CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

Time Discounting and Wealth Inequality

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External members

Many different fields: Public Economics, Labor Economics, Health Economics, Experimental Economics, Behavioral Economics, Household Finance, Political Economy, Microeconometrics...

CEBI research agenda: Examples of CEBI projects

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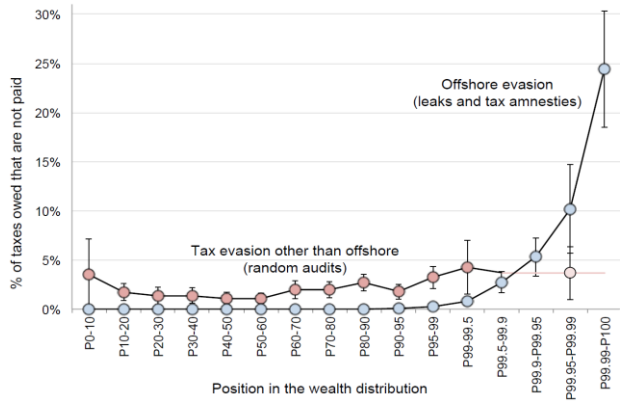
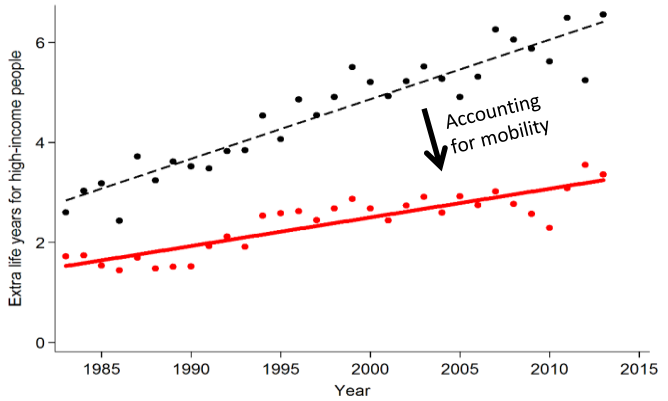
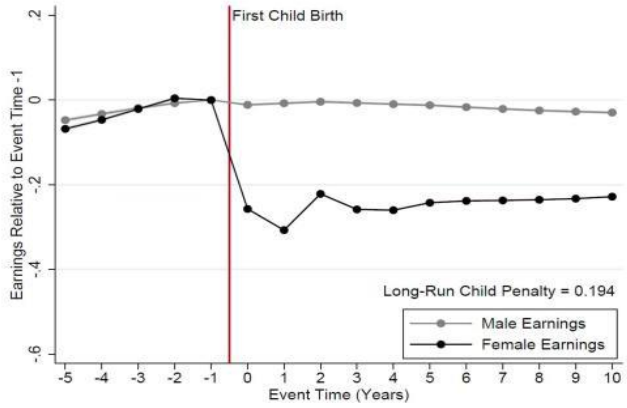
Wealth Inequality: Role of tax evasion behaviour, preference heterogeneity and wealth taxation…



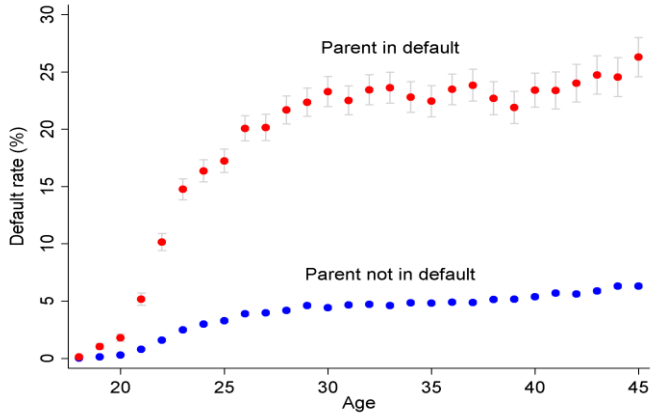
Life-expectancy inequality: Role of income mobility, innovations and technology adoption



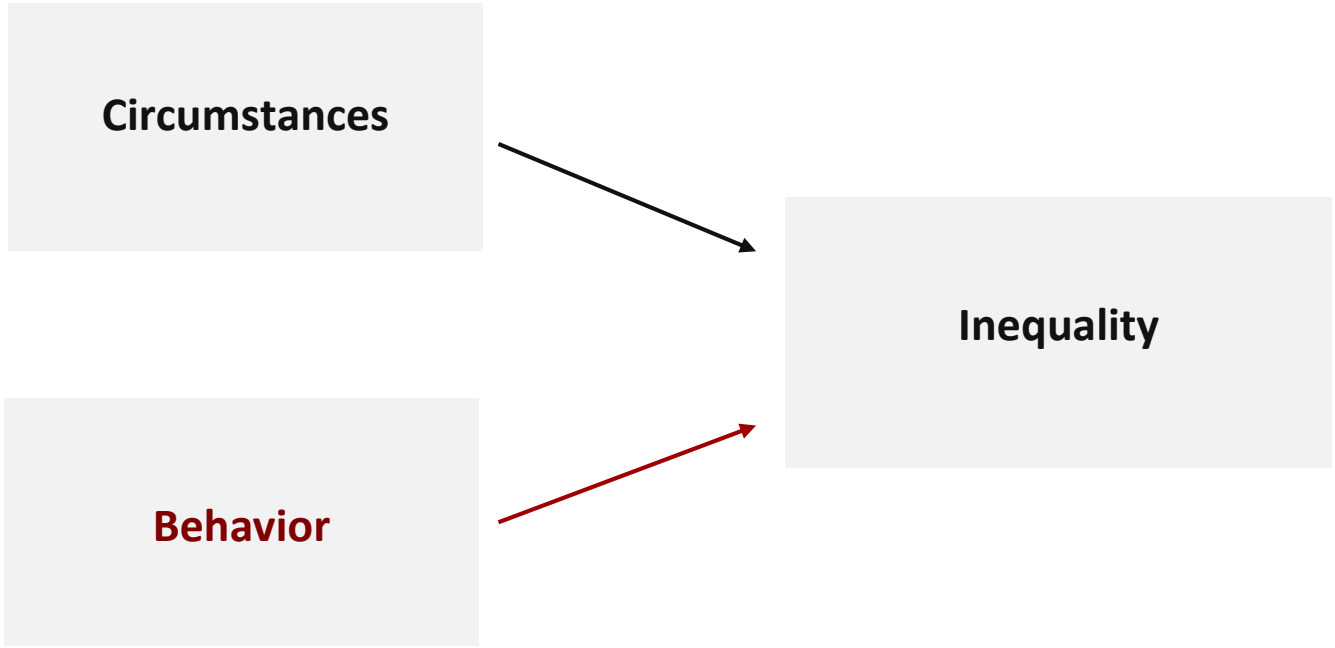
Gender inequality: Role of children, social norms and parental leave policy



