Intergenerational Altruism and Transfers of Time and Money: A Life-Cycle Perspective

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Introduction

Goals

- Intergenerational persistence in education, earnings and wealth has been well-documented
- Parental investments in children vary substantially with parental background
- Goals of this paper:

  1. Jointly estimate human capital production technology and parental investment preferences
  ... where parental transfers can take the form of
     i. parental time investment in human capital
     ii. education investments
     iii. intergenerational money transfers (inter-vivos and bequests)

  2. Evaluate policies that affect intergenerational persistence allowing for behavioral responses
     ... in particular relaxing borrowing constraints via a student loan policy

Approach

Using 55 years of longitudinal data, estimate:

1. a) Child skill production function (of parental investments)

   b) Wages as a function of ultimate skill and education
2. Dynastic model which embeds (1a) and (1b) in which parents choose investments

National Child Development Study (NCDS):

- Population ($\approx$ 17,000) born in a one week in Britain in 1958
- Followed at ages 0, 7, 11, 16, 23, 26, 33, 37, 42, 49, 55, (62)
- Data on:
  - Inputs: Parental characteristics, time investments, education
  - Outcomes: chidren's cognitive skill, earnings, wealth

What We Find:

- Technology of human capital production:
  - Modest complementarity in skill production between early and some later time investments
  - Substantial complementarity in wage production between realized skills and education

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- Preferences over parental investment:
  - Parents consider time investing in children to be intermediate between work and leisure
- On relaxing intergenerational borrowing constraints:
  - Introducing student loans reduces intergenerational correlation in outcomes
  - Biggest winners: higher skill kids of low-educated parents, but many children worse off

Related Literature

- Parental time spent with children. Todd & Wolpin (2003), Cunha & Heckman (2008), Cunha et al. (2010), Del Boca et al. (2014), Gayle et al. (2022), Attanasio et al. (2020), Agostinelli & Wiswall (2025), Mullins (2025)
- Educational decisions Abbott et. al. (2019), Golan et al. (2018), Heckman et al. (2018), Fu et al. (2019)
- Intergenerational money transfers (inter-vivos or bequests) to children Castaneda et al. (2003), De Nardi (2004), Altonji & Villaneuva (2007), Daruich & Kozlowski (2019), Black et al. (2022)

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- Time, money and education: Lee & Seshadri (2019), Daruich (2022), Krueger et. al. (2024), Caucutt & Lochner (2020)

Our primary contribution: bring to such a model: i) methods in skill production function estimation, ii) data that directly links early life investments to lifecycle outcomes

Key Facts

Facts

- Inputs:
  - Parents with more education invest more time in their children's human capital
  - Parents with more education have kids with more education
  - Parents with more education give more cash to their kids
- Outcomes:
  - Parents with more education have kids with greater skills
  - Richer parents have richer kids

Data: NCDS Investment Measures

Measures of parental investments in early (0 to 6), mid (7 to 10) and late (11 to 15) childhood:

- Outings with child
- Library membership
- Frequency of reading to the children
- Teacher's assessment of parent's involvement in education
- Parents' ambitions regarding child's educational attainment

Transfer Type 1: Time

	Father's Education		
Variable	Low	Medium	High
Age 7			
% of fathers very interested in child's education	20.0	42.6	65.5
% of mothers very interested in child's education	32.5	58.3	75.4
Age 11			
% of fathers very interested in child's education	23.4	52.3	73.0
% of mothers very interested in child's education	33.4	59.3	76.3
Age 16			
% of fathers very interested in child's education	28.4	56.6	79.7
% of mothers very interested in child's education	31.6	58.6	78.3

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Transfer Type 2: Education

	Father's Education		
Variable	Low	Medium	High
% in medium or high education (post-compulsory)	70.0	89.7	97.6

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Transfer Type 3: Cash

	Father's Education		
Variable	Low	Medium	High
Inter-vivos transfers received			
Mean (£)	1,921	7,949	9,575
Received	6%	10%	20%
Mean excluding zeros (£)	30,639	77,909	49,073
Inheritances (1950's birth-cohort)			
Mean (£)	27,394	75,363	115,330
Received	36%	58%	54%
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Data: NCDS Cognitive Skill Measures

Multiple measuress of cognitive skill:

- Age 0: gestation, birth weight
- Age 7: reading score, math score, drawing score, copying a design
- Age 11: reading score, math score, copying a design
- Age 16: reading score, math score

Outcome 1: Cognitive Skills

	Father's Education		
Variable	Low	Medium	High
Age 7			
Math Score	-0.08	0.26	0.54
Reading Score	-0.09	0.33	0.58
Age 11			
Math Score	-0.13	0.48	0.91
Reading Score	-0.13	0.46	0.91
Age 16			
Math Score	-0.14	0.48	0.99
Reading Score	-0.11	0.47	0.77

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    - Richer parents have richer kids–IGE ≈ 0.35 (Blanden et al. (2007), Bolt et al. (2024))

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Model

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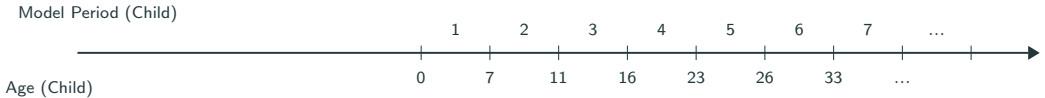
- Timeline
- Preferences
- Choices & Constraints
- Skill and Wages
- Decision Problems
  - Parenthood phase
  - Independence phase
  - Later Life

Model Timeline

Phase

Decisions



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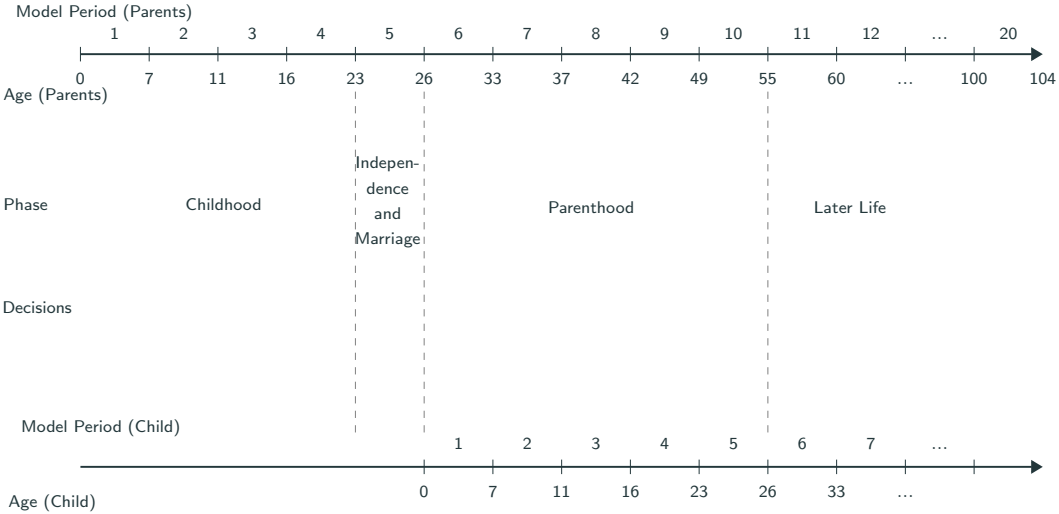

