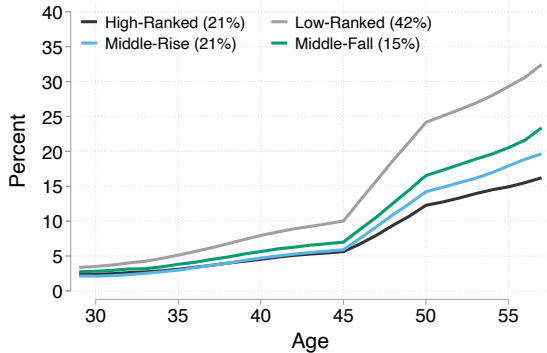


# Transfers: Unemployment, Disability, Sick Leave, Nursing [◀ Back](#)

## Share with Unemployment Benefits (%)



## Share with Health-Related Transfers (%)

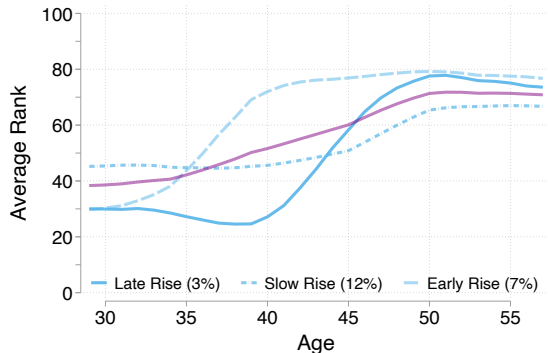


# Characteristics of Sub-Clusters

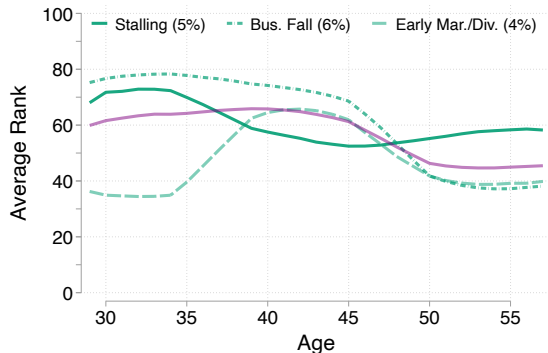
# Heterogeneity in Trajectories

[▶ Wealth](#)[▶ Portfolio](#)[▶ Homeownership](#)[▶ Inc.](#)[▶ SE](#)[▶ Edu.](#)

## Middle-Risers



## Middle-Fallers

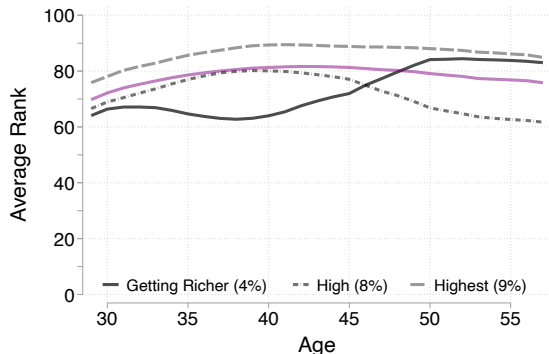


- Risers differ mainly in timing of changes (similar initial conditions)
- Fallers differ in initial conditions and timing of changes (similar final conditions)

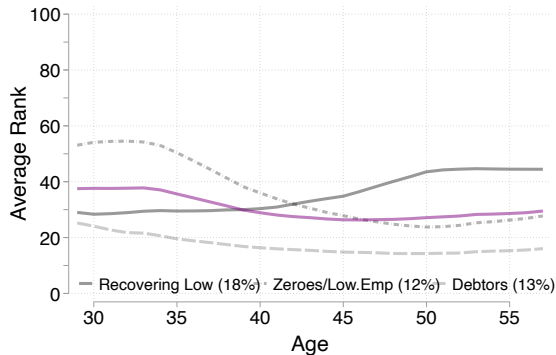
# Heterogeneity in Trajectories

[▶ Wealth](#)[▶ Portfolio](#)[▶ Homeownership](#)[▶ Inc.](#)[▶ SE](#)[▶ Edu.](#)

## High-Ranked



## Low-Ranked



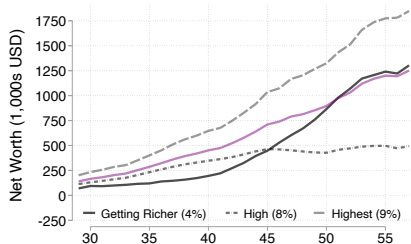
- Top and bottom groups differ mainly in avg. levels
- Zeros are quite different from debtors