Inequality in financial trouble: Role of shocks vs behavioral heterogeneity

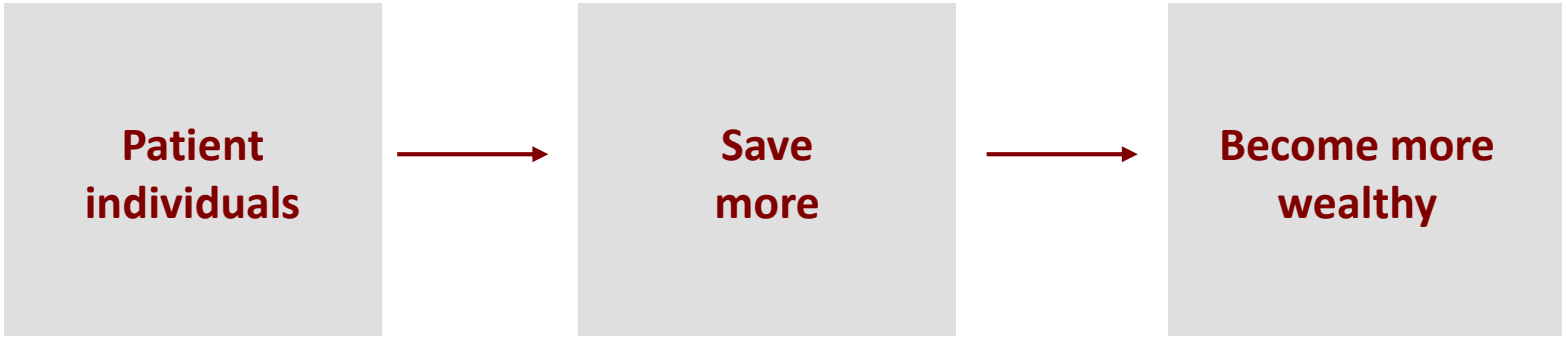


CEBI research agenda



Research agenda of this paper

Hypothesis from basic theory of savings behavior:



Contribution

I. Measure whether differences in patience predict wealth inequality:

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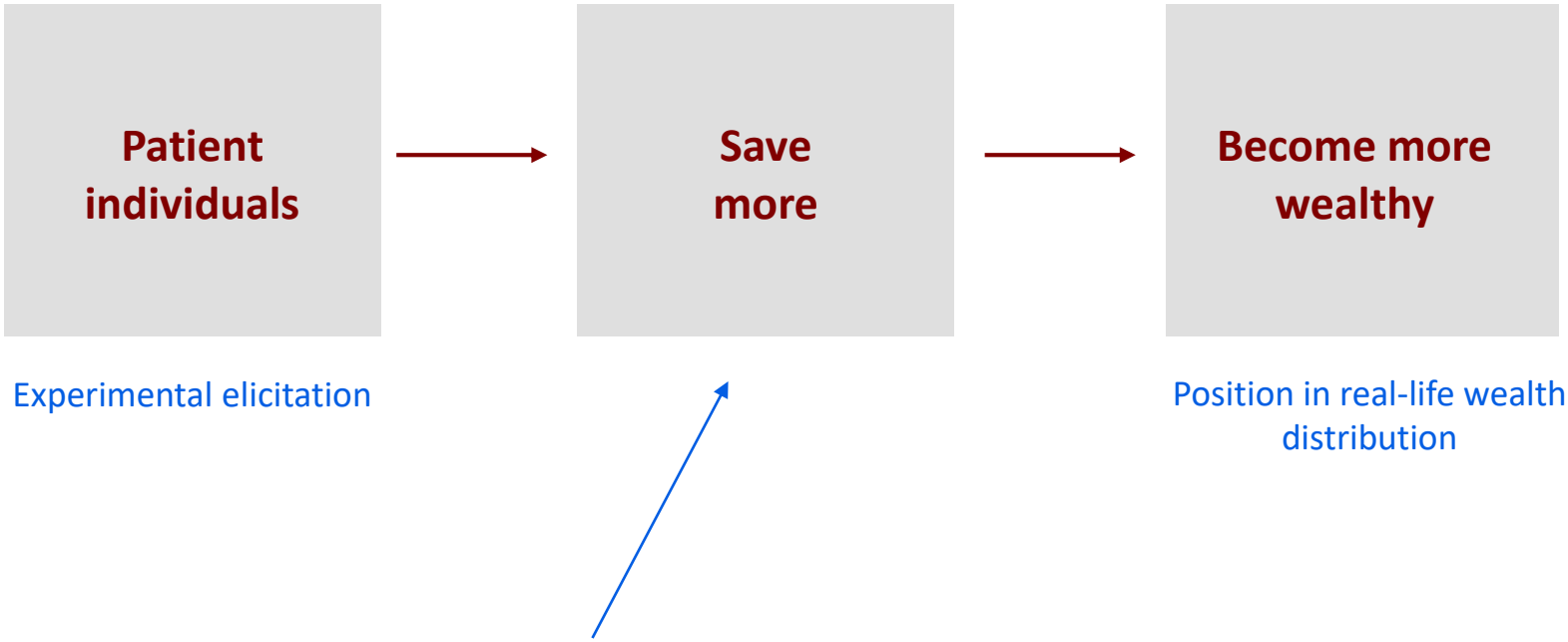


II. Provide suggestive evidence about the role of the savings channel by controlling for other factors relevant according to theory

Contribution

Public Finance and Macro literature (e.g. Krusell & Smith 1998; Carroll et al. 2014, 2017; Krueger et al. 2016; Boserup et al. 2016, 2018; De Nardi and Fella 2017; ...

Models with heterogeneity in time discounting better at matching wealth inequality + propagation of business cycle shocks and effects of stimulus policy

Experimental literature (e.g. Mishel et al 1989; Harrison et al 2002; Andreoni & Sprenger 2012; Attema et al 2016; ….

Evidence starting with the famous marshmallow experiments w. children in the 60s to recent research using intertemporal choices of adults point to pervasive heterogeneity in time discounting

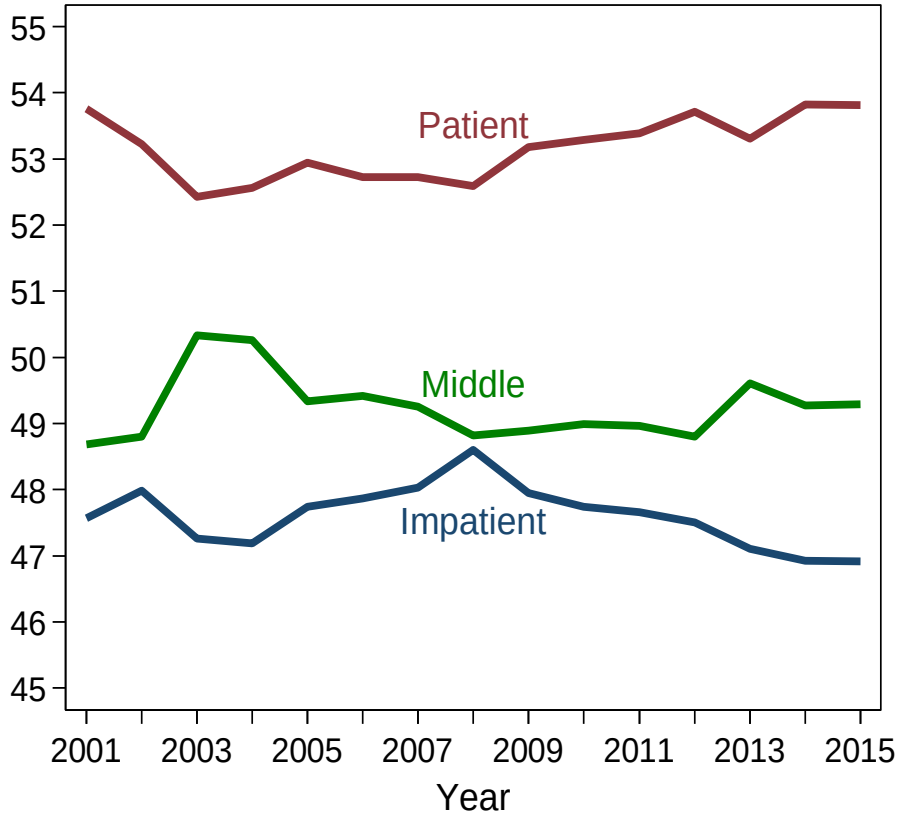
Has predictive power of behavior outside the laboratories

We bridge these literatures

Q: Do differences in *elicited* time discounting predict *real-life* wealth inequality?

