The Cross-Section of Household Preferences

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Are Households All the Same?

- Epstein-Zin preferences are a workhorse of modern asset pricing theory, with three free parameters:
  - Time discount factor δ / time preference rate (TPR) $-\ln(\delta)$,
  - Relative risk aversion (RRA) γ,
  - Elasticity of intertemporal substitution (EIS) ψ.
- Many general equilibrium models assume these preferences for a representative agent.
  - Long-run risk models have RRA ≈ 10 and EIS ≈ 1.5.
- But one might ask whether households are sufficiently homogeneous for their preferences to aggregate this way.
  - If not, changes in the wealth distribution can cause aggregate preferences to appear time-varying.
    Dumas (1989), Chan and Kogan (2002).

Our Approach

- Specify a stylized life-cycle model with Epstein-Zin preferences and:
  - borrowing constraints,
  - transitory and permanent labor income risk,
  - saving for retirement, but no bequest motive,
  - a single risky asset and a single safe asset, with iid returns.
- Measure the wealth and income of Swedish households, aged 40-60, assigned to 4151 groups by education, sector, birth cohort, initial wealth-income (WY) ratio and initial risky share, over 1999–2007.
- Estimate preference parameters that best match each year's
  - WY
  - risky portfolio share

  conditional on the year's initial WY, risky returns, and income growth.

Our Main Findings

- Some basic predictions of life-cycle theory are confirmed:
  - Wealth accumulation with age,
  - Declining risky share with age and initial WY
    (as predicted by theory if human capital is relatively safe).
- Preference estimates:
  - RRA has a mean of 5.24 and a cross-sectional s.d. of 0.47.
  - TPR is right-skewed (median 4.08%, mean 6.18%) and dispersed (s.d. 6.03%).
  - EIS is right-skewed (median 0.42, mean 0.99) and dispersed (s.d. 0.96). Estimate of EIS <1 for 60% of households.
- We strongly reject the null hypothesis of homogeneous preferences.

Our Main Findings

- Weak correlations among preference parameters.
  - Relation between RRA and EIS inconsistent with power utility.
- RRA is lower for educated households working in risky sectors.
  - Risk-tolerant households choose to acquire education and select risky occupations, or investment strategies insensitive to income risk for behavioral reasons.
- TPR is high for households with low initial wealth and rapid wealth accumulation.
  - These households start retirement saving late in life and then catch up.

Outline

1. Measuring wealth and asset allocation
2. Income and life-cycle model
3. Preference estimates

The Household Balance Sheet

- Components of net wealth

$$W_{h,t} = LW_{h,t} + RE_{h,t} + DC_{h,t} - D_{h,t},$$

  - $LW_{h,t}$ is liquid financial wealth (36% aggregate share in 1999)
  - $RE_{h,t}$ is real estate wealth (76%)
  - $DC_{h,t}$ is DC retirement wealth (13%)
  - $D_{h,t}$ is debt (-25%)
  - Missing: other durable goods, private businesses.

- We map these wealth components into implied holdings of a single composite risky asset, which has the same volatility as the after tax return in local currency on the MSCI world index.

- The risky share is $\alpha_{h,t} = \sigma(R^e_{h,t+1})/\sigma(R^e_{N,t+1})$.

Mapping the Wealth Components

- We map the components of $LW_{h,t}$ to a mix of cash and stocks earning the return on the MSCI world index (without currency hedging).
- We treat all real estate $RE_{h,t}$ as invested in a diversified portfolio of Swedish real estate (FASTPI index).
- $DC_{h,t}$ accumulates tax-free but is taxed upon withdrawal, so we convert to after-tax units using the average withdrawal rate $\tau = 32\%$. We assume it is invested in cash and stocks following the age pattern of Swedish life-cycle funds.
- $D_{h,t}$ is mostly floating-rate mortgage debt, so we treat it as a negative cash position paying a higher borrowing rate.

Household Data

- We use administrative data on Swedish residents.
  Administrative records are important sources of big data (Einav and Levin 2014).
- We start with 7.7 million household-year observations on cohorts that are between 40 and 60 in the period 1999–2007.
- We exclude households headed by students, households without any taxable risky assets ("nonparticipants"), and households in the top 1% of the financial wealth distribution in 1999.
- This gives us 2.6 million household-year observations on 291,488 households.

