Designing Cash Transfers in the Presence of Children's Human Capital Formation

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Motivation: policies $\rightarrow$ time and money $\rightarrow$ skills $\rightarrow$ resources in long-run literature

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(4) Pose/solve nonlinear cash assistance problem (Mirrlees, 1971; Diamond, 1980)
  - Two new ingredients change planner's calculus: factor shares of (1) time and (2) money

Three punchlines

(1) Optimal transfers are (conservatively) about 20% more generous than current benchmark

(2) Optimal transfers feature work disincentives at the bottom of the income distribution

(3) Welfare reform era led to average skill losses ($1,800 in NPV per kid) and welfare losses (3% consumption)

A twist on classic public finance

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- $\boldsymbol{\lambda}$: multiplier on resource constraint (MVPF)
- Planner maximizes weighted sum of utility subject to resource constraint.

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$$\mu(e)P(e)u_c(\boldsymbol{y}(e)) - \boldsymbol{\lambda} \;\leftarrow \text{direct effect}$$

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$$+\boldsymbol{\lambda}\frac{\partial P(e)}{\partial \boldsymbol{y}(e)}\left(e - \boldsymbol{y}(e) + \boldsymbol{y}(0)\right)$$ ← behavioral effect

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$$+\,\boldsymbol{\lambda} \times \text{Marginal effect of income on skills}$$ ← direct effect on skills

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$+\boldsymbol{\lambda}\frac{\partial P(e)}{\partial \boldsymbol{y}(e)} \times$ Net effect of employment on skills $\leftarrow$ factor share of time and money

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more details

Model Overview: Solution and Empirical Content

Log preferences:

→ linear investment rules:

$$\tau_{m,f,t} = \phi_{\tau,m}(a_{m,f,t}, \boldsymbol{a}_{m,t}, \boldsymbol{\delta}) \times \text{non-work hours}$$
$$x_{m,t} = \phi_{x,m}(a_{m,t}, \boldsymbol{a}_{m,t}, \boldsymbol{\delta}) \times \text{net income}$$

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$$\tau_{m,f,t} = \phi_{\tau,m}(a_{m,f,t}, \boldsymbol{a}_{m,t}, \boldsymbol{\delta})(112 - H_{m,t})$$
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$$u_{m,t}(Y, d) = \tilde{\alpha}_{C,m}(\boldsymbol{a}) \log(Y) + \tilde{\alpha}_{l,m}(\boldsymbol{a}) \log(112 - H_d) - \alpha_{m,d,t}$$

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→ child outcomes:

$$\log(\theta_{m,f,t+1}) = \delta_{x,a} \log(Y_{m,t}) + \delta_{\tau,a} \log(112 - H_{m,t}) + \delta_{\theta} \log(\theta_{m,f,t}) + \mu_{\theta,m,a} + e_m(a, \boldsymbol{a}) + \eta_{m,f,t}$$

Planner's Problem

The planner chooses:

$$\boldsymbol{y}(e) = e - \boldsymbol{\tau}(e)$$

to maximize

$$\text{weighted sum of utilities} + \boldsymbol{\lambda}(-\text{costs today} + \text{NPV of skills})$$

- $\boldsymbol{\lambda}$: marginal value of resources
- e: earnings
- s: household type
- d: work decision

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$u_d(y, s)$: indirect utility

Planner's Problem

$$
\begin{aligned}
\max_{\boldsymbol{y}} \sum_{s,e} \pi(s,e) \Bigg[& \mu(s,e) \max_{d \in \{0,1\}} \{ u_d(\boldsymbol{y}(d \cdot e), s) + \epsilon_d \} \\
& + \boldsymbol{\lambda}(1 - P(s,e)) \left[\tilde{\delta}_x(s) \log(\boldsymbol{y}(0)) + \tilde{\delta}_\tau(s) \log(112) - \boldsymbol{y}(0) \right] \\
& + \boldsymbol{\lambda} P(s,e) \left[\tilde{\delta}_x(s) \log(\boldsymbol{y}(e)) + \tilde{\delta}_\tau(s) \log(112 - H) + e - \boldsymbol{y}(e) \right] \Bigg]
\end{aligned}
$$