Preview of main results

Wealth rank by patience group, 2001-2014



(*i*) Patience quantitatively as important as education in predicting wealth inequality

(*ii*) 75% of association exists after including a large set of controls for differences in life-time resources ⇒ savings channel seems important

(*iii*) Robust to controlling for differences in market interest rates

(*iv*) Same results if using an early elicitation measure of time discounting (1973 survey)

Remaining talk

- Standard savings theory
- Data construction
- Main empirical results
- Robustness analyses
- Some concluding remarks

Savings Theory

$$\max_{(c(a))_0^T} U = \int_0^T \frac{c(a)^{1-\theta}}{1-\theta} e^{-\rho a} da$$

$$\text{s.t.} \quad \dot{w} = rw(a) + y(a) - c(a)$$

$$\Downarrow$$

$$w(a) = Y\left(\gamma(a) - \frac{1 - e^{\frac{r(1-\theta)-\rho}{\theta}a}}{1 - e^{\frac{r(1-\theta)-\rho}{\theta}T}}\right)e^{ra}$$

where

- Y is life-time resources/permanent income
- $\gamma(a)$ is share of life-time resources received up to age a

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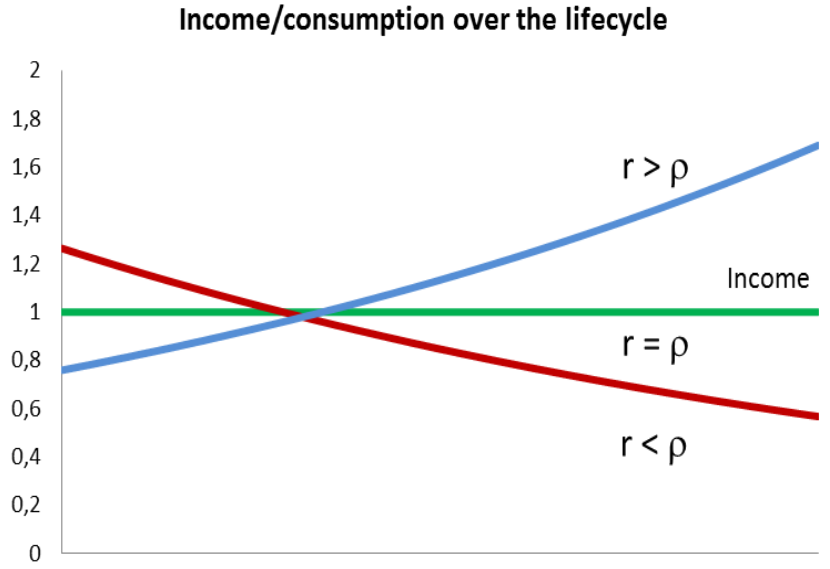

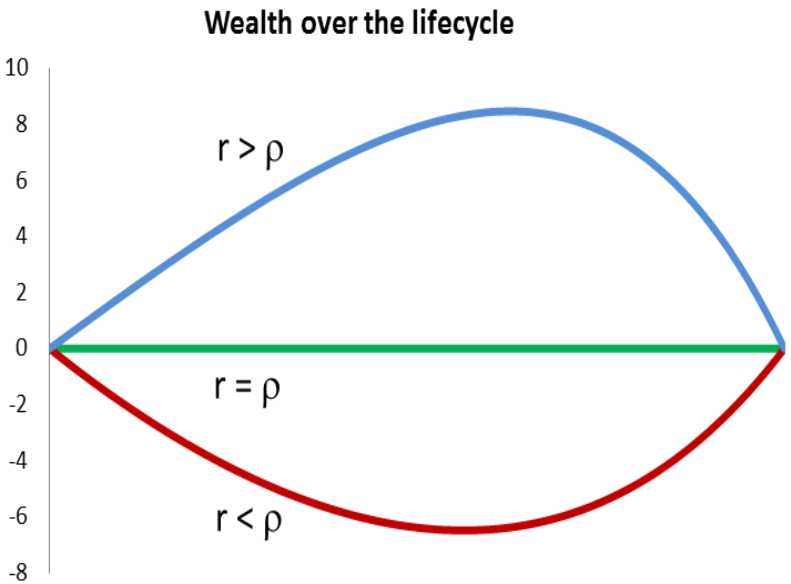

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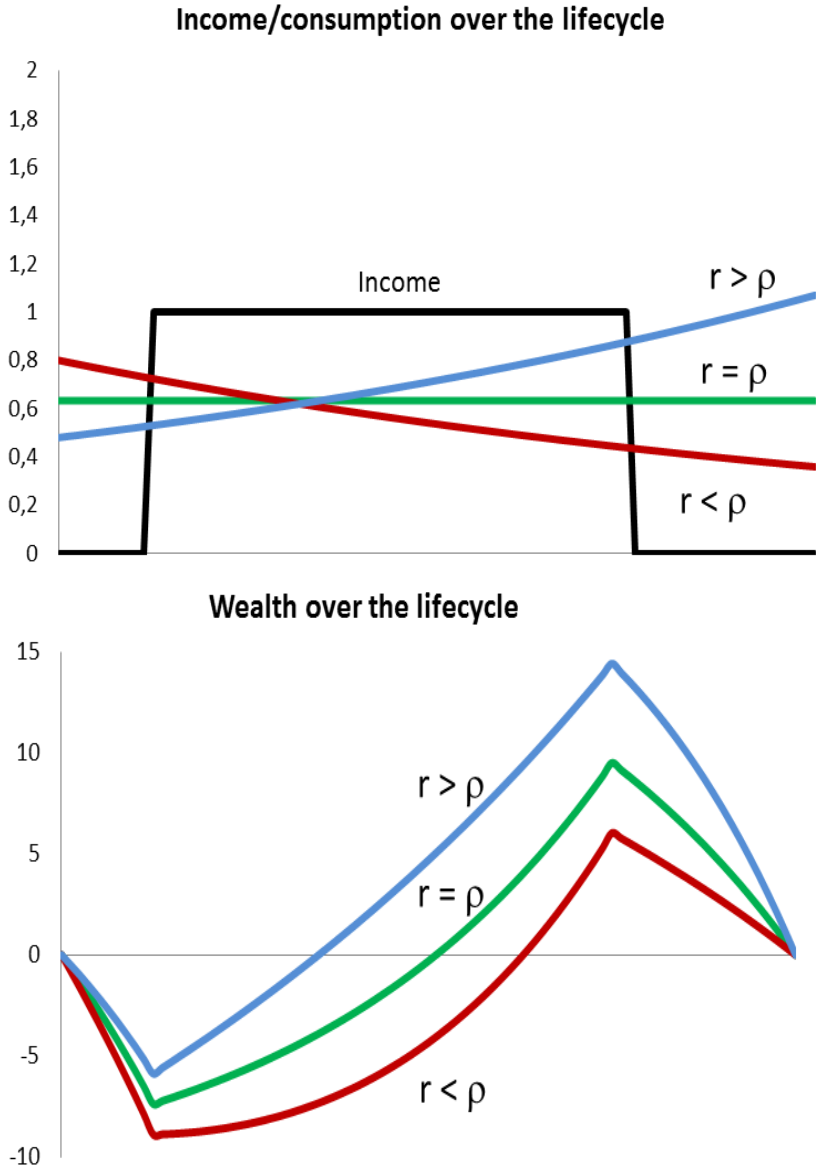

Savings Theory

Main results

- Patient individuals hold more wealth *at all ages* in the life cycle

  (Conditional on permanent income, timing of income, market interest rate, CRRA parameter)

- No clear cross sectional relationship between patience and levels of consumption and savings ⇒ focus on wealth

- Borrowing constraints
  - Low-patience individuals more likely to be borrowing constrained
  - No patience-wealth relationship for borrowing constrained individuals (⇒ mutes the association btw. patience and wealth inequality)