Grouping Households

- We classify by 3 education levels and 3 levels of sectoral income volatility to get 9 large groups.
- We two-way sort each of these groups into 7 categories of the initial risky share and 7 categories of the initial wealth-income ratio.
  Lowest and highest 2 deciles and middle 3 quintiles for each of the 9 large groups.
- We subdivide by 13 birth cohorts, to obtain $5733 = 9 \times 49 \times 13$ groups.
- We eliminate groups with missing members in any year to get a balanced panel of 4151 groups.
  - Median group size 63 households, mean 86 households.
  - We size-weight statistics in the paper.

Labor Income Process

$$\log(L_{h,t}) = a_c + b' x_{h,t} + \nu_{h,t} + \varepsilon_{h,t},$$

- a_c is a cohort fixed effect.
- $x_{h,t}$ captures deterministic components of income (age profile, retirement).
- $\nu_{h,t}$ is permanent income, with a group-level component and an idiosyncratic component:

$$\nu_{h,t} = \zeta_t + z_{h,t}.$$

  - The components ζ_t and $z_{h,t}$ follow independent random walks.
  - The group-level shock can be correlated with asset returns.

- $\varepsilon_{h,t}$ is transitory income shock, purely idiosyncratic.
  - Fits the fact that group-level income is positively, not negatively autocorrelated in our data.

Wealth and Asset Allocation (Table 3)

	(1) WY	(2) RS	(3) RS
Age	0.147***	-0.014***	-0.010***
	(0.016)	(0.001)	(0.001)
Total income volatility	18.375***	-0.193	0.345**
	(2.152)	(0.128)	(0.105)
High school	0.538***	-0.011	0.005
	(0.136)	(0.009)	(0.008)
Post-high school	1.020***	-0.017	0.013
	(0.145)	(0.009)	(0.007)
WY			-0.029***
			(0.001)
Constant	-6.437***	1.515***	1.326***
	(0.817)	(0.056)	(0.046)
Year fixed effects	Yes	Yes	Yes
R^2	0.105	0.180	0.388

Drivers of Wealth and Asset Allocation

- WY increases with education, income risk, and age.
  - Income risk effect consistent with precautionary savings motive.
- Risky share varies little with education and income risk.
- Risky share falls with age and WY.
  - Consistent with a static model in which income is safe and tradable, so human capital is an implicit holding of a safe asset.
  - Our life-cycle model with risky income and borrowing constraints has similar predictions.

Life-Cycle Model

- Epstein-Zin preferences with no bequest motive.
  - Labor income process already defined, with fixed retirement at age 65.

- Budget constraint

$$W_{h,t+1} = (R^f + \alpha_{h,t} R^e_{N,t+1})(W_{h,t} + L_{h,t} - C_{h,t}),$$

  - Wealth must be positive (no borrowing against future income), but a leveraged risky position ($\alpha_{ht} \geq 1$) is permitted.

- Calibrated asset parameters:
  - 2% after-tax interest rate.
  - Risky asset: 13.3% volatility, 0.26 after-tax Sharpe ratio (MSCI index 1984–2007).

Preference Parameter Estimation Method

- Indirect inference estimation applied to the sequence of 8 WY ratios and 8 risky shares.
- Minimize distance between observed moments and simulated moments, where simulations
  - condition on initial WY in each year.
  - feed in realized shocks to financial returns and group-level income, and average across possible realizations of idiosyncratic income shocks.
- We use a fixed weighting matrix that reflects the difference in scale between WY and risky share.
- We calculate standard errors using asymptotic theory as group size becomes large.
- We validate this estimation method by Monte Carlo.

Cross-Sectional Distribution (Table 4)

	Mean	Median	Std. Dev.	10%	25%	75%	90%
RRA	5.24	5.30	0.47	4.60	4.90	5.50	5.90
TPR (%)	6.18	4.08	6.03	1.01	3.15	7.42	18.39
EIS	0.99	0.42	0.96	0.10	0.10	1.97	2.50

Hypothesis Tests

- Our preference estimates are inconsistent with power utility.
  - We reject power utility for 34% of households.
  - We estimate EIS $>$ 1/RRA for 65% of households.
- Our average EIS estimate is close to 1, but the EIS does not look much like the long-run risk model.
  - We reject EIS $<$ 1 for only 17% of households.
  - We reject EIS $>$ 1 for 49% of households, because high estimates have high standard errors.
- We find strong evidence that preferences are heterogeneous.
  - We reject the null that all three preference parameters equal their cross-sectional means for 98% of households.

