Parental Occupational Choice and Child Development

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Motivation

- Early childhood investments yield high and persistent returns. (Heckman, 2006)
  - Parental time and financial resources are central to child skill formation.

    (e.g., Cunha & Heckman, 2007; Del Boca, Flinn, & Wiswall, 2014; Gayle, Golan, & Soytas, 2015)

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  - Evidence on maternal employment effects is mixed.

    (e.g. Hsin & Felfe, 2014; Agostinelli & Sorrenti, 2021)
  - Paternal time investments are positively associated with child outcomes.

    (e.g. Cano, Perales, & Baxter, 2019)
  - Occupations differ in their time vs money trade-offs.
  - Self-employment may offer greater flexibility but lower income.
  - These trade-offs differ by gender. (e.g. Hamilton, 2000; Boden Jr, 1996)

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  - Occupations differ in their time vs money trade-offs.
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  - These trade-offs differ by gender. (e.g. Hamilton, 2000; Boden Jr, 1996)
- How do the returns to early childhood investments vary across occupations?

This Paper

Research Question

How do parental occupational choices shape early childhood development outcomes?

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How do parental occupational choices shape early childhood development outcomes?

- Examine the time vs money trade-off by parental occupations
- Document parental occupational transitions and time allocations
- Address endogeneity and selection through a dynamic discrete choice model with
  - Occupational choice and time allocations
  - Child production functions
  - Latent wife's human capital
- Conduct counterfactual analyses on child subsidy, business transfers, and tax systems.

Related Literature

1. Parental investments and child outcomes
   - Behrman, Pollak & Taubman, 1982; Becker & Tomes, 1986; Todd & Wolpin, 2003; Cunha & Heckman, 2007; Fiorini & Keane, 2014; Del Boca, Flinn, & Wiswall, 2014; Del Bono et al., 2016; Gayle, Golan & Soytas, 2022, García-Vazquez, 2025...

     $\Rightarrow$ Provide evidence on parental behaviors by occupations.

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2. Job Flexibility
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     $\Rightarrow$ Model self-employment as a flexible margin and study women's life-cycle decisions

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3. Self-employment
   - Individual: Taylor, 1996; Marlow, 1997; Hamilton, 2000; Lombard, 2001; Mattis, 2004; Budig, 2006; Rutigliano, 2024; Bonney et al., 2025; Ferrando et al., 2025 ...
   - Household: Bernhardt, 1994; Blanchflower & Oswald, 1998; Devine, 2001; Bryan & Sevilla, 2017...

     $\Rightarrow$ Examine household self-employment and differences by gender

Roadmap

1. Data and Empirical Facts
2. Model
3. Conclusion and Next Steps

Data: UK

1. British Household Panel Study (BHPS)
   - Nationally representative annual household panel (cf. PSID) from 1991 - 2008
   - Sample: Stable couples with wives aged 21–51; $\sim$ 4,200 households.
2. Millennium Cohort Study (MCS)
   - $\sim$ 1,200 children/households.
   - Cognitive skills: Denver developmental screening test (9 months) and British Ability Scales verbal subtests (ages 3–7) Questions
   - Non-cognitive skills: Carey infant temperament scale (9 months) and Strengths and Difficulties Questionnaire (SDQ) – total difficulties score (ages 3–7) Questions

Empirical Facts

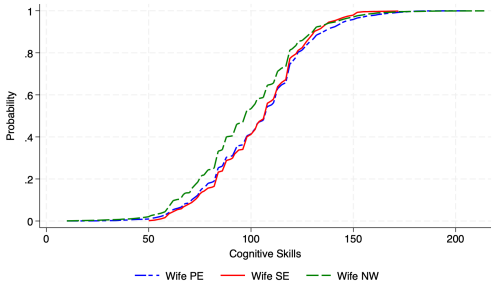
1. Child development outcomes vary by parental occupations.
2. Wives exit the labor force upon childbirth, whereas husbands do not.

   (Kleven et al., 2019)
3. Conditional on working, wives enter self-employment after child birth.

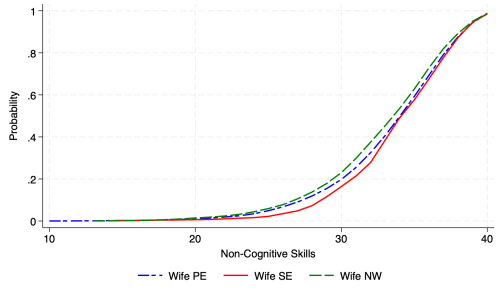
   (Berniell et al., 2021, Ferrando et al., 2025)
4. With a young child, wives increase home production and decrease hours worked.