Data: overview

Experimental data

Online Experiment 2015

Invite individuals born in Copenhagen 1973-83

3620 respondents

Choice tasks measuring:

- Patience
- Risk aversion
- Altruism

Typical after-tax payout: 245 DKK (≈€33)

Pay-out transferred directly to bank account

CPR

Administrative data

Info during adulthood about

- Wealth
  - Bank deposits
  - Market value stocks, bonds
  - Tax assessed property value
  - Pension wealth and market value of cars (only 2014-)
- Income
- Education
- Parental wealth
- Demographics

Also information for

- non-respondents
- 10% random sample

Data construction: Summary statistics

	(a) Respondents	(b) Population	(c) (a)-(b)	
Age	37.32	37.31	0.01	(0.82)
Woman (=1)	0.50	0.50	-0.01	(0.44)
Single (=1)	0.28	0.28	-0.01	(0.23)
Dependent children (=1)	0.70	0.68	0.02	(0.00)
Years of education	14.90	14.70	0.20	(0.00)
Gross income distribution				
p5	135,745	113,992	21,753	
p25	287,472	263,532	23,941	
p50	382,997	355,896	27,101	(0.00)
p75	484,463	453,367	31,096	
p95	719,754	698,786	20,968	
Wealth distribution				
p5	-337,615	-234,125	-103,490	
p25	93,899	124,101	-30,202	
p50	486,006	458,345	27,661	(0.00)
p75	1,066,468	947,205	119,263	
p95	2,395,664	2,215,063	180,601	
Observations	3,620	70,756	74,376	

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Data construction: Experiment

Notes: (a) Five savings tasks with different gains from postponing
(b) 100 points = DKK 25 ≈ €3.60

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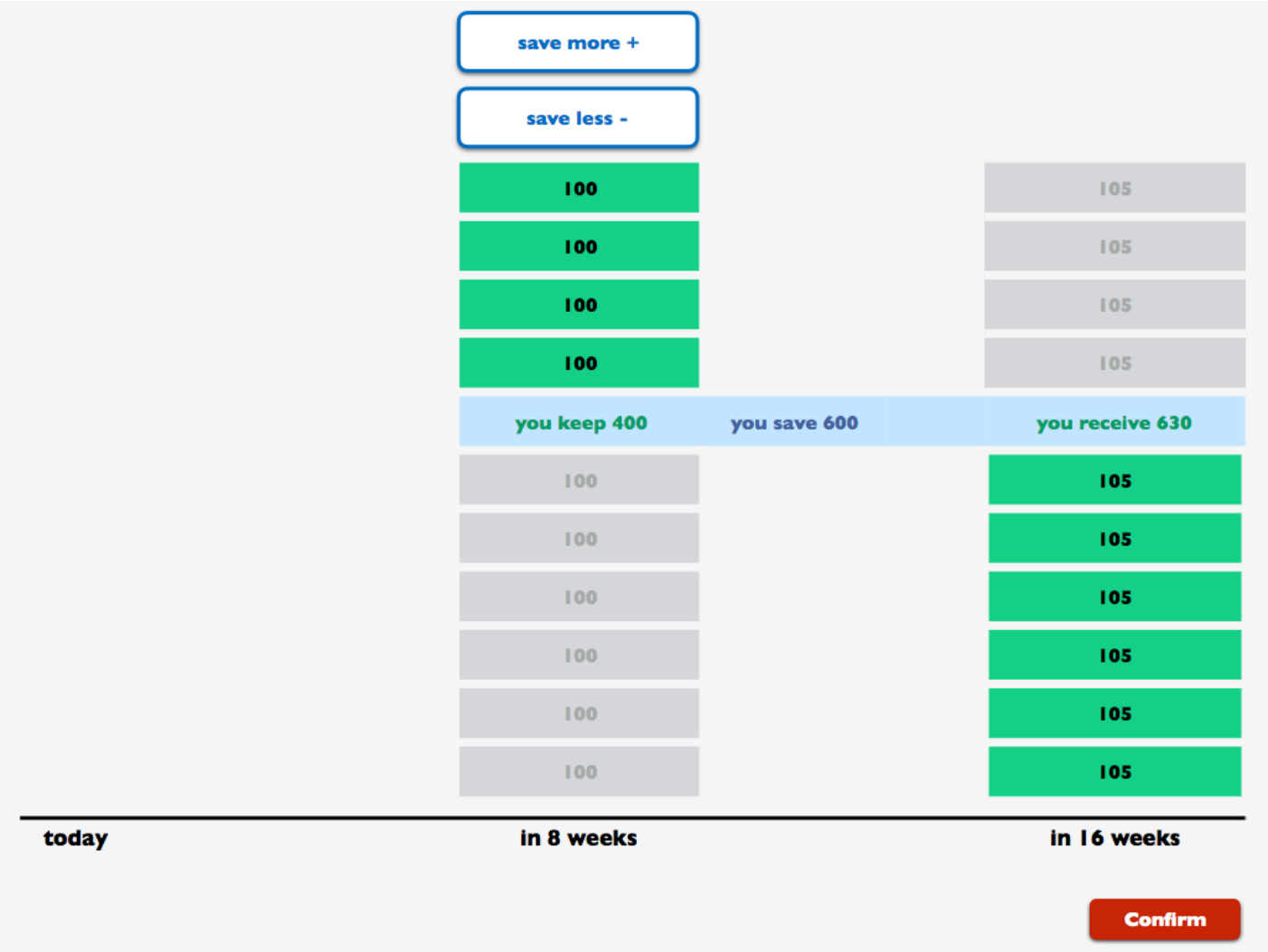
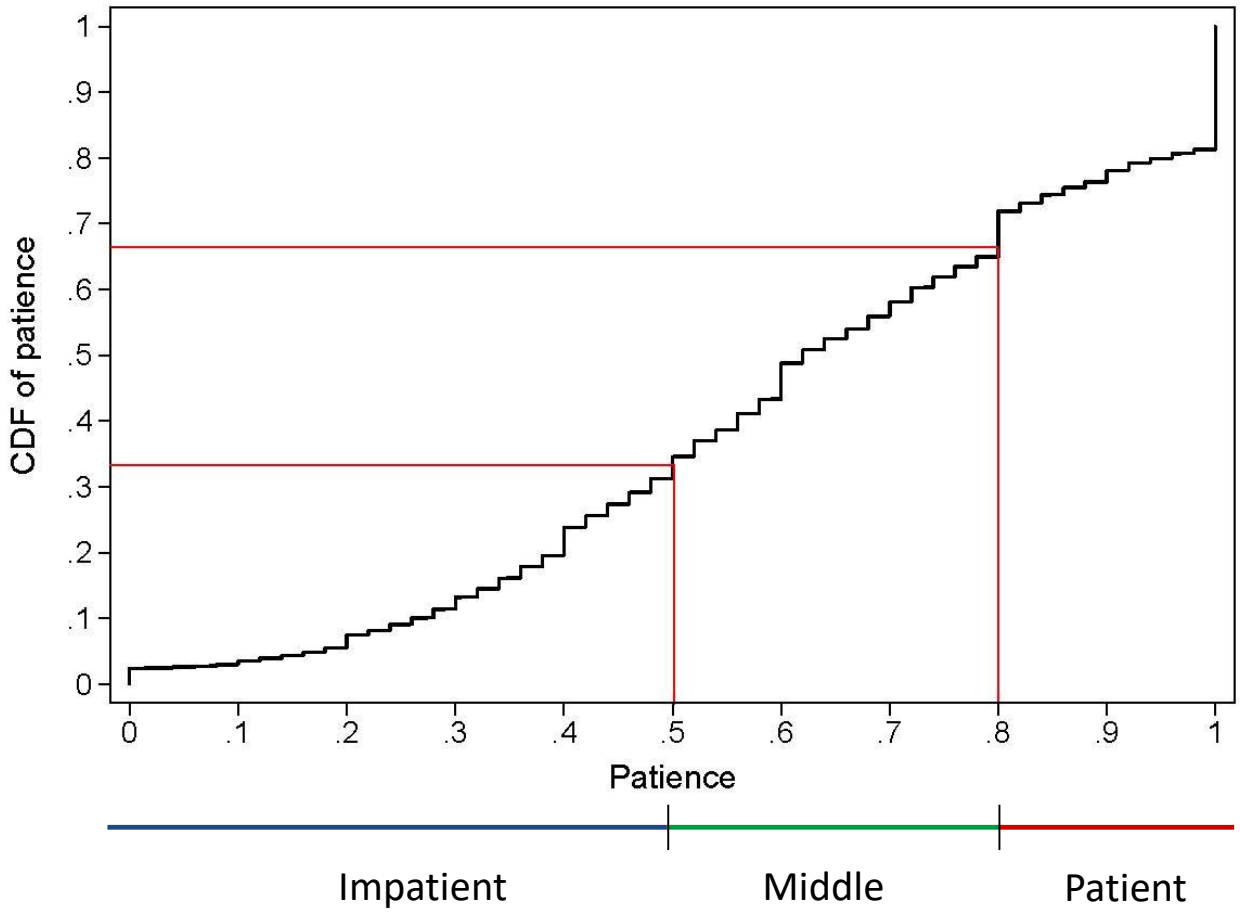