Model Fit (Table 8)

	Mean	Median	Std. Dev.	10%	25%	75%	90%
WY RMSE	30.81	19.92	36.69	8.67	12.60	36.21	66.71
RS RMSE	4.66	4.14	2.13	2.48	3.13	5.69	7.43
Scaled WY RMSE	6.25	4.04	7.45	1.76	2.56	7.35	13.54
Scaled RS RMSE	7.16	6.37	3.27	3.81	4.82	8.75	11.42
RMSE-scaled OF	6.67	5.92	5.42	2.42	4.31	7.99	11.59

We beat atheoretical models:

- random walk for WY (mean RMSE 33%, median 31%),
- RS equal to its time-series mean (mean RMSE 6.2%, median 5.2%).

Preferences and Characteristics (Table 6)

	(1) RRA	(2) TPR	(3) EIS
Total income volatility	-6.752***	-0.334***	1.595*
	(0.239)	(0.042)	(0.721)
High school	-0.462***	0.023***	-0.123**
	(0.018)	(0.003)	(0.046)
Post-high school	-0.570***	0.009***	-0.051
	(0.015)	(0.003)	(0.046)
Constant	6.599***	0.132***	0.701***
	(0.053)	(0.010)	(0.156)
Cohort dummies	Yes	Yes	Yes
R^2	0.379	0.068	0.006

Conclusion

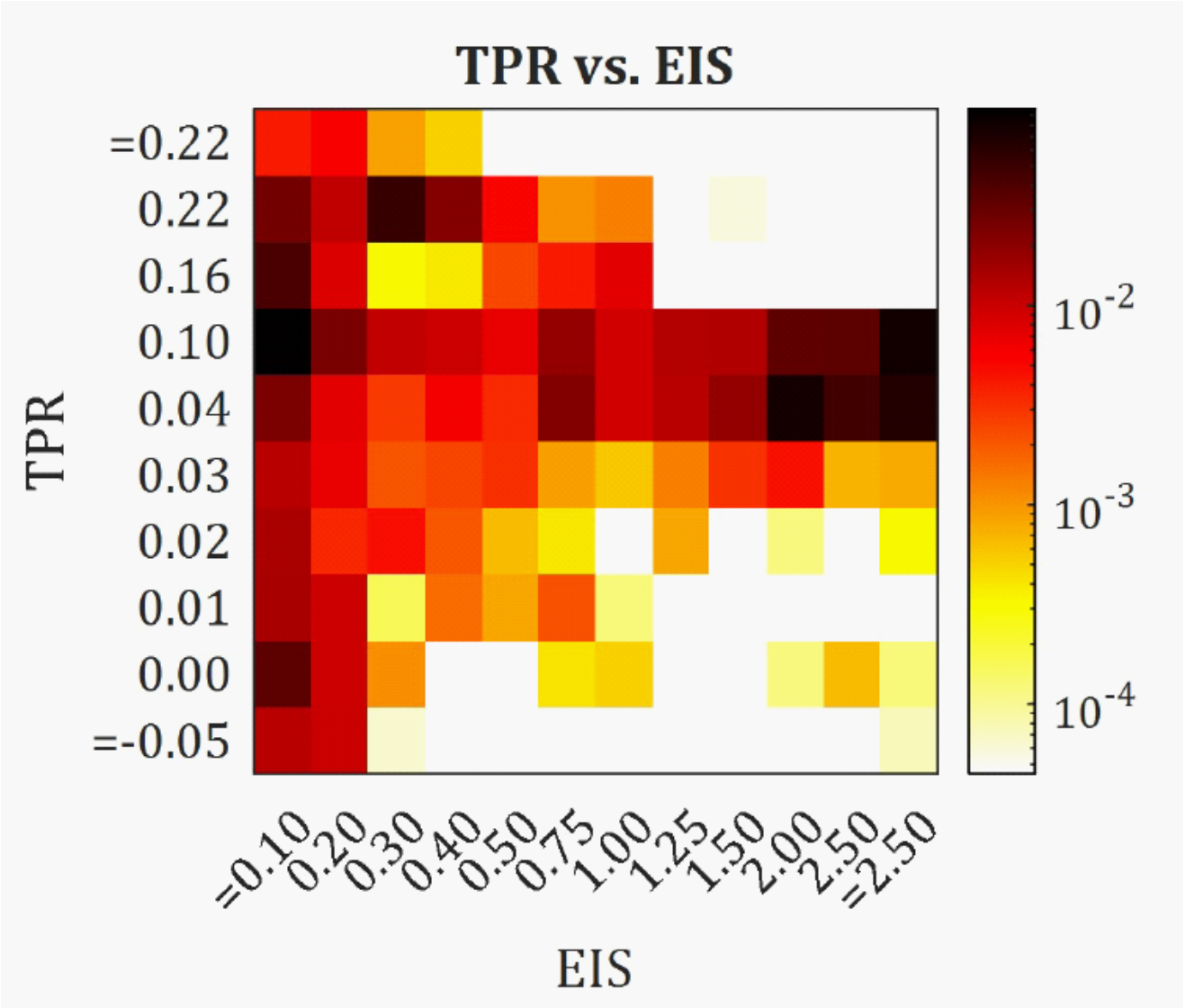
- This paper develops the estimation of Epstein-Zin preferences based on a standard life-cycle model.
- We measure weak cross-sectional correlation between preference parameters.
  - Multi-dimensional heterogeneity
- We show that our results are robust to some heterogeneity in beliefs.
- Cross-sectional variation in preferences, particularly TPR and EIS, is large enough to matter.
  - Wealth changes across groups might generate detectable time-variation in preference parameters for a representative agent.
  - "One-size-fits-all" financial regulation may be welfare-reducing.