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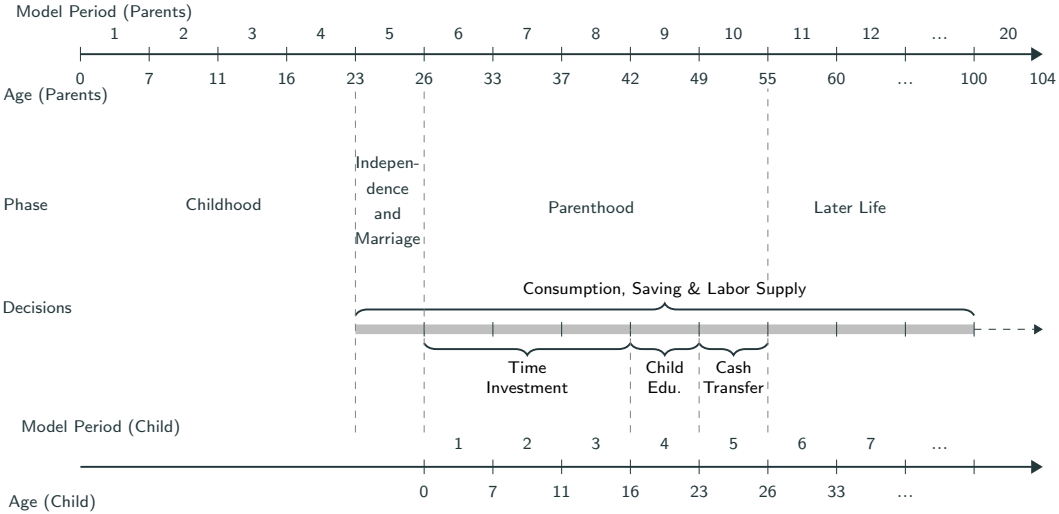

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Preferences

- Utility function for each gender ($g \in \{m, f\}$):

$$u_g(c_g, l_g) = \frac{\left(c_g^{\nu_g} l_g^{(1-\nu_g)}\right)^{1-\gamma}}{1-\gamma}$$

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- Leisure is a function of endowment, work, investment in kids

$$l_g = T - (\theta ti_g + hrs_g)$$

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- HH utility is sum of both utility functions, scaled by (equivalized) household size (n_t):

$$u(c_m, c_f, l_m, l_f, n_t) = n_t \left(u_m(c_m, l_m) + u_f(c_f, l_f) \right)$$

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- Households discount future at rate (β) and lifetime utility of children at rate (λ)

▸ More

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Choices & Constraints

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- Consumption, labor supply and saving:
  1. Consumption of each adult
  2. Hours of work of each adult
  3. Savings in a risk-free asset

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  1. Time investments of each parent
     - Up to age at which their child turns 16
  2. Childrens' years of education
     - In the period the children turn 16
  3. Cash transfer
     - In the period the children turn 23

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Constraints:

- Time budget constraint
  → time investments vs. work trade-off
- Money budget constraint
  → timing of consumption & investments
- Lifecycle borrowing constraint
  → child education, cash transfer to child
- Intergenerational borrowing constraint
  → parents can't saddle their kids with debt

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Skill and Wages

- From birth to age 16, skill evolves:

$$\underbrace{h'_{t+1}}_{\substack{\text{next period}\\ \text{kid skill}}} = g_t\Big(\underbrace{h'_t}_{\substack{\text{kid}\\ \text{skill}}}, \underbrace{inv_t}_{\substack{\text{parental}\\ \text{investment}}}, \underbrace{ed^m}_{\substack{\text{mom's}\\ \text{education}}}, \underbrace{ed^f}_{\substack{\text{dad's}\\ \text{education}}}, \underbrace{u'_{h',t}}_{\substack{\text{skill}\\ \text{shock}}}\Big)$$

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- From 16 wages evolve:

$$\ln w_t = f(\underbrace{t}_{Age}, \underbrace{hrs_t}_{hours}, \underbrace{ed}_{education}, \underbrace{h}_{\substack{\text{final}\\ \text{skill}}}, \underbrace{v_t}_{\substack{\text{earnings}\\ \text{shock}}})$$

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Demographics

- At age 23 individuals matched probabilistically into couples, conditional on education
  - Man with ed_m gets married to a woman with education ed_f with probability $Q_m(ed_m, ed_f)$.

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- At age 23 individuals matched probabilistically into couples, conditional on education
  - Man with ed_m gets married to a woman with education ed_f with probability $Q_m(ed_m, ed_f)$.
- At age 26, a pair of identical twins is born to the couple.
  - Assume that the twins are faced with identical sequences of shocks (Abbott et al. 2019)

Model

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  - Parenthood phase ▸ More
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Data

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- Main data is from the National Child Development Study
  - Population ($\approx$ 17,000) born in a one week in Britain in 1958
  - Followed at ages 0, 7, 11, 16, 23, 26, 33, 37, 42, 49, 55, (62)
  - Data on:
    - Production Function Inputs: Parental characteristics, investments
    - Outcomes: Child/adolescent skill
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- We supplement the NCDS this with:
  - English Longitudinal Study of Ageing – wealth late in life and money transfers moments
  - UK Time Use Surveys – moments of time (by parent and age of child)

Estimation and Identification

Estimation Approach

Part 1) Technology which relates investments during childhood to earnings over the lifecycle

a) Child skill production function, estimated accounting for

... measurement error in skills and investment, e.g., Agostinelli & Wiswall (2025) ▸ More

b) Wages as a function of ultimate skill and education, estimated accounting for

... selection and measurement error in skills and wages ▸ Details

Part 2) Estimate preference parameters using method of simulated moments

- β: discount factor (wealth)
- ν_f, ν_m: consumption weights (labor supply)
- γ: risk aversion (labor supply, time investments versus money transfers)
- λ: altruism parameter (time investments, cash transfers, education)
- $\kappa_{j,t}$: anchoring of latent investment to time (gradient of skill outcomes wrt education)
- θ: share of time with kids which is work (time investments)