Notes: (a) Five savings tasks with different gains from postponing
(b) 100 points = DKK 25 ≈ €3.60

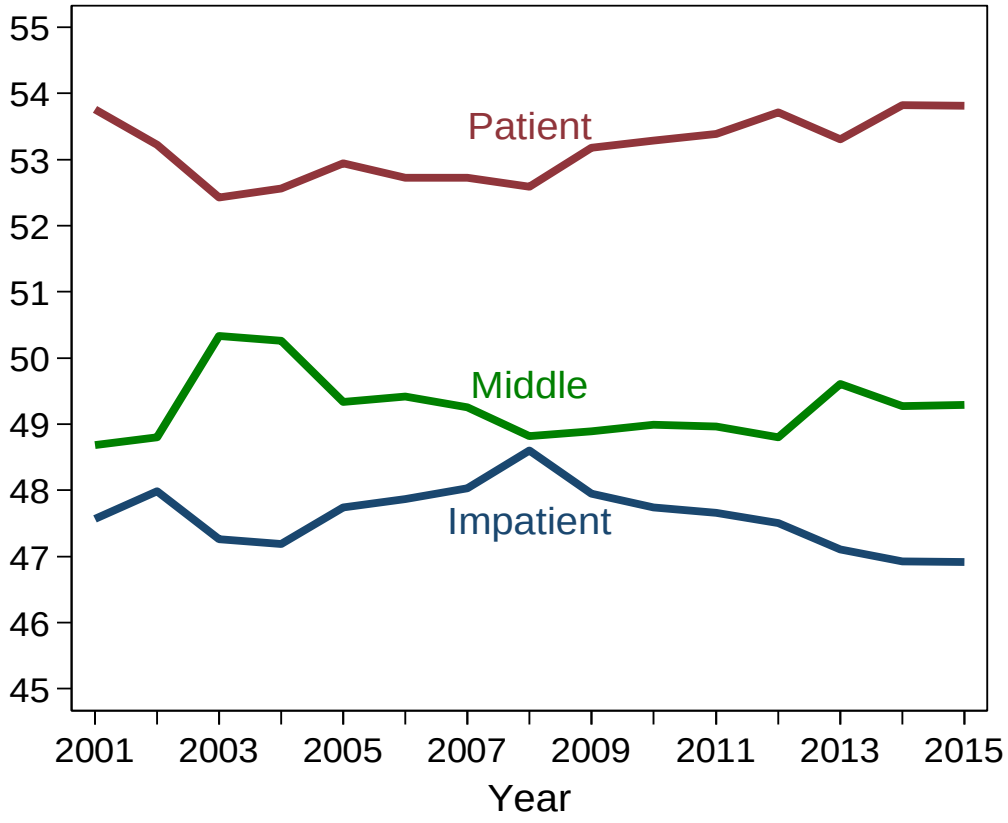
Data construction: Elicited patience

Measure of patience: mean$\left(\frac{z_1}{10}, \ldots, \frac{z_n}{10}\right)$, where z_i is # blocks saved



Results:
Patience and position in the wealth distribution

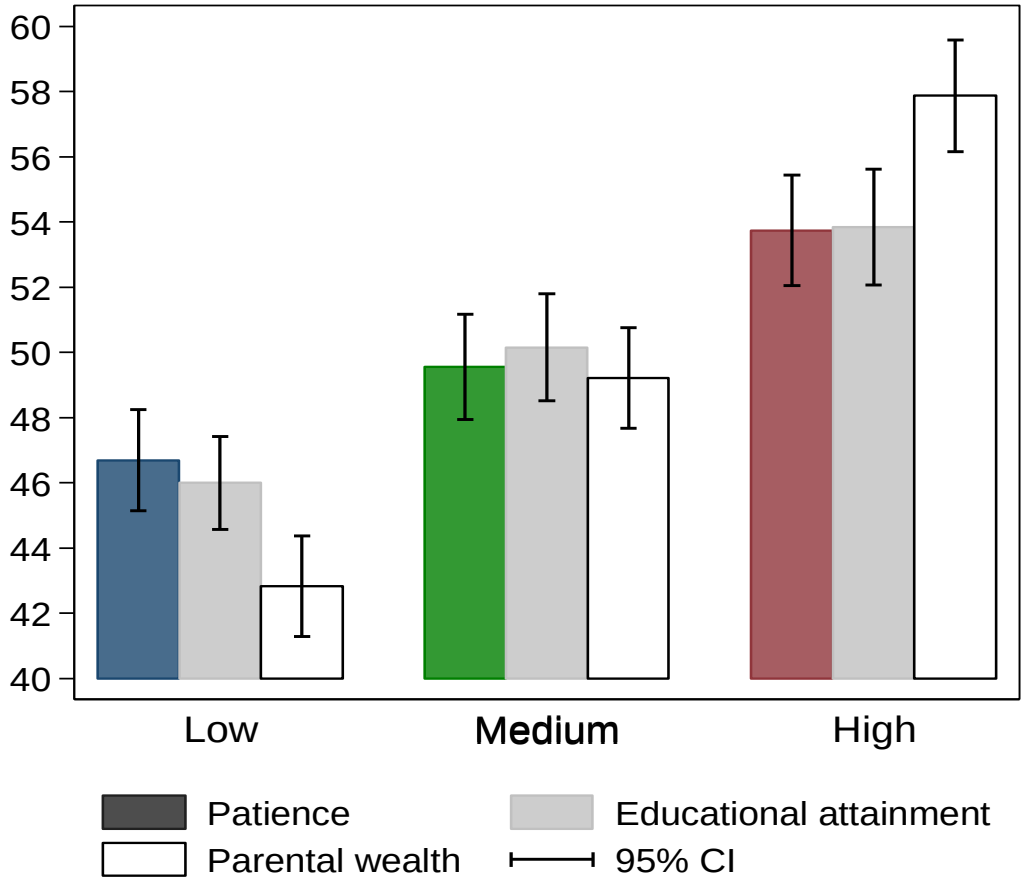
Wealth rank by patience group, 2001-2014