Additional Slides

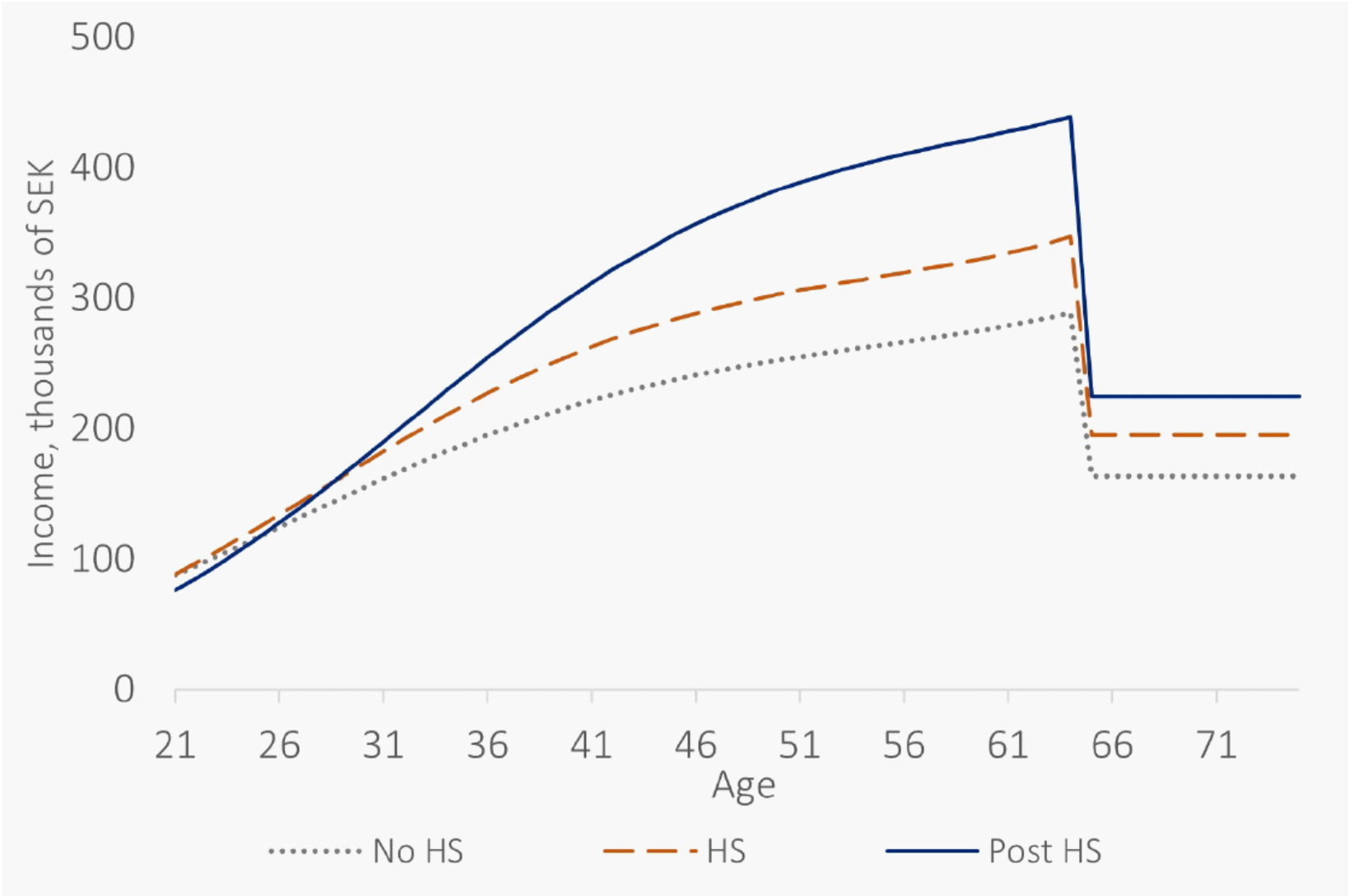
Parameter Identification

- Conditional on initial WY,
  - RRA is the main influence on the risky share.
  - TPR is the main influence on the rate of wealth accumulation.
- How is the EIS identified?
  - We have risky labor income and borrowing constraints, implying both a time-varying portfolio and expected return, and a target WY at each level of other state variables.
  - A saver with a high EIS adjusts more rapidly to the target WY.
  - Model simulations verify good identification conditional on model specification.

Joint Distribution of TPR and EIS (Figure 4)



Estimated Age Profiles



Labor Income Profiles

- We estimate steeper age-income profiles in Sweden than in the US.
  - Income rises all the way to retirement age.
  - This is related to rapid aggregate income growth (1.75%) in Sweden during our sample period.
- We estimate that educated workers have higher transitory income risk, whereas the opposite is true in the US.
  - Result of Swedish labor market regulations and social insurance.
- Sectoral variation in income risk is intuitive.
  - Low risk: public sector, utilities.
  - High risk: hotels and restaurants, real estate, construction (for less educated), finance (for more educated).