   (Flores, Gayle, Hincapié, 2025)
5. The money trade-off varies by occupation and gender.

Fact 1: Child's skills vary by maternal occupations

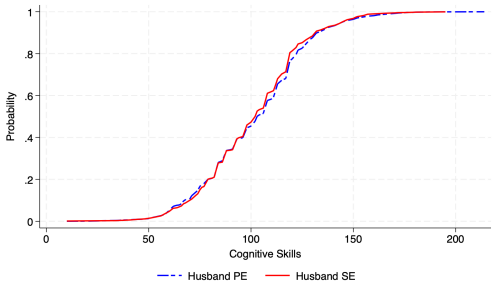


(a) Cognitive Skills

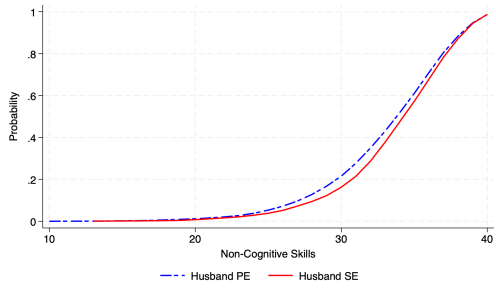


(b) Non-Cognitive Skills

Fact 1: Child's skills vary by paternal occupations.



(a) Cognitive Skills



(b) Non-Cognitive Skills

Regression

Fact 2: Wives exit the labor force after childbirth; Husbands do not.

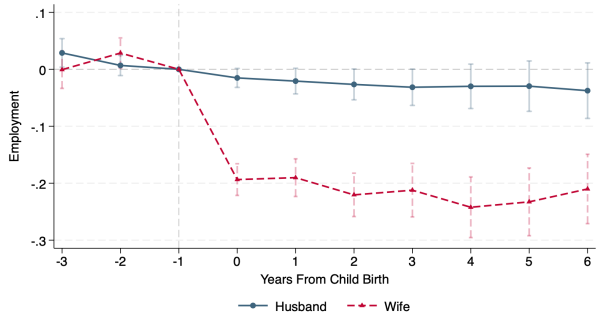
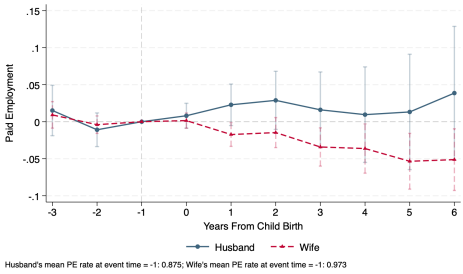
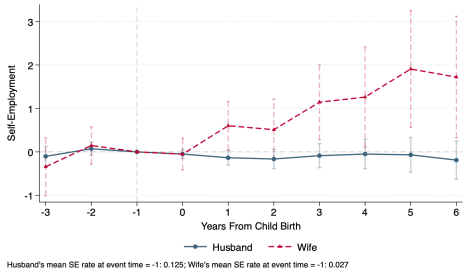


Figure: Child Effect on Employment

Fact 3: Working wives enter self-employment after childbirth.



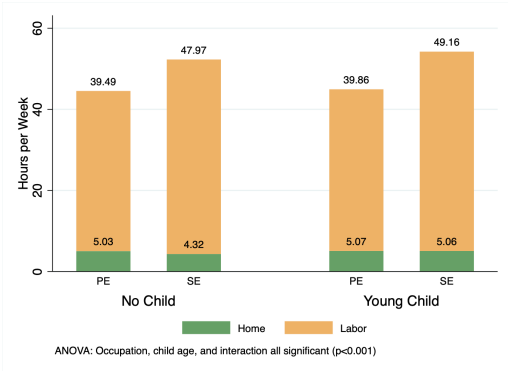
(a) Paid Employment Part-time



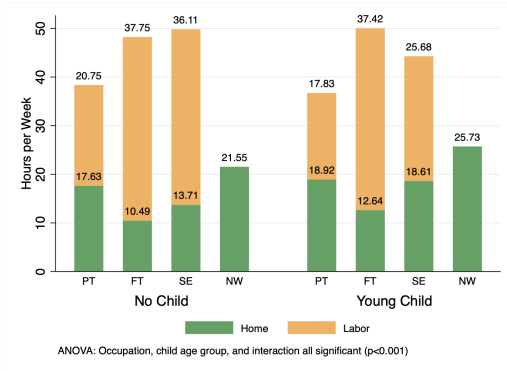
(b) Self-Employment

$\Rightarrow$ Self-Employment probability increases for women after child birth.