Estimation Approach

Part 1) Technology which relates investments during childhood to earnings over the lifecycle

a) Child skill production function

... accounting for measurement error in skills and investment e.g., Agostinelli & Wiswall (2025)

b) Wages as a function of ultimate skill, education

... accounting for selection and measurement error in skills and wage

Part 2) Estimation using method of simulated moments (most relevant moment). Key parameters:

- β: discount factor (wealth)
- ν_f, ν_m: consumption weights (labor supply)
- γ: risk aversion (labor supply, educational investments vs. money transfers)
- λ: altruism parameter (cash transfers, education)
- $\kappa_{j,t}$: anchoring of latent investment to time (final skills)
- θ: share of time with kids which is work (time investments)

▸ Moments Used ▸ Identifcation κ and θ

Results

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1. Production function and earnings equation
2. Parameter estimates
3. Returns to time investments
4. Relaxing intergenerational borrowing constraints

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Skill Production Function Estimates

$$\underbrace{\ln h'_{t+1}}_{\text{next period kid skill}} = \gamma_{1,t} \underbrace{\ln h'_t}_{\text{kid skill}} + \gamma_{2,t} \underbrace{\ln inv_t}_{\text{parental investment}} + \gamma_{3,t} \underbrace{\ln inv_t \cdot \ln h'_t}_{\text{interaction}} + \gamma_{4,t} \underbrace{ed^m}_{\text{mom's education}} + \gamma_{5,t} \underbrace{ed^f}_{\text{dad's education}} + \underbrace{u'_{h',t}}_{\text{skill shock}}$$

	Age 7	Age 11	Age 16
skill_{t-1}	**0.154**	**0.739**	**0.939**
	[0.057;0.521]	[0.696;0.834]	[0.918;0.993]
investment_{t-1}	**0.146**	**0.097**	**0.131**
	[0.113;0.171]	[0.079;0.116]	[0.093;0.161]
skill_{t-1} x inv_{t-1}	-0.021	**0.040**	**-0.038**
	[-0.067;0.01]	[0.0027;0.068]	[-0.066;-0.009]

Bootstrapped confidence intervals. **Bold** values significant at 10 % level

▸ Full Estimates

Complementarity Between Education and Skill

$$\ln w_t = f(t, hrs_t) + \delta \ln h + v_t$$

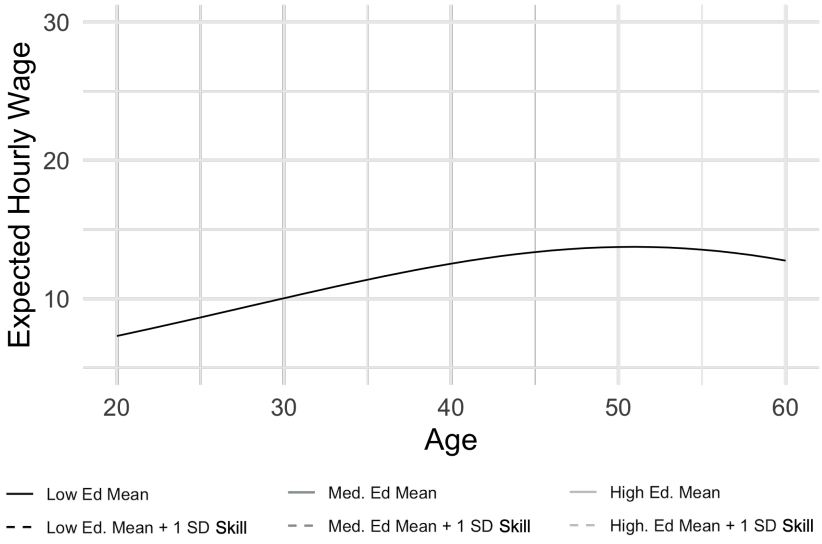
δ: log-point change in wages for a 1 standard deviation increase in log-skill:

	Male	Female
Low	0.084 (0.025)	0.078 (0.024)
Middle	0.167 (0.019)	0.103 (0.018)
High	0.205 (0.027)	0.127 (0.027)

- Quantitatively important wage complementarity between between skill and education

▸ Picture

Wage and Skill: Men



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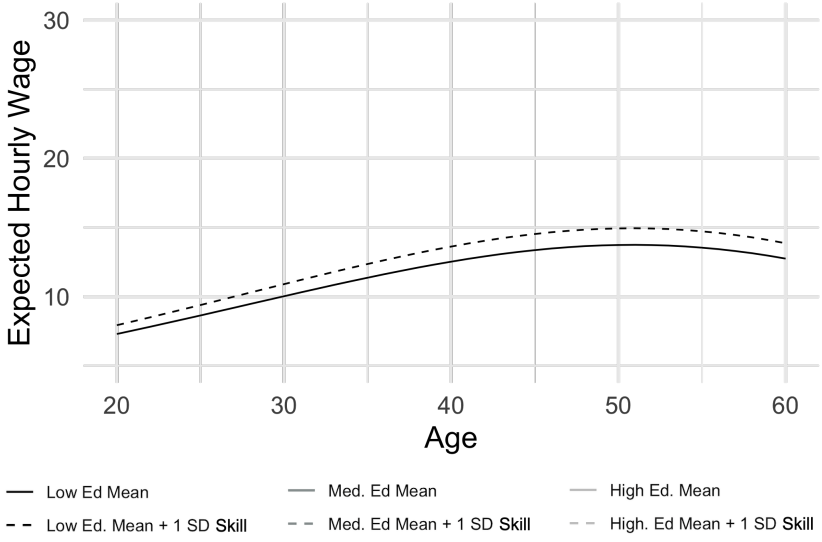