**Next Step:** Relate differences in timing/level to individual circumstances

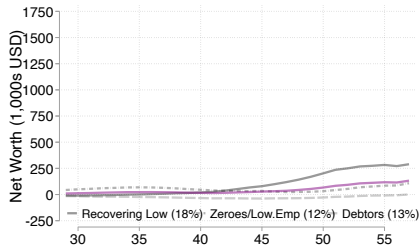
# Sub-Clusters: Wealth Levels

[◀ Back](#)

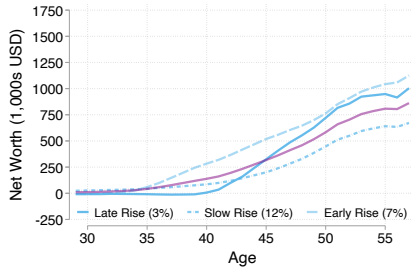
## High Ranked



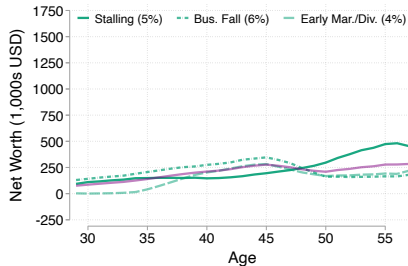
## Low Ranked



## Middle Risers



## Middle Fallers

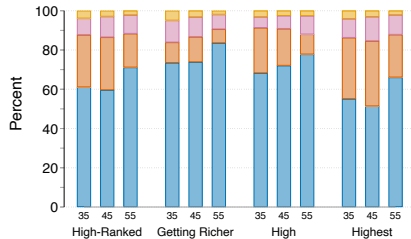




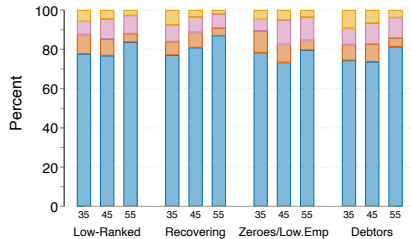
# Sub-Clusters: Portfolio

[◀ Back](#)

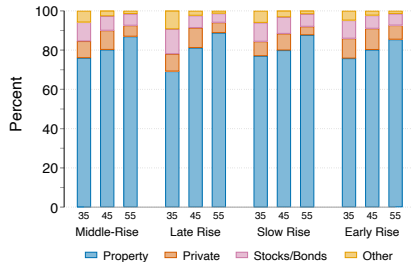
## High Ranked



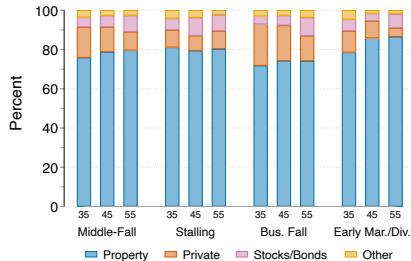
## Low Ranked



## Middle Risers



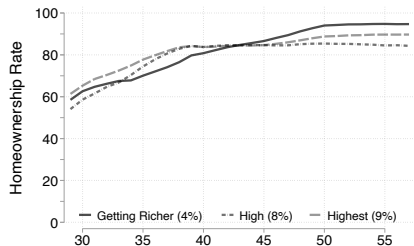
## Middle Fallers



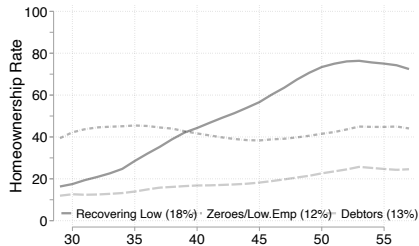
# Sub-Clusters: Homeownership

[◀ Back](#)