Fact 4: With a young child, wives ↑ home production and ↓ hours worked.



(a) Husband



(b) Wife

⇒ Especially for self-employed wives; Again, husbands' behaviors do not change.

Fact 5: Monetary trade-off varies by occupation and gender

ES - Husband ES - Wife

	Weekly Income		Hours Worked		Hourly Wage	
Occupation	NChild	YChild	NChild	YChild	NChild	YChild
Husband						
PE	423.6	479.4	39.5	39.9	10.9	12.2
	(230.0)	(325.1)	(6.6)	(7.0)	(6.1)	(8.5)
SE	339.6	387.4	48.0	49.2	8.1	9.0
	(391.4)	(390.9)	(15.2)	(14.7)	(13.9)	(14.3)
Wife						
PE / PT	153.8	148.6	20.7	17.8	7.6	8.2
	(125.6)	(107.1)	(6.6)	(6.6)	(12.5)	(5.8)
PE / FT	326.7	350.7	37.8	37.4	8.7	9.4
	(166.5)	(159.4)	(3.9)	(3.7)	(4.4)	(4.3)
SE	236.7	164.7	36.1	25.7	8.0	10.3
	(329.4)	(220.0)	(18.2)	(16.7)	(12.7)	(27.7)

Summary: Time vs Money Tradeoff

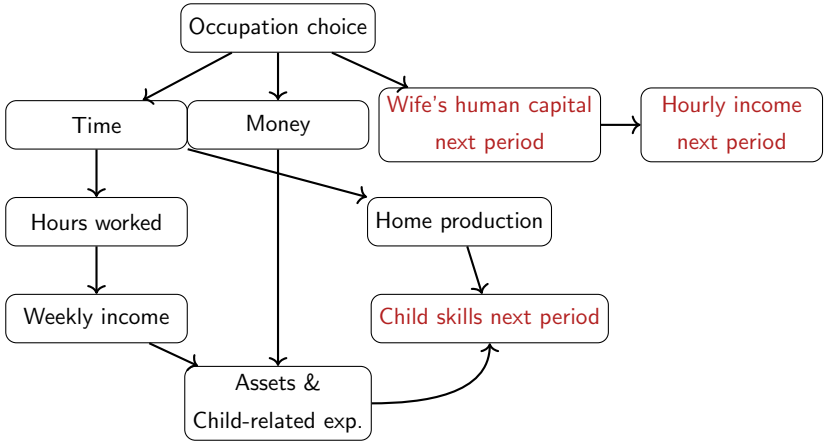
	Earnings	Hours Worked	Home Production
Husband			
SE vs PE	↓	↑	↓
Wife			
SE vs PE/PT	↑	↑	↓
SE vs PE/FT	↓	?	↑
SE vs NW	↑	↑	↓

Model Overview

- Unitary household model with husband ($i = h$) and wife ($i = w$), $\sim$ wife's age 51
- Childbirth is exogenous (21 - 45) and child is a public good.
- Couples care about child's cognitive and non-cognitive skills

  $\theta_{D,g_t}, D \in \{k, s\},\ g_t \in \{1, 3, 5, 7+\}$
- Forward-looking couples making decisions on:
  - Occupation: $q \in \{1, 6\}$
    - Husband: {PE, SE}
    - Wife: {PE, SE, NW}
  - Time: hours worked n_t^i, home production τ_t^i
  - Money: assets a_{t+1}, child-related expenditure M_t