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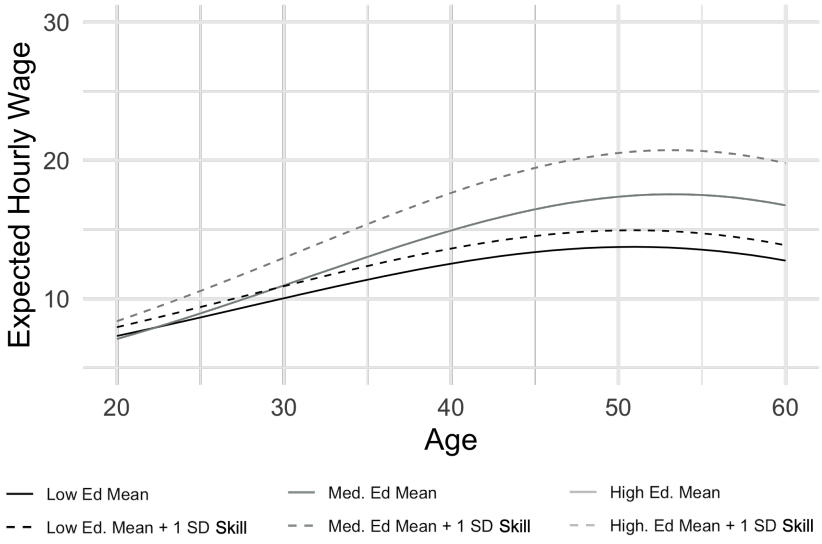

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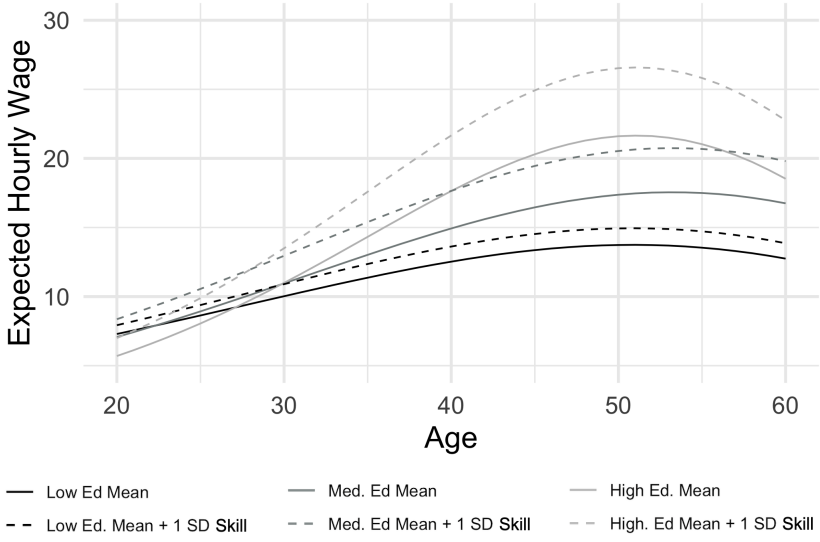
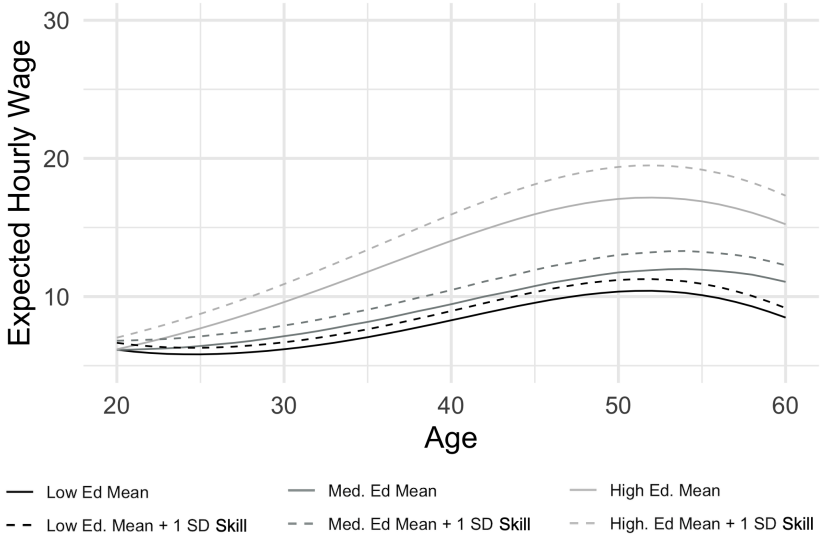


Wage and Skill: Women



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Estimated Parameters

Parameter	Estimate
β: discount factor	0.992
ν_f: consumption weight, female	0.463
ν_m: consumption weight, male	0.477
γ: risk aversion	4.13
2λ: altruism parameter	0.532
θ: time cost of investment	0.401

- $2\lambda \approx 0.5 \Rightarrow$ Parents are partially altruistic
- $\theta \approx 0.4 \Rightarrow$ investing in your kids is not all work...

▸ Model Fit ▸ Sensitivity to Theta

Results

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Returns to Time Investments

$$
\begin{aligned}
\ln inv_t &= \kappa_{0,t} + \kappa_{1,t} \ln(ti_{m,t} + ti_{f,t}) \\
\ln h'_{t+1} &= \gamma_{1,t} \ln h'_t + \gamma_{2,t} \ln inv_t + \dots \\
\ln w_t &= f(t, hrs_t) + \delta \ln h + \dots
\end{aligned}
$$

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\end{aligned}
$$

- In the model, holding other choices fixed, give extra hour a week for first seven years of life:
  - $\Rightarrow$ Δ 364 hours parental investment
  - $\Rightarrow$ Δ £2,880 kids lifetime earnings on average
  - $\Rightarrow$ 2,880/364 $\approx$ Δ £7.90 extra lifetime earnings per hour investment

Returns to Time Investments

	Lifetime wage	Per hour
Mean Increase:	£2,880	**£7.90**
... *among those who obtain low education*		
... *among those who obtain medium education*		
... *among those who obtain high education*		
... *among children of low education fathers*		
... *among children of medium education fathers*		
... *among children of high education*		

- Returns to *parental* time investing in children largely below the market wage
  - ... contrasts with Heckman et al., 2010 that returns to *professional* time above market return

Returns to Time Investments

	Lifetime wage	Per hour
Mean Increase:	£2,880	£7.90
... *among those who obtain low education*	£1,340	£3.70
... *among those who obtain medium education*	£2,600	£7.10
... *among those who obtain high education*	£4,020	£11.00
... *among children of low education fathers*		
... *among children of medium education fathers*		
... *among children of high education*		

- Returns to *parental* time investing in children largely below the market wage
  - ... contrasts with Heckman et al., 2010 that returns to *professional* time above market return
- Substantial heterogeneity

Returns to Time Investments

	Lifetime wage	Per hour
Mean Increase:	£2,880	£7.90
... *among those who obtain low education*	£1,340	£3.70
... *among those who obtain medium education*	£2,600	£7.10
... *among those who obtain high education*	£4,020	£11.00
... *among children of low education fathers*	£1,730	£4.80
... *among children of medium education fathers*	£3,130	£8.60
... *among children of high education*	£4,010	£11.00