Stable association over more than a decade

Results:
Patience and position in the wealth distribution

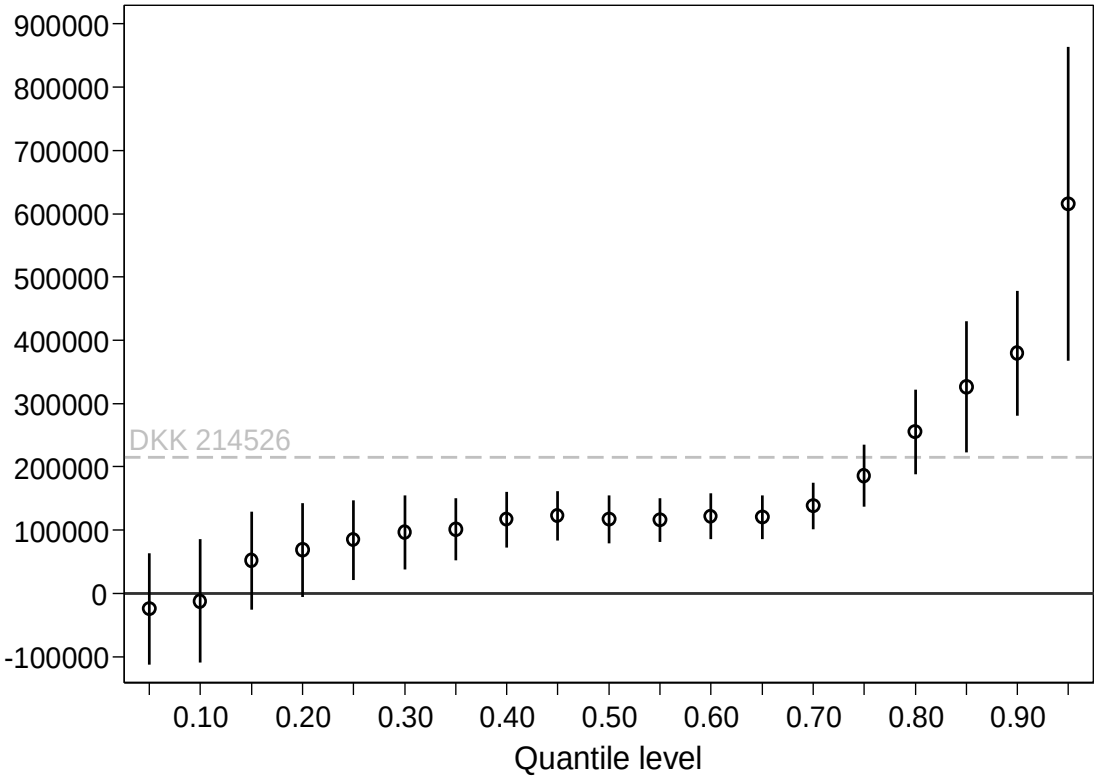
Wealth rank by patience , education, and parental wealth



Association is quantitatively important

Results:
Patience and position in the wealth distribution

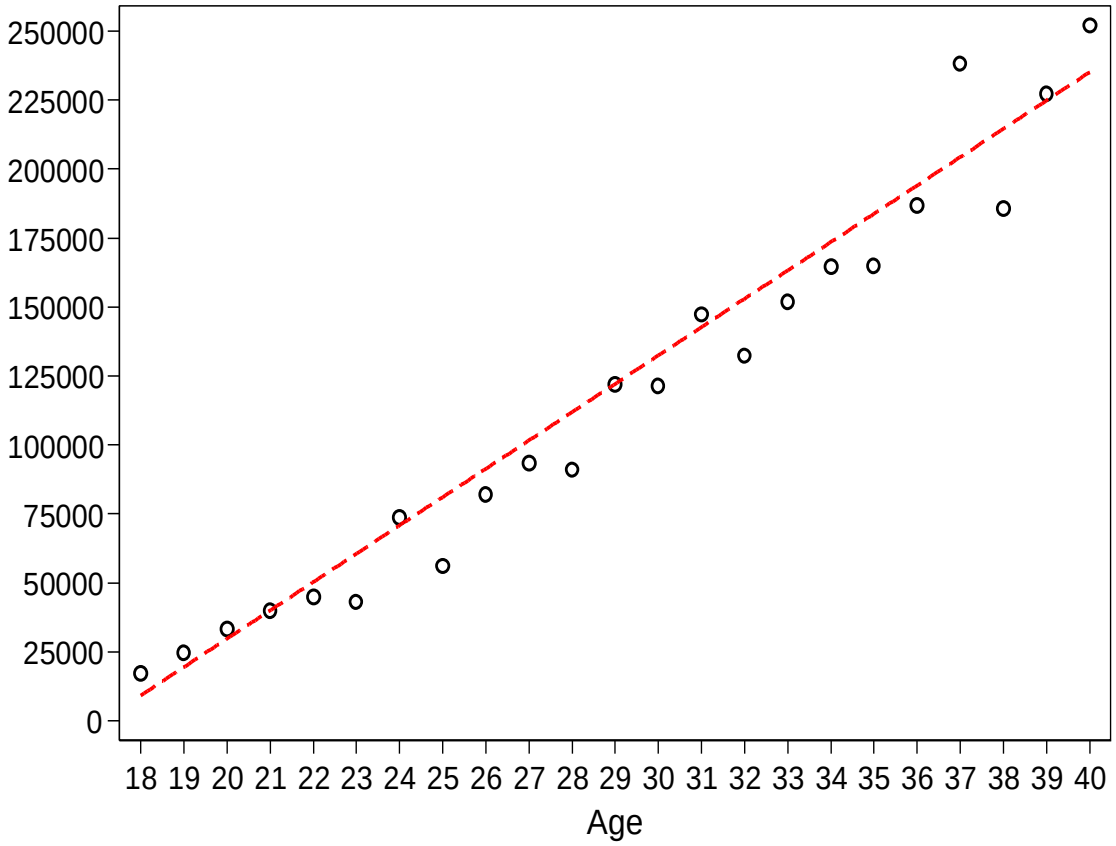
Quantile regression of wealth on patience



Association exists throughout the wealth distribution

Results:
Relationship between wealth and patience by age

Patience-wealth association by age



Increasing over the (first part of) the life-cycle

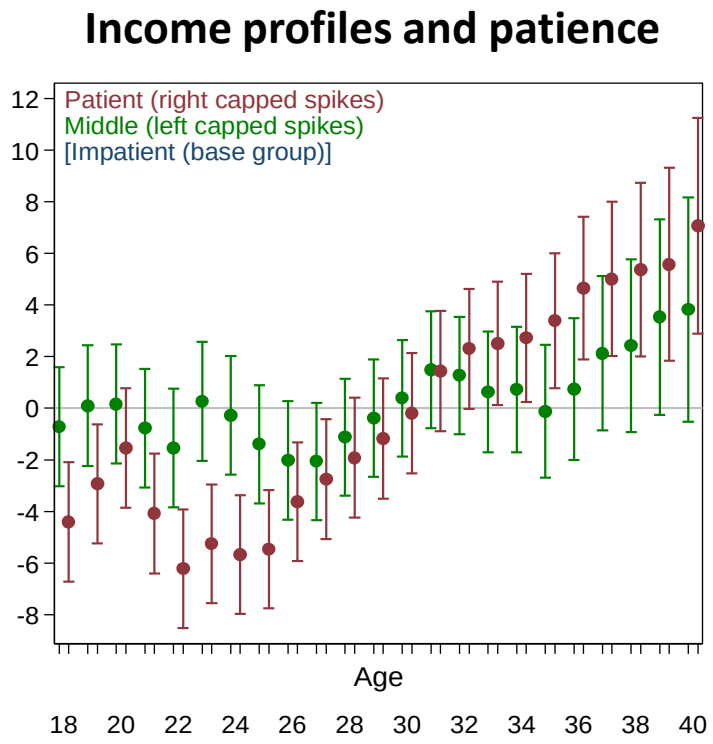
Results:
Effect still large in multivariate setting