Hypothesis Tests (Table 7)

Economically motivated hypotheses about TPR and EIS.

Condition	Fraction of the Population
$\text{TPR} < 0$	0.065
Reject null that $\text{TPR} > 0$	0.021
Reject null that $\text{TPR} < 0$	0.611
Reject null that $\text{TPR} = 0$	0.587
$\text{EIS} < 1$	0.597
Reject null that $\text{EIS} > 1$	0.490
Reject null that $\text{EIS} < 1$	0.172
Reject null that $\text{EIS} = 1$	0.633
$\text{EIS} < 1/\text{RRA}$	0.347
Reject null that $\text{EIS} > 1/\text{RRA}$	0.054
Reject null that $\text{EIS} < 1/\text{RRA}$	0.331
Reject null that $\text{EIS} = 1/\text{RRA}$	0.340

Furthermore, we strongly reject the homogeneity of preferences.

Link Between Income Risk and RRA

- Variation in risk aversion with income risk is consistent with self-selection.
  - Occupations with high lifetime risk appeal more to risk-tolerant people.
- However our results are also consistent with household underreaction to information.
  - Households with high income risk invest more conservatively, but not enough so to be consistent with rational expectations and homogeneous preferences.
  - We interpret this as preference heterogeneity, but households in risky occupations may underestimate the labor income risk they face.