- Returns to *parental* time investing in children largely below the market wage
  - ... contrasts with Heckman et al., 2010 that returns to *professional* time above market return
- Substantial heterogeneity which contributes to intergenerational persistence of outcomes

Results

1. Production function and earnings equation
2. Parameter estimates
3. Returns to time investments
4. Relaxing intergenerational borrowing constraints

Relaxing Intergenerational Borrowing Constraints

- Intergenerational borrowing constraints are a key inefficiency in our model
  - ... Intergenerational financial transfers often central to student financing

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Study introduction of student loans allowing parents to borrow against children's future income:

1. Only if their children go to college
2. Up to a cap that prevents borrowing more than cost of college

Relaxing Intergenerational Borrowing Constraints

Outcome	Baseline	Student Loans
Lifetime wage of children	454,000	463,000
Age left education	18.8	19.5
Intergen. correlation education	0.30	0.25
Intergen. elasticity earnings	0.50	0.43
Change in utility of children		
. . . high educated in baseline		
. . . not high educated in baseline		
. . . of low-ed father		
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. . . of high-ed father		

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Change in utility of children		-£2,000
... *high educated in baseline*		-£31,000
... *not high educated in baseline*		£34,000
... *of low-ed father*		£1,800
... *of medium-ed father*		-£800
... *of high-ed father*		-£13,200

Relaxing Intergenerational Borrowing Constraints

Outcome	Baseline	Student Loans	Targeted SL
Lifetime wage of children	454,000	463,000	467,000
Age left education	18.8	19.5	19.2
Intergen. correlation education	0.30	0.25	0.34
Intergen. elasticity earnings	0.50	0.43	0.49
Change in utility of children		-£2,000	£1,300
... *high educated in baseline*		-£31,000	-£18,700
... *not high educated in baseline*		£34,000	£21,800
... *of low-ed father*		£1,800	£5,000
... *of medium-ed father*		-£800	£2,300
... *of high-ed father*		-£13,200	-£9,200

Targeted Student Loans: available only to students in the top 1/2 of the skill distribution

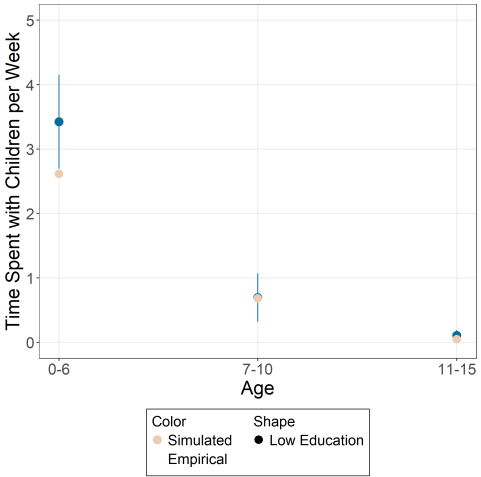
Conclusion

Conclusion

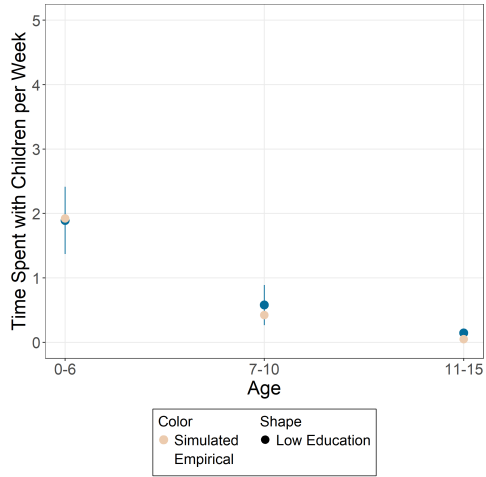
- Technology of human capital:
  - Substantial complementarity in earnings production between realized skills and education
- Preferences over parental investment (to match observed investments):
  - Parents' consider time 'investing' their children to be intermediate between work and leisure
- Role of relaxing intergenerational borrowing constraints
  - Introduction of students loans reduces intergenerational persistence in outcomes
  - Biggest winners: higher skill kids of low educated parents but on average children worse off
  - Targeted loans improves welfare of children but increases intergenerational persistence