Decision Problem and Dynamics



Flow Utility

- Conditional on occupation q, the flow utility is:

$$\mathcal{U}_t = \underbrace{logC_t}_{\text{consumption}} + \underbrace{\alpha_Q logQ_t}_{\text{household home production}} + \underbrace{[\alpha_l^w + \alpha_{yc}^w \mathbb{1}[ychild_t = 1]] \cdot logl_t^w + \alpha_l^h logl_t^h}_{\text{couple's leisure}}$$
$$+ \underbrace{\alpha_k log\theta_{k,t}}_{\text{child's cognitive skills}} + \underbrace{\alpha_s log\theta_{s,t}}_{\text{child's non-cognitive skills}} \quad (1)$$
$$+ \underbrace{\sum_{j=1}^{2}[\alpha_{j,1}^w + \alpha_{j,2}^w logl_t^w] \cdot d_{j,t}^w}_{\text{(dis)utility from occupation, leisure tradeoff for wife}} + \underbrace{[\alpha_{2,1}^h + \alpha_{2,2}^h \mathbb{1}[ychild_t = 1]] \cdot d_{2,t}^h}_{\text{(dis)utility for SE for husband}} + \underbrace{\xi_t}_{\text{preference shocks}}$$

- The terminal value is:

$$\mathbb{E}V_{T+1} = \psi_h loghc_{T+1}^w \quad (2)$$

Household Constraints

1. Budget constraint:

$$C_t + \underbrace{M_t}_{\text{child-related expenditure}} + a_{t+1} = (1+r)\cdot a_t + \underbrace{\mathcal{T}(Y_t^m, Y_t^f, \mathbf{x}_t)}_{\text{tax-and-transfer system}} \tag{3}$$

   with a borrowing constraint $a_{t+1} \geq \underline{a}$. Fortax

2. Each couple faces the time constraint:

$$\underbrace{l_t^i}_{\text{leisure}} + \underbrace{n_t^i}_{\text{work}} + \underbrace{\tau_t^i}_{\text{home production}} = \bar{T} \tag{4}$$

3. Couples allocate home production time to nonmarketable public goods:

$$Q = (\tau^w)^{\alpha_Q^w} (\tau^h)^{1-\alpha_Q^w} \tag{5}$$

Income Process

- Weekly income is hourly income times hours worked:

$$Y^i_{j,t} = y^i_{j,t} \cdot n^i_{j,t}, \quad i \in \{w, h\},\ j \in \{1, 2\} \tag{6}$$

- Husband's hourly income depends on education (θ^h) and his age:

$$logy^h_{j,t} = \phi^h_{j,0} + \phi^h_{j,1}\theta^h_p + \phi^h_{j,2}t + \phi^h_{j,3}t^2 + \varepsilon^h_{j,t} \tag{7}$$

- Wife's hourly income depends on education (θ^w) and human capital (hc^w_t): HC

$$logy^w_{j,t} = \phi^w_{j,0} + \phi^w_{j,1} \cdot \theta^w_p + \phi^w_{j,2} loghc^w_t + \varepsilon^w_{j,t} \tag{8}$$

- Couples' income shock come from a joint normal for assortative matching.

Child Production Function

- Child skill production $D \in \{k, s\}$ at age g_t follows:

$$
\begin{aligned}
log\theta_{D,g_t+1} = & \underbrace{logA_{D,g_t}}_{\text{TFP}} + \gamma_{D,1} \underbrace{log\theta_{D,g_t}}_{\substack{\text{own} \\ \text{skill}}} + \gamma_{D,2} \underbrace{log\theta_{D',g_t}}_{\substack{\text{other} \\ \text{skill}}} + \gamma^w_{D,3} \underbrace{log\tau^w_{g_t}}_{\substack{\text{mother's time} \\ \text{with child}}} \\
& + \gamma^w_{D,4} \underbrace{log\tau^w_{g_t} \times \theta^w}_{\substack{\text{interacted with} \\ \text{mother's education}}} + \gamma^h_{D,3} \underbrace{log\tau^h_{g_t}}_{\substack{\text{father's time} \\ \text{with child}}} + \gamma^h_{D,4} \underbrace{log\tau^h_{g_t} \times \theta^h}_{\substack{\text{interacted with} \\ \text{father's education}}} \\
& + \gamma_{D,6} \underbrace{logM_{g_t}}_{\text{child-related expenditure}} + \gamma_{D,7} \underbrace{lognkids_{g,t}}_{\text{number of siblings}} + \nu_{D,g_t}
\end{aligned} \tag{9}
$$