Dep. var.: Wealth	(1) Rank	(2) Rank	(3) Rank	(4) DKK	(5) Rank	(6) Rank	(7) Rank	(8) Rank
Patience	11.37***	9.59***	8.45***	146914.66***	9.45***	-1.44	11.14***	7.71***
	(1.73)	(1.75)	(1.75)	(39742.53)	(1.92)	(2.29)	(2.41)	(2.25)
Risk aversion			2.53	49227.45	2.45	-2.81	5.31*	3.18
			(2.04)	(56820.65)	(2.04)	(2.84)	(2.70)	(2.54)
Altruism					-3.67			
					(2.16)			
Future bias=1					2.58			
					(1.32)			
Present bias=1					1.23			
					(1.33)			
Non-monotonic choices in time tasks=1					-1.99			
					(1.07)			
Interest rate on liquidity								-1.63***
								(0.10)
Owned stocks, 2008-2014=1								6.21***
								(1.56)
Rate of return on stocks, 2008-2014								0.36
								(0.54)
Year dummies for educational attainment	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gross income decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Steepness of income profile decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Expected income growth decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Self-reported school grades decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Parental wealth decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Wealth at age 18 decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Demographic controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Age dummies	No	No	No	Yes	No	No	No	No
Constant	42.81***	39.56***	31.84***	-305236.88***	32.13***	38.56***	26.64***	45.80***
	(1.16)	(1.82)	(3.94)	(82509.23)	(4.24)	(4.95)	(6.40)	(6.00)
Observations	3620	3620	3552	3552	3552	1353	2157	2157
Adj. R-squared	0.01	0.02	0.08	0.08	0.08	0.03	0.08	0.19

Bivariate

Results:
Controlling for level and timing of income

Patient individuals have different permanent income and timing of income

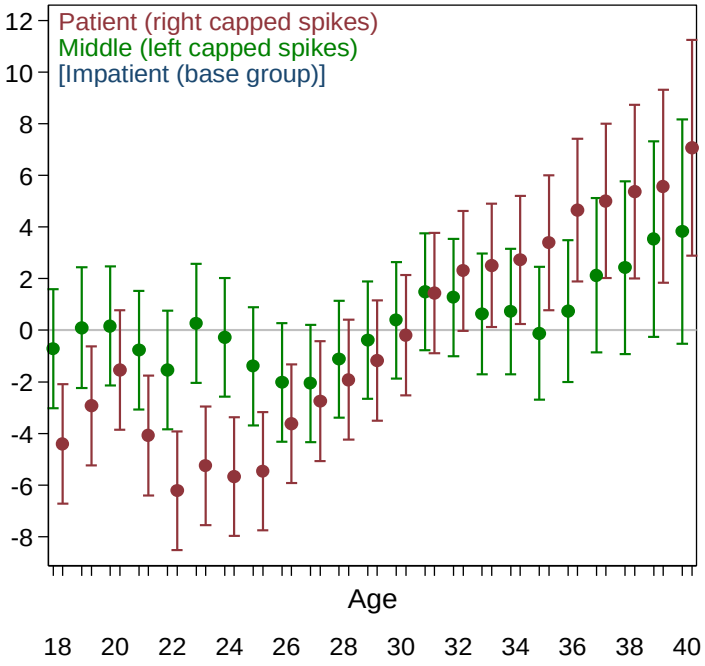


Results:
Controlling for level and timing of income

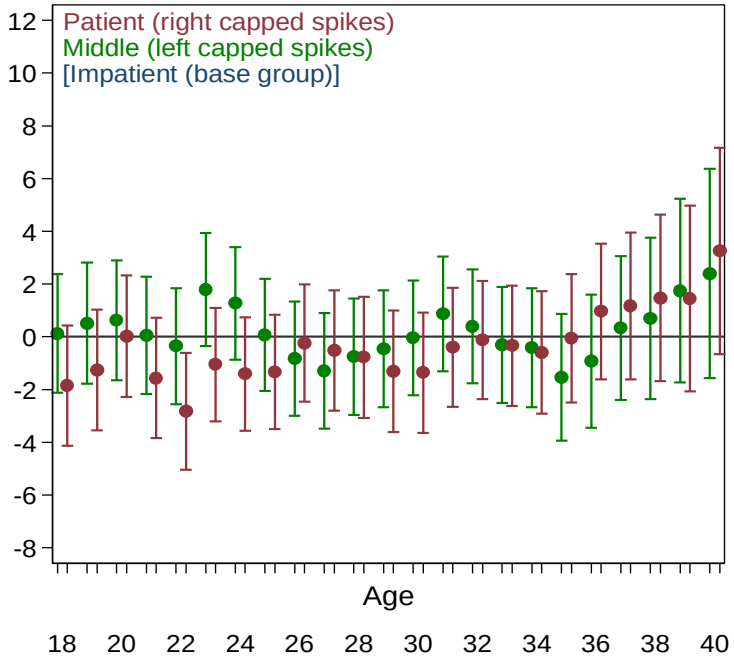
Patient individuals have different permanent income and timing of income

These differences vanish when controlling for education

Income profiles and patience



After controlling for education



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Education

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Risk aversion + Education + Income + Income growth + Expected income growth
+ GPA + Initial wealth + Parental wealth + Demographics

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	(1.73)	(1.75)	(1.75)	(39742.53)	(1.92)	(2.29)	(2.41)	(2.25)
Risk aversion			2.53	49227.45	2.45	-2.81	5.31*	3.18
			(2.04)	(56820.65)	(2.04)	(2.84)	(2.70)	(2.54)
Altruism					-3.67			
					(2.16)			
Future bias=1					2.58			
					(1.32)			
Present bias=1					1.23			
					(1.33)			
Non-monotonic choices in time tasks=1					-1.99			
					(1.07)			
Interest rate on liquidity								-1.63***
								(0.10)
Owned stocks, 2008-2014=1								6.21***
								(1.56)
Rate of return on stocks, 2008-2014								0.36
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Year dummies for educational attainment	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gross income decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Steepness of income profile decile dummies	No	No	Yes	Yes	Yes	Yes	Yes	Yes
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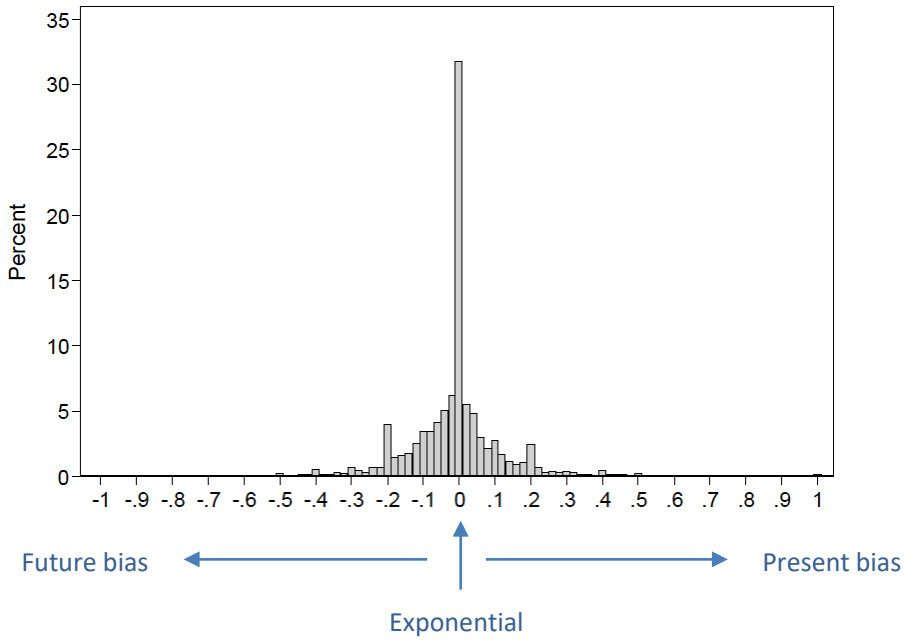
Demographic controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Age dummies	No	No	No	Yes	No	No	No	No
Constant	42.81***	39.56***	31.84***	-305236.88***	32.13***	38.56***	26.64***	45.80***
	(1.16)	(1.82)	(3.94)	(82509.23)	(4.24)	(4.95)	(6.40)	(6.00)
Observations	3620	3620	3552	3552	3552	1353	2157	2157
Adj. R-squared	0.01	0.02	0.08	0.08	0.08	0.03	0.08	0.19

Quantitative effect still large with controls (median: 487k)

Non-constant discounting and monotonicity violations

- Non-constant discounting:
  - # blocks paid out early: (0;8) - (8;16)
  - For each of five interest rates offered in the experiment
  - Calculate average within each individual.