Additional Slides

Model fit: Time



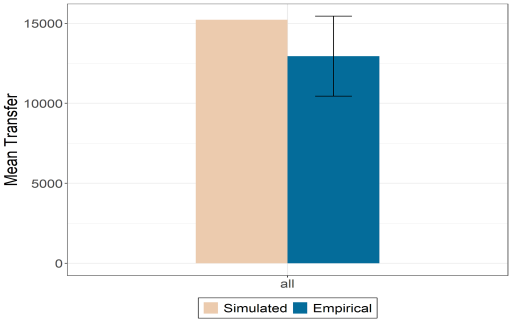
(a) Mother's Time with Kids



(b) Father's Time with Kids

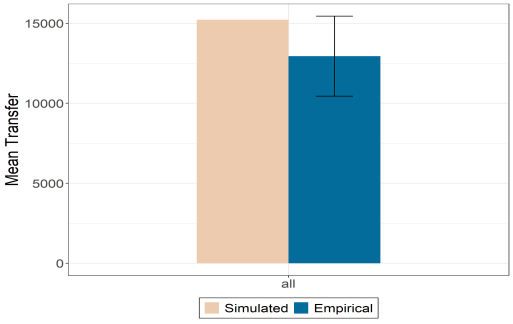
Back

Model Fit: Cash Transfers and Education

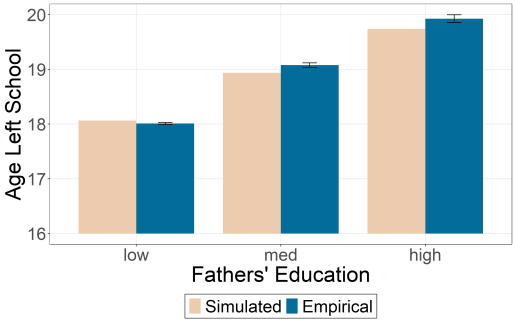


(a) Money Transfers

Model Fit: Cash Transfers and Education



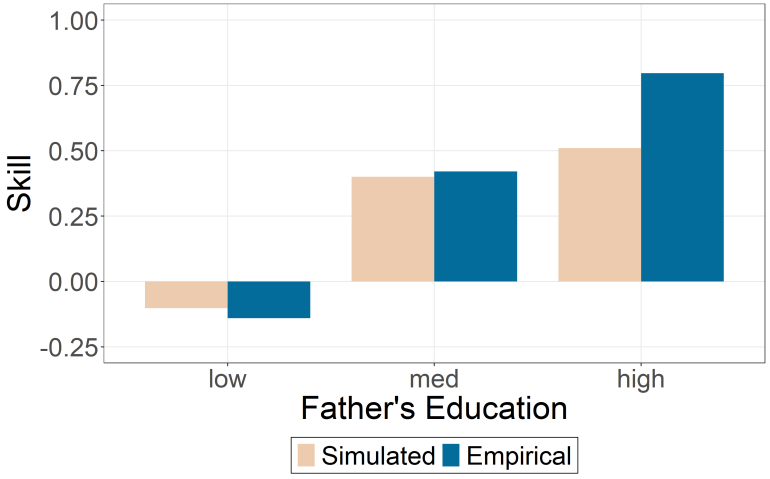
(a) Money Transfers



(b) Education choices by father's education

Back

Model Fit: Cognitive Skill



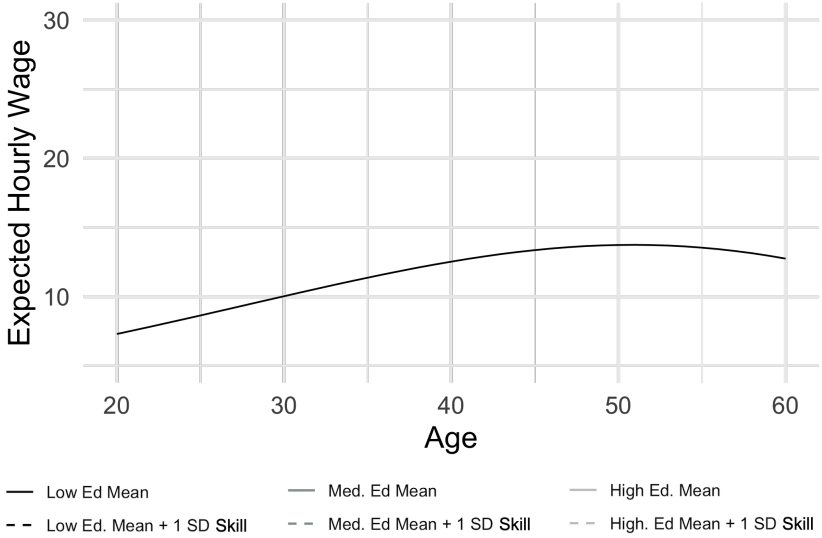
Back

Sensitivity to utility of time investment

Outcome	Baseline $\theta = 0.41$	Experiment $\theta = 1.00$
Lifetime wage	454,000	416,000
Age Left Education	18.8	19.0
Fraction high educated	51%	57%
Transfers	£15,200	£16,700
Skill at 16	0.28	-0.43
Intergenerational Correlation Education	0.30	0.27
Intergenerational Elasticity of Earnings	0.50	0.40
Intergenerational Elasticity of Wealth	0.27	0.21

Back

Men: Complementarity between education and skill



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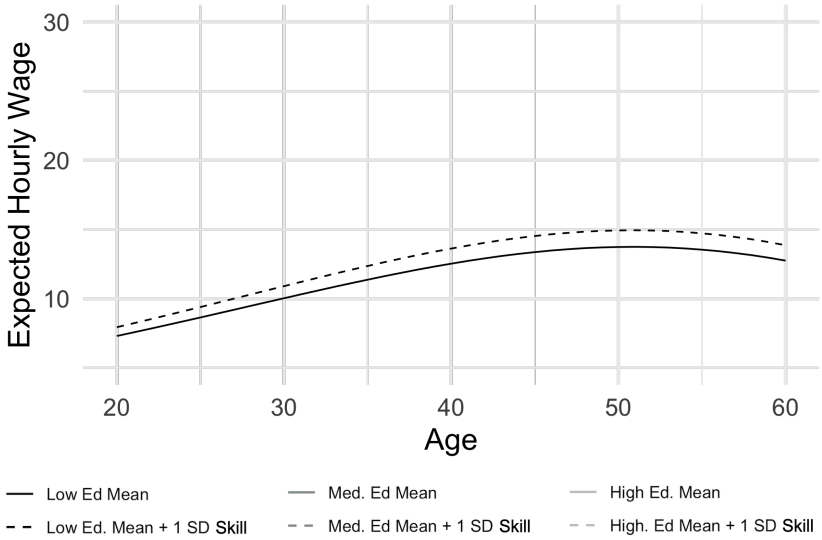

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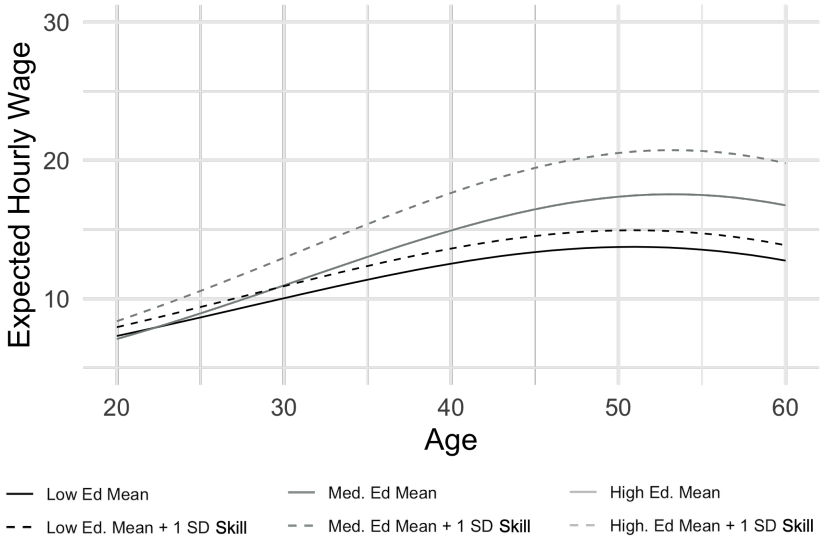