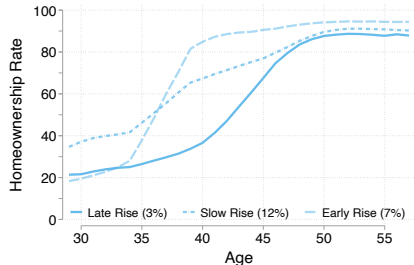
## High Ranked



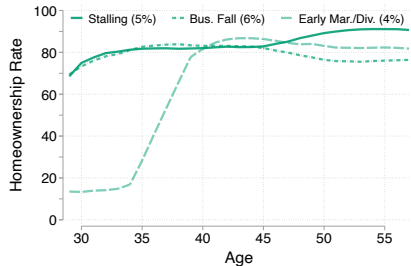
## Low Ranked



## Middle Risers



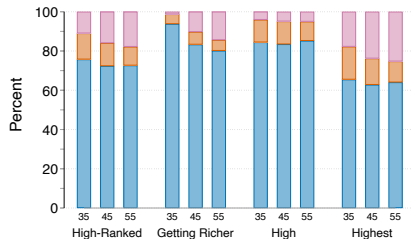
## Middle Fallers



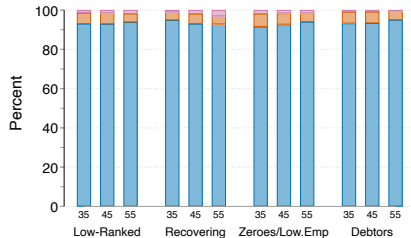
# Sub-Clusters: Income Composition

[◀ Back](#)

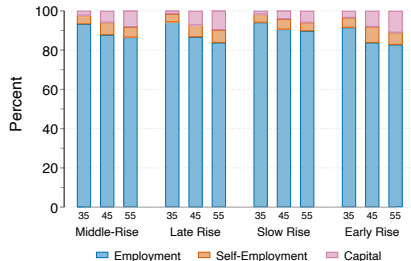
## High Ranked



## Low Ranked



## Middle Risers

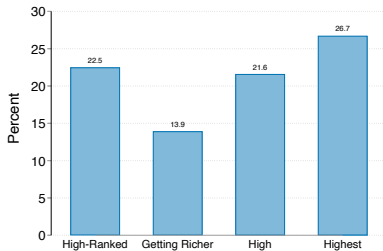


## Middle Fallers

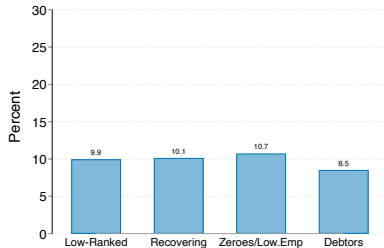


# Sub-Clusters: Self-Employment [◀ Back](#)

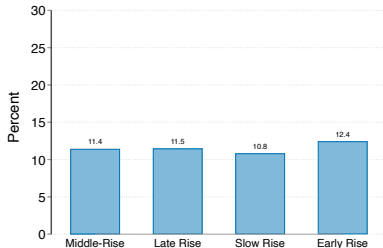
## High Ranked



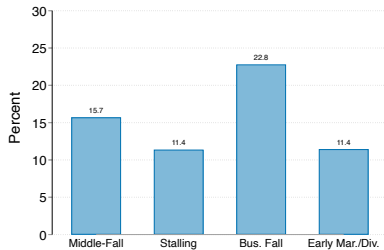
## Low Ranked



## Middle Risers



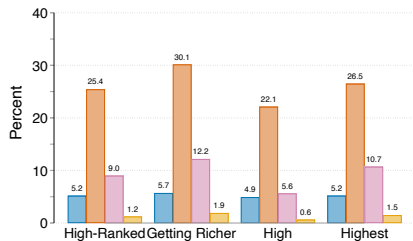
## Middle Fallers



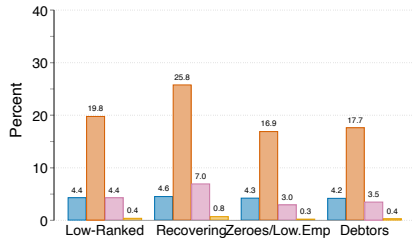
# Sub-Clusters: Education

[◀ Back](#)

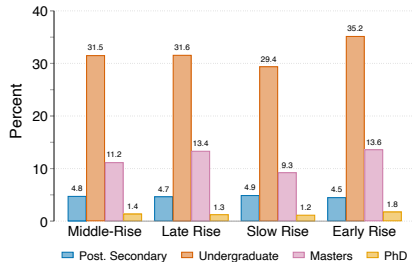
## High Ranked



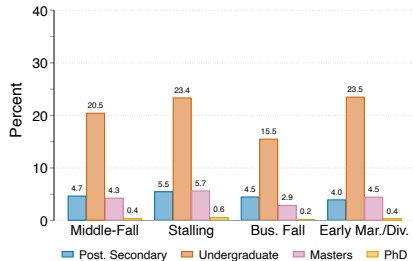
## Low Ranked



## Middle Risers



## Middle Fallers



# Shapley-Owen Decomposition

# How Important Are Ex-Ante Explanations? [◀ Back](#)

Two measures:

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

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

# How Important Are Ex-Ante Explanations? [◀ Back](#)

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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:

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

- 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
<b>Share of Distance Variation Explained by Variable (pp)</b>				
5.9	2.4	2.3	0.8	0.4
<b>Share of Individuals Correctly Classified (pp)</b>				
3.1	1.1	1.3	0.6	1.2

\* Contribution relative to random classification using population shares.

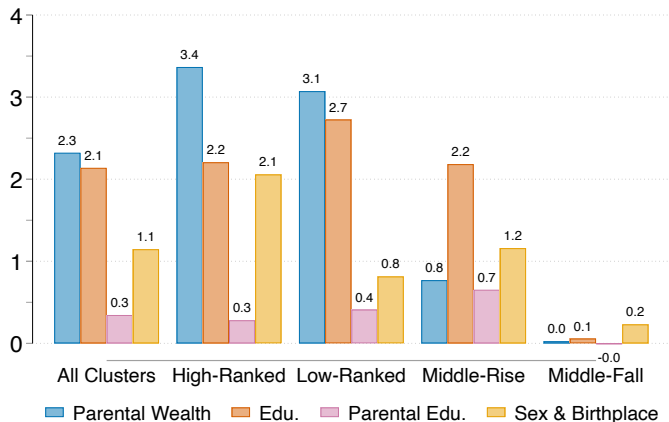
Share of individuals correctly classified by random classification 29.3% vs 32.5% with full model.

[▶ D by Cluster](#)

[▶ C by Cluster](#)

# How Important Are Ex-Ante Explanations? [◀ back](#)

## Share of Cross-Group Variation Explained by Variable



# How Important Are Ex-Ante Explanations? [◀ back](#)

## Share of Individuals Correctly Classified



\* 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
<b>Share of Distance Variation Explained by Variable (pp)</b>						
20.0	1.6	2.0	0.6	0.3	0.6	15.0
<b>Share of Individuals Correctly Classified (pp)</b>						
10.6	0.8	1.1	0.4	0.2	0.3	7.9

\* Contribution relative to random classification using population shares.

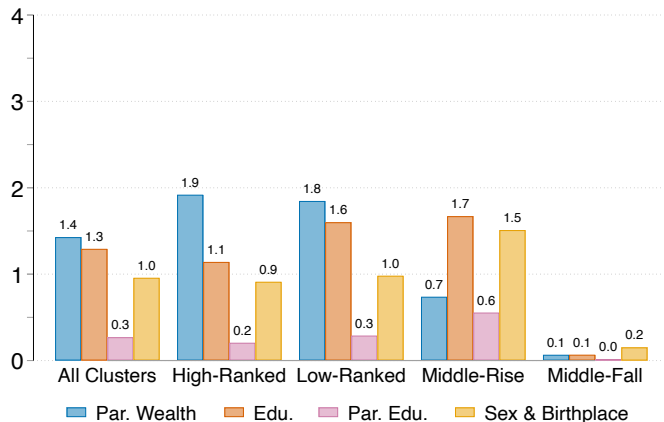
Share of individuals correctly classified by random classification 29.3% vs 40.0% with full model.

[▶ D by Cluster](#)

[▶ C by Cluster](#)

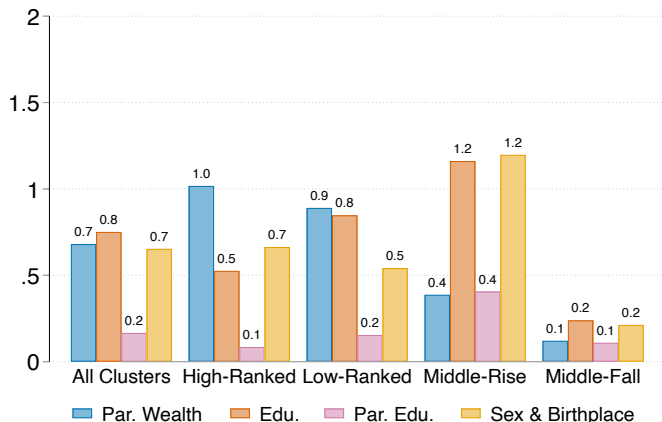
# How Important Are Ex-Ante Explanations? [◀ back](#)