Child Production Function via 2SLS

Measurement

	$\text{Log(Cognitive)}_{t+1}$		$\text{Log(Non-Cognitive)}_{t+1}$	
	Estimate	SE	Estimate	SE
Constant	-1.104	0.253	-0.706	0.234
Log(Cognitive)	0.537	0.058	0.035	0.054
Log(Non-Cognitive)	0.199	0.061	0.750	0.057
Log(Mother's time)	0.138	0.050	0.024	0.049
Log(Mother's time) $\times$ College degree	0.065	0.010	0.047	0.009
Log(Father's time)	0.181	0.096	0.015	0.078
Log(Father's time) $\times$ College degree	0.051	0.017	0.062	0.016
Log(Child Expenditure)	0.076	0.019	0.080	0.020
Log(Nkids)	-0.239	0.037	0.105	0.036

Note: Cognitive score is captured by the age-appropriate tests: Denver Development Screening Test for 9 months, and British Ability Score (BAS) verbal skills for age 3 and 5. Non-cognitive scores are measured by the Carey Temperament Assessment Tool for 9 months and the Total Difficulties Score of the Strength and Difficulties Questionnaire (SDQ) for ages 3 to 7. Standard errors are estimated through bootstrapping.

Next Steps

- Parental occupations matter for time vs money trade-off, influencing early childhood development.
- Estimate the full structural model
- Conduct counterfactual policy simulations:
  - Child transfers $\rightarrow$ Examine household occupation and time allocations.
  - Tax reforms $\rightarrow$ Simulate welfare gains
  - Business support (e.g. *UK Invest in Women Fund, Women in Innovation*) $\rightarrow$ Self-employment incentives and welfare.
- Examine implications for child skill formations and women's human capital.

Thank you!

Cognitive Skills - Denver Developmental Screening Test 9 months

- Screens age-appropriate developmental milestones (pass/fail items).
- Domains:
  - **Fine motor**
    - "Can the child pick up a small object using thumb and forefinger?"
    - "Can the child stack two blocks?"
  - **Gross motor**
    - "Can the child sit without support?"
    - "Is the child able to pull themselves to stand?"

Cognitive: British Ability Scales (BAS): Ages 3 - 7 back

- Early vocabulary, verbal reasoning, and comprehension.
- **Vocabulary**
  - Picture naming: "What is this?" (e.g. ladder, umbrella)
  - Word definitions: "What does *empty* mean?"
- **Verbal similarities**
  - "How are a boat and a car alike?"
  - "How are a dog and a horse alike?"
- **Early reasoning**
  - "A bird can fly. A fish can _?"
  - "A cow is big, but a mouse is _?"

Non-Cognitive: Carey Infant Temperament Scale: 9 months

- Parent-report profile of early temperament.
- Domains:
  - **Adaptability**

    "How quickly does your baby adjust to new people or places?"

    (Response options: *immediately* / *slowly* / *with difficulty*)
  - **Mood**

    "How often does your baby fuss or cry when left alone?"
  - **Activity level**

    "Is your baby usually calm, or does your baby move around a lot?"
  - **Regularity**

    "Is your baby's sleep schedule predictable?"

Non-Cognitive: Strengths and Difficulties Questionnaire (SDQ): Ages 3 - 7 back

- Parent-report behavioral screening tool (ages 3, 5, 7).
- Example items:
  - **Emotional symptoms**: "My child is often worried or anxious."
  - **Conduct problems**: "My child often has temper tantrums."
  - **Hyperactivity**: "My child is easily distracted, concentration wanders."
  - **Peer problems**: "My child is often picked on or bullied by other children."
  - **Prosocial behaviour (reverse)**: "My child is kind to younger children."
- Response scale: Not true/Somewhat true/Certainly true.

Occupational Changes After Childbirth For Wives back

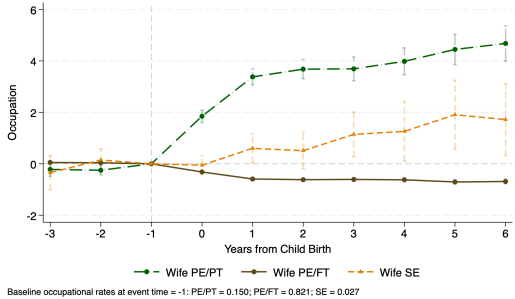
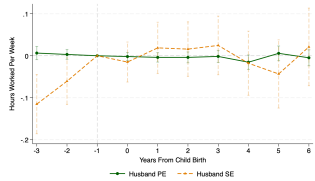


Figure: Child Effect on Wife's Occupations

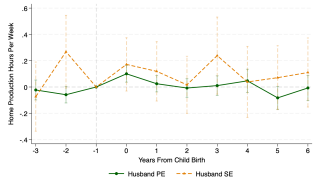
$\Rightarrow$ Paid employment/part-time and self-employment probabilities increase for women after child birth.