- Monotonicity violations in choice tasks: dummy.

Results:
Effect still large in multivariate setting

Dep. var.: Wealth	(1) Rank	(2) Rank	(3) Rank	(4) DKK	(5) Rank	(6) Rank	(7) Rank	(8) Rank
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Non-constant time discounting + monotonicity violations + altruism

Credit constraints and slope of the intertemporal budget constraint

- **Credit constraint**: 1[Liquid assets<1 month disposable income]

  E.g. Zeldes 1989; Johnson et al. 2006; Leth-Petersen 2010

- **Soft credit constraint / marginal interest rate**
  - Use account level data for all our subjects (from tax authorities), 2014
  - Marginal interest rate = highest rate from loan accounts or lowest rate from deposit accounts if no loans
  - Kreiner et al. (AEJ: POL 2019)

- **Stock market participation and rate of return**

Results:
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Low / high
Split by hard constraint

Results:
Effect still large in multivariate setting

CENTER FOR ECONOMIC BEHAVIOR & INEQUALITY

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High Liquid asset group: marginal interest rate + stock ownership + stock return

Robustness:
Measure of time discounting thirty years earlier

Danish Longitudinal Survey of Youth (DLSY)

Crude measure of time discounting collected in 1973 for a sample of 2,389 individuals from the 1952-1955 cohorts

If given the offer between the three following jobs, which one would you choose?

(i) *A job with an average salary from the start* (impatient)

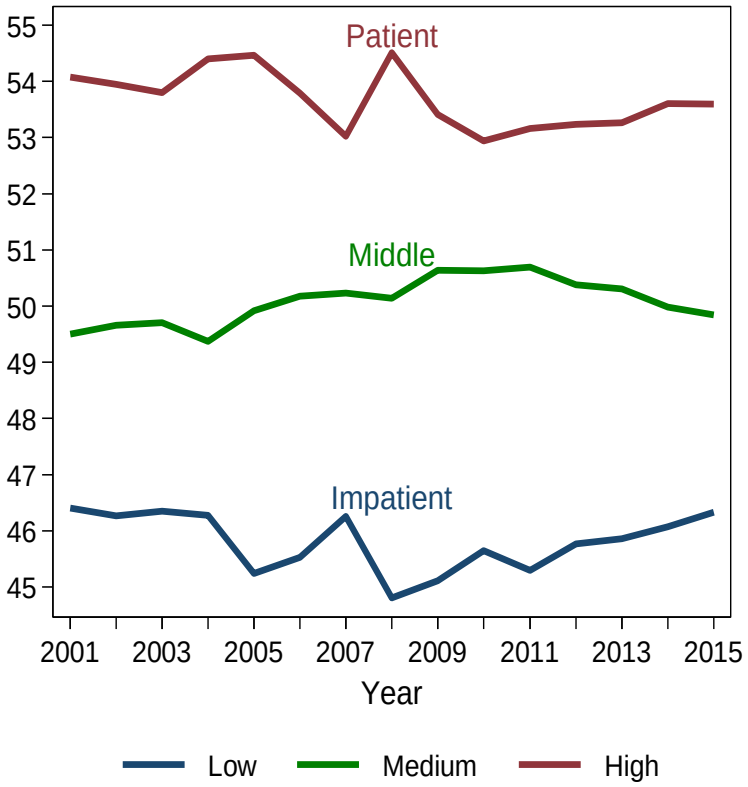
(ii) *A job with low salary the first two years but high salary later* (middle).

(iii) *A job with very low salary the first four years but later very high salary* (patient)

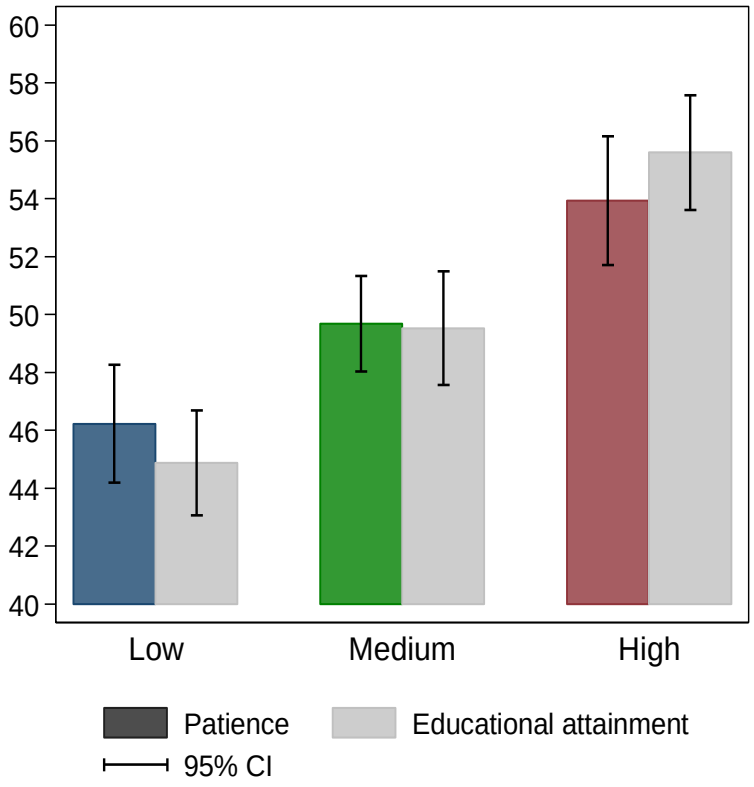
Robustness:
Measure of time discounting thirty years earlier

Patience 1973 and wealth rank

Patience 1973 and wealth rank, 2001-2015



Patience 1973 vs education, wealth rank 2001



Robustness - summary

- Broad wealth concept (housing, car assets, pension wealth – only 2014)
- Narrow wealth concept (financial wealth)
- Structural estimation of preferences (RUM), including present bias
- 248 education groups
- Subsample: Stable income (no health events, no unemployment shocks), average income and wealth over 3, 5, 7 years to reduce importance of transitory components…
- Rank based on wealth-to-permanent income
- Selection into experiment: Inverse probability weighting
  - respondents vs. non-respondents
  - respondents vs. population
- ….

Summary and conclusion

Association between patience and position in the wealth distribution:

- Quantitatively important
- Precisely estimated
- Stable over time
- Operates throughout the wealth distribution

Still large association when including a comprehensive set of theory motivated controls for life-time resources $\Rightarrow$ suggests that savings behaviour is a driver as predicted by standard savings theory

Point to the fruitfulness of incorporating heterogeneous time discounting in models of consumption and savings behavior

Krusell and Smith (1998), Hubmer et al. (2016), Krueger et al. (2016), Carroll et al. (2017), De Nardi and Fella (2017) and Alan et al. (2018)

More generally, the findings suggest that behavioral heterogeneity has an important role to play in the formation of inequality