## Share of Cross-Group Variation Explained by Variable



# How Important Are Ex-Ante Explanations? [◀ back](#)

## Share of Individuals Correctly Classified

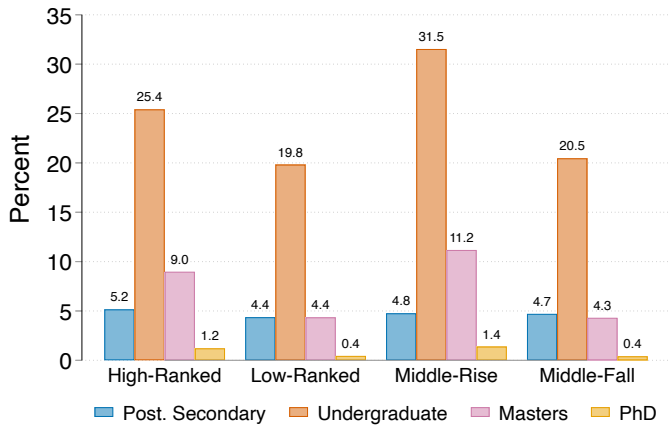


\* Contribution relative to random classification using population shares.

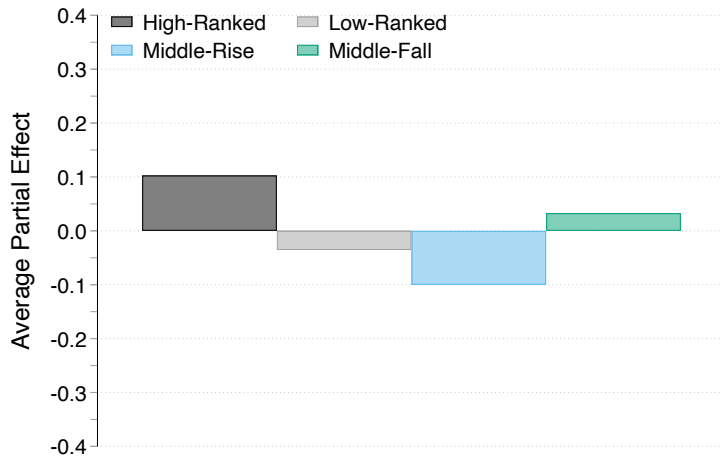
# Additional Classification Results: Main Clusters



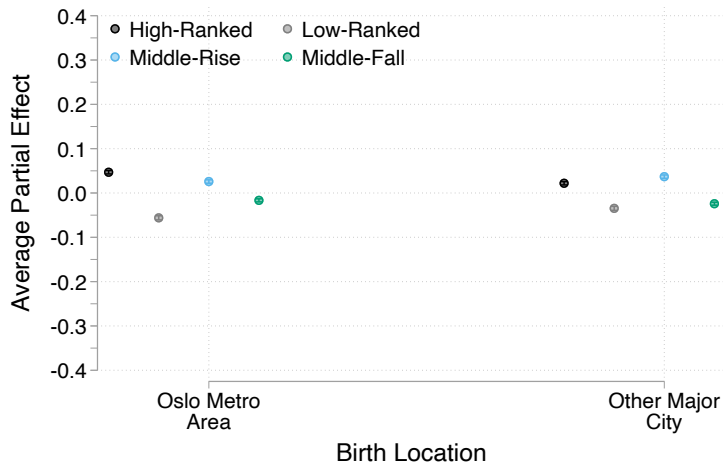
### Highest Education Level Shares (%)



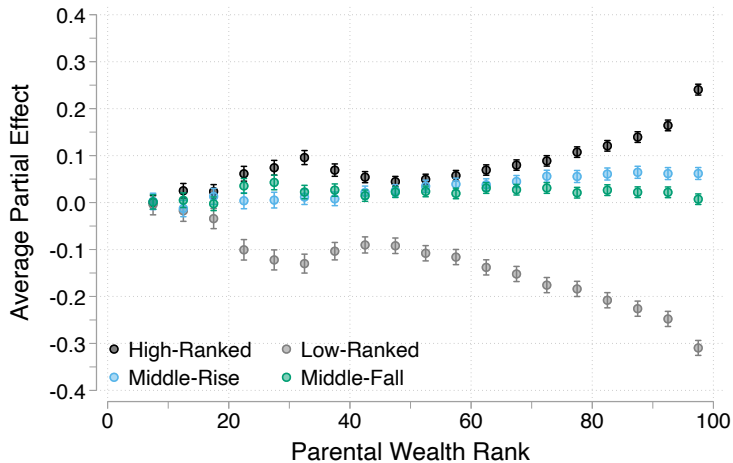
# Sex Average Partial Effect

[◀ back](#)