Event Study Analyses: Husband

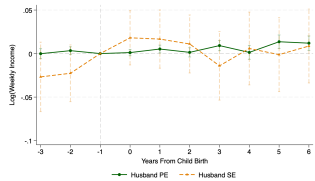
back



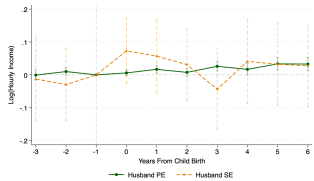
(a) Hours Worked



(b) Home Production



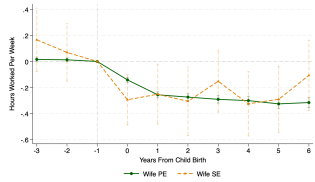
(c) Log(Weekly Income)



(d) Log(Hourly Income)

Event Study Analyses: Wife

back



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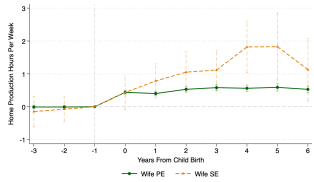

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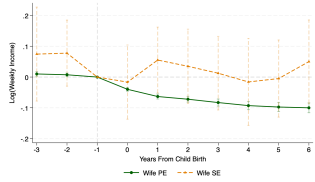

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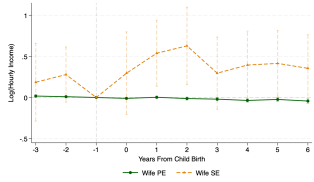

(d) Log(Hourly Income)

Child's Skills by Parental Occupations

back

	Wife		Husband		Household	
	Log(Cognitive)	Log(Non-Cognitive)	Log(Cognitive)	Log(Non-Cognitive)	Log(Cognitive)	Log(Non-Cognitive)
	(1)	(2)	(1)	(2)	(1)	(2)
Wife's Occupation (ref: NW)						
Paid Employed/FT	0.0836***	0.172***			0.0582**	0.153***
	(0.026)	(0.028)			(0.027)	(0.029)
Paid Employed/PT	0.0782***	0.128***			0.0518***	0.113***
	(0.019)	(0.020)			(0.020)	(0.020)
Self Employed	0.192***	0.237***			0.141***	0.188***
	(0.033)	(0.037)			(0.034)	(0.039)
Husband's Occupation (ref: PE)						
Self Employed			-0.0332	0.0501**	-0.0376	0.0524**
			(0.023)	(0.025)	(0.023)	(0.025)
_cons	-0.0808***	-0.0914***	-0.000866	0.00271	-0.0376**	-0.0778***
	(0.015)	(0.015)	(0.010)	(0.012)	(0.016)	(0.017)
Observations	18160	18160	15974	15974	15964	15964

Note: Cognitive score is captured by the age-appropriate tests: Denver Development Screening Test for 9 months, and British Ability Score (BAS) verbal skills for age 3 and 5. Non-cognitive scores are measured by the Carey Temperament Assessment Tool for 9 months and the Total Difficulties Score of the Strength and Difficulties Questionnaire (SDQ) for ages 3 to 7. Standard errors are clustered at the child level and are in parentheses.

States and Outcomes back

State variables at start of time t:

- Parental education θ^i, $i \in \{w, h\}$
- Child age g_t (if any)
- Assets a_t

Uncertainty coming from:

- (Fertility shocks $\epsilon_t \rightarrow$ Child arrival)
- Occupation preference shocks $\boldsymbol{\xi}_t \rightarrow$ Choose q_t
- Wage shocks $\boldsymbol{\varepsilon}_t \rightarrow$ Consumption C_t
- State-specific preference shocks $\boldsymbol{\zeta}_t$
  $\rightarrow$ Choose assets and time
- Human capital shocks $\boldsymbol{\eta}_{hc,t}$
  $\rightarrow$ Determine wife's human capital hc^w_{t+1}