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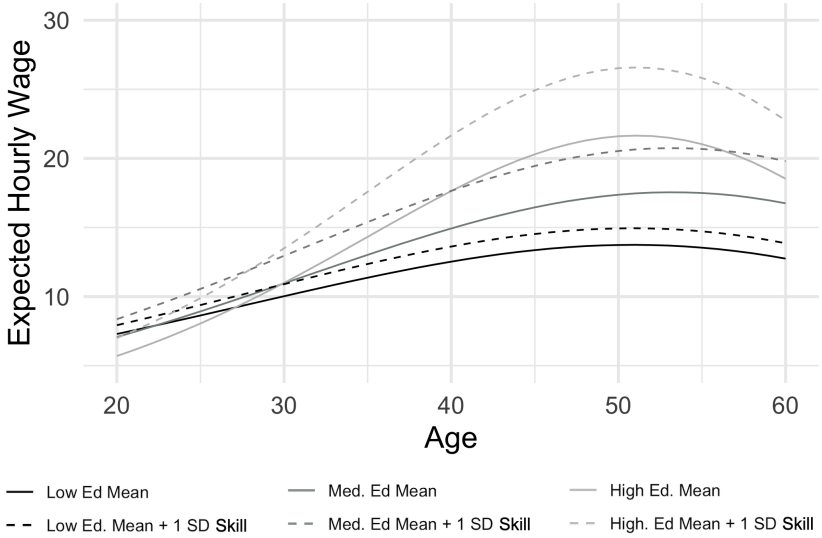
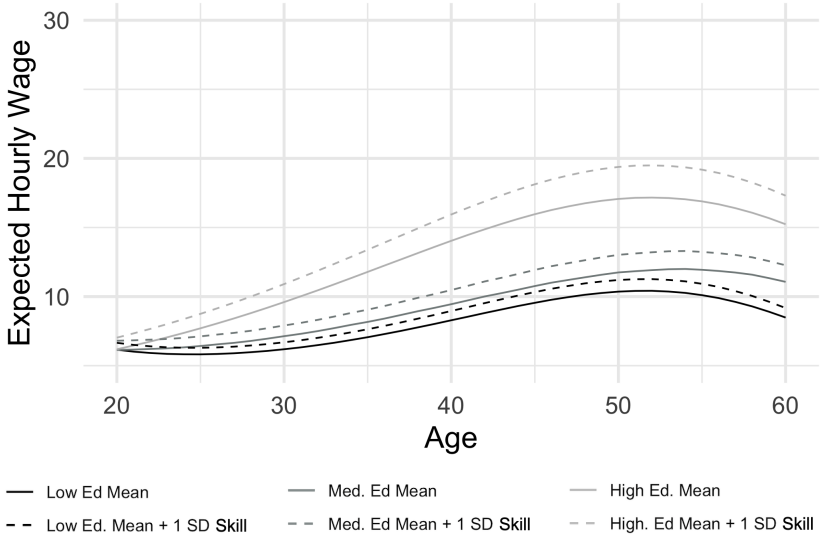


Women: Complementarity between education and skill



Moments used in estimation

1. Employment rates, by age, gender, and education (NCDS)
2. Fraction in FT work conditional on being employed, by age, gender and education, (NCDS)
3. Mean time spent with children, by child's age and parent's gender (UKTUS)
4. Mean skill at age 16 by father's education
5. Mean age at which individuals left fulltime education by fathers' education level (NCDS)
6. Mean lifetime inter-vivos transfers (ELSA)
7. Median wealth at 60 (ELSA)

Back

Measurement system

- We do not directly observe skill (h) and investment (inv)

Measurement system

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- We observe multiple noisy measures for each $\omega \in \{\ln h, \ln inv\}$

$$Z_{\omega,t,m} = \mu_{\omega,t,m} + \lambda_{\omega,t,m}\, \omega_t + \epsilon_{\omega,t,m}$$

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- Estimate measurement system (Cunha et al. (2010), Attanasio et al. (2020), Agostinelli & Wiswall (2020))
- Key idea: use measures $Z_{\omega,t,m}$ as instruments for other measure $Z_{\omega,t,m'}$

Back Signal Noise

Signal to noise ratios: Skill

$$Z_{ab,t,m} = \mu_{ab,t,m} + \lambda_{ab,t,m} ab_t + \epsilon_{ab,t,m}$$

$$s_{ab,t,m} = \frac{(\lambda^2_{ab,t,m}) Var(ab_t)}{(\lambda^2_{ab,t,m}) Var(ab_t) + Var(\epsilon_{ab,t,m})}$$

Age 0		*Age 7*		*Age 11*		*Age 16*	
Birthweight	0.862	Read	0.385	Read	0.555	Read	0.570
Gestation	0.140	Math	0.335	Maths	0.942	Math	0.713
		Copy	0.259	Copy	0.104		
		Draw	0.281				

Back

1b) Estimating the Wage Process with Noisy Skill Measures

- Allow wages to be measurement with error (u_t):

$$\ln w_{t,observed} = f_{ed}(t, hrs_t) + \delta_{ed} \ln h + v_t + u_t$$

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- Rewrite wage equation using observed wages and skill measures:

$$\ln w_{t,obs,m} = f_{ed}(t, hrs_t) + \delta_{ed}\left(\frac{Z_{h,m} - \mu_{h,m}}{\lambda_{h,m}}\right) + v_t + u_t - \delta_{ed}\frac{\epsilon_{h,m}}{\lambda_{hh,m}}$$

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- Use $Z_{h,m'}$ as instruments for $Z_{h,m}$ + GMM to estimate δ_{ed}
- Account for selection using approach in French (2005)

Back

Identification of κ

- Investment in production function measured in units of latent investment
- Investment in the model is measured in units of time
- To generate a mapping between these measures we assume:

$$inv_t = \kappa_{0,t} + \kappa_{1,t} \ln(ti_{m,t} + ti_{f,t})$$

- To identify the parameter of the mapping:
  - The higher is κ_1, the higher greater will be the cross-sectional dispersion of final skill (and we match final skill by parental education)
  - Mean time investments identifies κ_0

Decision Problem in Parenthood Phase

$$V_t(\mathbf{X}_t) = \max_{c_{m,t}, c_{f,t}, hrs_{m,t}, hrs_{f,t}, ti_{m,t}, ti_{f,t}, ed'_g} \left\{ u(c_{m,t}, c_{f,t}, l_{m,t}, l_{f,t}, n_t) + \beta_{t+1} \mathbb{E}\left[V_{t+1}(\mathbf{X}_{t+1}) \right] \right\}$$

subject to time and budget constraints More

- $\mathbf{X}_t = \{t, a, w_m, w_f, ed_m, ed_f, g', h'\}$ are states:
- expectation operator is wage innovations the initial skill of the child
- $\beta_{t+1} = \beta^{(\#\text{of years between periods})}$