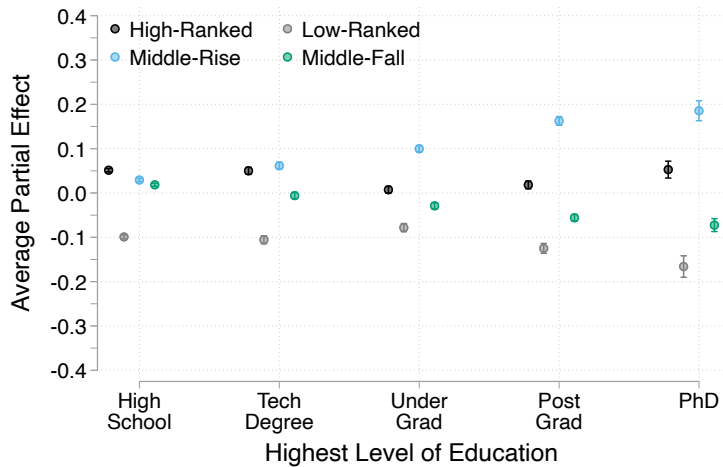
# Where Is The Land of Opportunity? Norway

[◀ back](#)

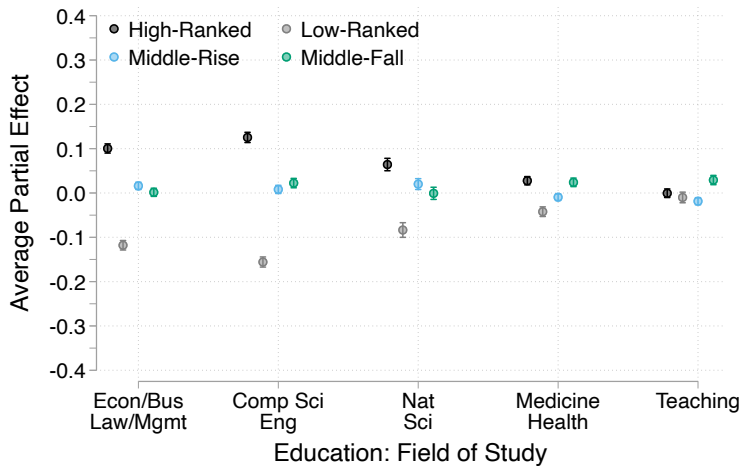
# The Non-Linear Effect of Parental Wealth: CI

[◀ back](#)

# Learn & Rise?: CI

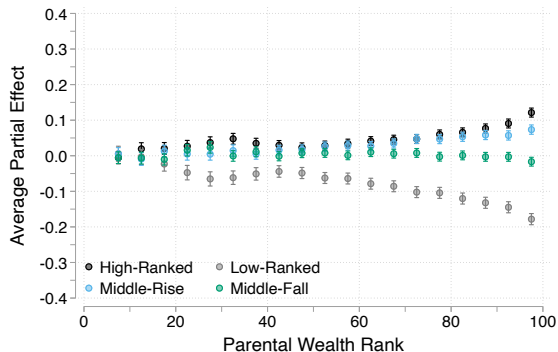
[◀ back](#)

## Education: Fields

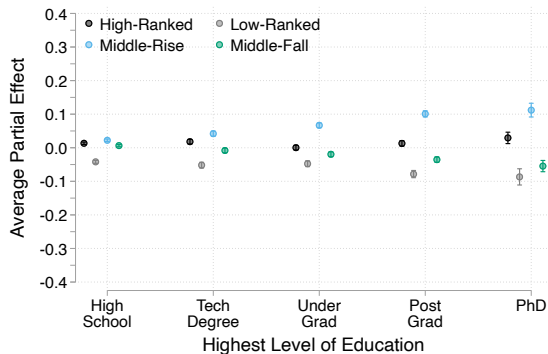
[◀ Back](#)

# Patterns still present after conditioning on own initial wealth [◀ Back](#)

## Parental Wealth



## Education



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