Model Timeline back

States: Education (θ^w, θ^h)
Wife's Human capital (hc_t^w)
Assets (a_t)

Choices: Occupation (q_t)
Assets (a_{t+1})
Home production (τ_t^i)
Hours worked (n_t^i)

States: Education (θ^w, θ^h)
Wife's Human capital (hc_t^w)
Assets (a_t)
Child skills $(\theta_{D,t})$

Choices: Occupation (q_t)
Assets (a_{t+1})
Home production (τ_t^i)
Hours worked (n_t^i)
Child expenditure (M_t)

States: Education (θ^w, θ^h)
Wife's Human capital (hc_t^w)
Assets (a_t)
Child skills (θ_t)

Choices: Occupation (q_t)
Assets (a_{t+1})
Home production (τ_t^i)
Hours worked (n_t^i)

Tax-and-Transfer System: *FORTAX* back

- *FORTAX* is a microsimulation library Shephard (2009), which calculates taxes, benefits, and household disposable income given labor market and family characteristics. (cf. NBER Taxism)
- The functional form is:

$$\mathcal{T}(Y_{j,t}^{w}, Y_{j,t}^{h}, \mathbf{x}_t) = \chi_1(\mathbf{x}_t)(\chi_3(\mathbf{x}_t) + Y_{j,t}^{w} + Y_{j,t}^{h})^{1-\chi_2(\mathbf{x}_t)} \tag{10}$$

where

- $\chi_1(\mathbf{x}_t)$: overall taxation
- $\chi_2(\mathbf{x}_t)$: progressivity
- $\chi_3(\mathbf{x}_t)$: baseline transfer

Wife's Human Capital

- Following Gayle, Lott, and Shephard, wife's human capital is an unobserved discrete state $\mathcal{H} = \{L, M, H\}$ with initial draw $hc_1^w \sim F(hc^w|\theta^w)$.
- Human capital influences hourly wages, while labor supply choices govern its stochastic evolution.
- Following Heckman and Singer (1984) and Keane and Wolpin (1997): unobserved heterogeneity is integrated out, and transitions capture expected dynamics conditional on observables and choices.

Wife's Human Capital: Stochastic Process back

1. Not Work: Depreciate or remain

$$\Pi^{nw} = \begin{pmatrix} 1 & 0 & 0 \\ \delta_{nw} & 1-\delta_{nw} & 0 \\ 0 & \delta_{nw} & 1-\delta_{nw} \end{pmatrix} \tag{11}$$

2. Intermediate hours: Depreciate, remain, or appreciate

$$\Pi(n_t^w) = (1-\omega(n_t^w)) \cdot \Pi^{nw} + \omega(n_t^w) \cdot \Pi^{ft} \tag{12}$$

$$\text{where} \quad \omega(n_t^w) = \left(\frac{n_t^w}{\overline{n^w}}\right)^{\nu_{hc}}, \nu_{hc} > 0 \tag{13}$$

3. Maximum hours: Depreciate or remain

$$\Pi^{ft} = \begin{pmatrix} 1-\kappa_L & \eta_L & 0 \\ \delta_{ft} & 1-\delta_{ft}-\kappa_M & \kappa_M \\ 0 & \delta_{ft} & 1-\delta_{ft} \end{pmatrix} \tag{14}$$

Child Production Function back

- Endogeneity due to measurement error in observed skills.
- Following Agostinelli and Wiswall (2025), the measurement system for each domain is:

$$log\widetilde{\theta}^{m}_{D,g_t} = \mu^{m}_{\theta_D,g_t} + \alpha^{m}_{\theta_D,g_t} \log \theta_{D,g_t} + \nu^{m}_{\theta_D,g_t} \tag{15}$$

- Normalize scale and location parameter:

$$\mu^{1}_{\theta_D,g_t} = 0, \quad \alpha^{1}_{\theta_D,g_t} = 1 \tag{16}$$

- Using an instrument Z_D correlated with $log\theta_{D,g_t}$ but orthogonal to $\nu^{m}_{\theta_D,g_t}$:

$$\alpha^{2}_{\theta_D,g_t} = \frac{\mathrm{cov}(log\widetilde{\theta}^{2}_{D,g_t}, Z_D)}{\mathrm{cov}(log\widetilde{\theta}^{1}_{D,g_t}, Z_D)} \tag{17}$$

where Z_D includes lagged cross-domain skills.