Back

Constraints

1. Intratemporal time constraint for each parent

   Endowment (T) for leisure (l), time with kids ($t(inv)$) and work (hrs)

$$T = l_{g,t} + t(inv_{g,t}) + hrs_{g,t}$$

2. Inter-temporal budget constraint for the household:

$$a_{t+1} = (1 + r_t)(a_t + y_t - c_t - x_t)$$

3. lifecycle borrowing constrinat for the household: $a_{t+1} \geq 0$
4. Intergenerational budget constraint for the household: $x_t \geq 0$

Back

Decision Problem as Kids are in Independence Phase

$$V_t(\mathbf{X}_t) = \max_{c_{m,t}, c_{f,t}, hrs_{m,t}, hrs_{f,t}, x_t} \Big\{ u(c_{m,t}, c_{f,t}, l_{m,t}, l_{f,t}, n_t) + \underbrace{2\lambda \mathbb{E}[V'_{t'}(\mathbf{X}'_{t'})]}_{\text{children's continuation value}} + \underbrace{\beta_{t+1} \mathbb{E}[V_{t+1}(\mathbf{X}_{t+1})]}_{\text{parent's continuation value}} \Big\}$$

subject to:

1. time and money budget constraints
2. lifecycle and intergenerational borrowing constraints More

- $\mathbf{X}_t = \{t, a, w_m, w_f, ed_m, ed_f, g', h', ed'\}$:
- First expectation operator over child's initial wage and their future spouse's attributes
- Second expectation operator over parents' wage draws Back

Decision Problem In Later Life

$$V_t(\mathbf{X}_t) = \max_{c_{m,t}, c_{f,t}, hrs_{m,t}, hrs_{f,t}} \Big\{ u(c_{m,t}, c_{f,t}, l_{m,t}, l_{f,t}) + \beta_{t+1} s_{t+1} \mathbb{E}[V_{t+1}(\mathbf{X}_{t+1})] \Big\}$$

- where s_{t+1} is probability of survival to $t+1$

Subject to time and budget constraints More

Back

Consumption choice

- For any household consumption choice we use an equivalence scale to allocate consumption to children (c_k) and adults (c_a)
  - $c_k = \frac{n_t - 1}{n_t}$ where n_t is the equivalent household size scaled such that for a childless couple $n_t = 1$
- Remaining consumption is allocated efficiently between spouses
  - i.e. conditional on labour choices, and for consumption:

$$\begin{aligned} \{c_m, c_f\} \quad &\in \quad \arg\max \left(u_m(c_m, l_m) + u_f(c_f, l_f) \right) \\ s.t. \quad & c_m + c_f = c_a \end{aligned}$$

- Utility function for each adult: $u_g(c_{g,t}, l_{g,t}) = \frac{(c_{g,t}^{\nu_g} l_{g,t}^{(1-\nu_g)})^{1-\gamma}}{1-\gamma}$

Back: Preferences Back: Choices

Productivity of Investments

	Age 7	Age 11	Age 16
Lagged Skill	0.154 [0.057, 0.251]	0.739 [0.696, 0.834]	0.939 [0.918, 0.993]
Investment	0.146 [0.113, 0.171]	0.097 [0.079, 0.116]	0.131 [0.093, 0.161]
Lagged Skill $\times$ Investment	-0.021 [-0.067, 0.010]	0.040 [0.027, 0.068]	-0.038 [-0.066, -0.009]
Mum: Medium Education	0.448 [0.347, 0.552]	0.181 [0.109, 0.235]	0.027 [-0.026, 0.075]
Mum: High Education	0.593 [0.388, 0.776]	0.414 [0.292, 0.571]	-0.088 [-0.242, 0.055]
Dad: Medium Education	0.472 [0.252, 0.611]	0.262 [0.179, 0.321]	0.056 [0.002, 0.115]
Dad: High Education	0.401 [0.313, 0.495]	0.460 [0.290, 0.548]	0.107 [0.010, 0.218]
Skill shock: $Var(u'_{h,t'})$	0.031	0.067	0.026

Back

1b) Estimating the Wage Process with Noisy Skill Measures

Wage Process:

$$\ln w_t = f_{g,ed}(t, hrs_t) + \delta_{g,ed} \ln h + v_t$$

with:

- $f(t, hrs_t)$: age polynomial, part-time dummy, v_t permanent shock
- $\delta_{g,ed}$: returns to age 16 skill ($\ln h$) for gender g and education ed
- Coefficients and shock variances differ by gender and education group
- Estimate accounting for measurement error in skills and wages plus selection Details

Back

1a) Estimating Production Function with Noisy Measures

Skill production function:

$$\underbrace{\ln h'_{t+1}}_{\substack{\text{next period}\\ \text{kid skill}}} = \gamma_{1,t}\underbrace{\ln h'_t}_{\substack{\text{kid}\\ \text{skill}}} + \gamma_{2,t}\underbrace{\ln inv_t}_{\substack{\text{parental}\\ \text{investment}}} + \gamma_{3,t}\underbrace{\ln inv_t \cdot \ln h'_t}_{\text{interaction}}$$

$$+\gamma_{4,t}\underbrace{ed^m}_{\substack{\text{mom's}\\ \text{education}}} + \gamma_{5,t}\underbrace{ed^f}_{\substack{\text{dad's}\\ \text{education}}} + \underbrace{u'_{h',t}}_{\substack{\text{skill}\\ \text{shock}}}$$

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- Estimation similar to Agostinelli & Wiswall (2025)
  - ... using multiple skill and investment measures to correct for measurement error Details
- Production function in units of latent investment, model investment units of time Back

$$\ln inv_t = \kappa_{0,t} + \kappa_{1,t}\ln(ti_{m,t} + ti_{f,t})$$

identification of κ

- Mapping from units of time to the production function's units of latent investment

$$\ln inv_t = \kappa_{0,t} + \kappa_{1,t} \ln(ti_{m,t} + ti_{f,t})$$

- Identification of κ_0: matching mean latent investments to mean time investments
- Identification of κ_1: matching final skill distribution given dispersion in time investments

  ... if too large (small) final skill explodes (collapses)

Identification of θ

$$u(c, l) = \frac{(c^{\nu} l^{(1-\nu)})^{1-\gamma}}{1-\gamma}$$

$$l = T - (\theta ti + hrs)$$

- We prove identification of θ in a simplified two-period deterministic model in which:
  - There are two transfers (time and money)
  - The production function is linear
  - Labor supply is continuous

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  - There are two transfers (time and money)
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$\Rightarrow$ Parents will invest time to point that cost (θw) is equal to the return (in human capital)

- With knowledge of the production function this allows identification of θ

Back