- π: distribution
- μ: weights
- $P(s,e)$: work probability

Key Equation 1: Optimal Size

$$\mathbb{E}[\boldsymbol{y}(e)] = \mathbb{E}\left[\frac{\mu\tilde{\alpha}_C(s)}{\boldsymbol{\lambda}} + \tilde{\delta}_x(s)\right] = \mathbb{E}[\boldsymbol{w}(s)]$$

"Average generosity (as measured by $\boldsymbol{y}$) is equal to average effective weight on households in recipient population"

Key Equation 2: Optimal Shape

Simplified version (fix η, s):

$$\boldsymbol{y}(e) = \underbrace{\boldsymbol{w}}_{\text{first best}} + \underbrace{\frac{\eta}{1+\eta}\left[e + \boldsymbol{y}(0) - \boldsymbol{w} + \mathcal{D}(s,e)\right]}_{\text{wedge}}$$

- $\mathcal{D}(s,e)$: effect of employment on NPV of skills ($\delta_x \uparrow,\ \delta_\tau \downarrow$)
- η: semi-elasticity of employment
- $\mathcal{D}(s,e)$ dictates presence of employment subsidies vs penalties more info

Identification and Estimation: Part 1 more details

Indirect utility:

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Grouped heterogeneity.

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- Can estimate preference parameters in reduced form without imposing cross-equation restrictions with δ.

Identification and Estimation: Part 2 more details

Child outcomes:

$$\log(\theta_{m,f,t+1}) = \delta_{x,a}\log(Y_{m,t}) + \delta_{\tau,a}\log(112 - H_{m,t}) + \delta_{\theta}\log(\theta_{m,f,t}) + \mu_{\theta,m,a} + e_m(a, \boldsymbol{a}) + \eta_{m,f,t}$$

- Use first stage estimates to form $\mathbb{E}[\log(Y)|Z]$ and $\mathbb{E}[\log(112 - H)|Z]$.

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- Explore robustness of δ_τ to alternative specifications (childcare and type)

Estimates

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Behavioral parameters:

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Production parameters:

- "Strict" and "Model" IV mostly consistent look
  - Use quasi-Bayesian methods to improve precision and impose theoretical content
- Estimates are conservative relative to literature look
- δ_x vs δ_τ: net effect of maternal employment on skills is negative look

There are a lot of assumptions to defend

Use data, prior evidence, or test directly:

- No borrowing/savings/childcare choice (use data)
  - Little savings in data
  - Little formal childcare use. Model identifies employment effects
- Exogenous births/marriage (use prior evidence)
  - Sparse evidence on responsiveness within sample (Gennetian and Knox, 2003)
  - Some evidence of response of selection into sample (Low, Meghir, Pistaferri, and Voena, 2018)
- No returns to experience (test directly)
  - Test and do not reject look
- No effect of skills on investment (test directly)
  - Test and do not reject look
- No substitution for time vs money (test directly)
  - Test and do not reject look

go back

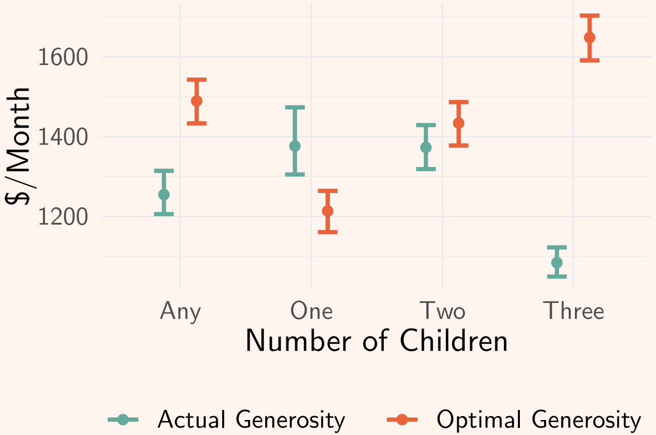
Quantitative Application

- Choose π using estimated distribution over (s, e) from year 2000
- Choose $\mu/\boldsymbol{\lambda}$ to match transfers to households if no children (using π)

$$\mathbb{E}[\boldsymbol{y}(e)|\text{No Kids}] = \frac{\mu\alpha_C}{\boldsymbol{\lambda}}$$

- Two exercises:
  1. Compare actual size to optimal size using equation (1)
  2. Solve full non-linear problem

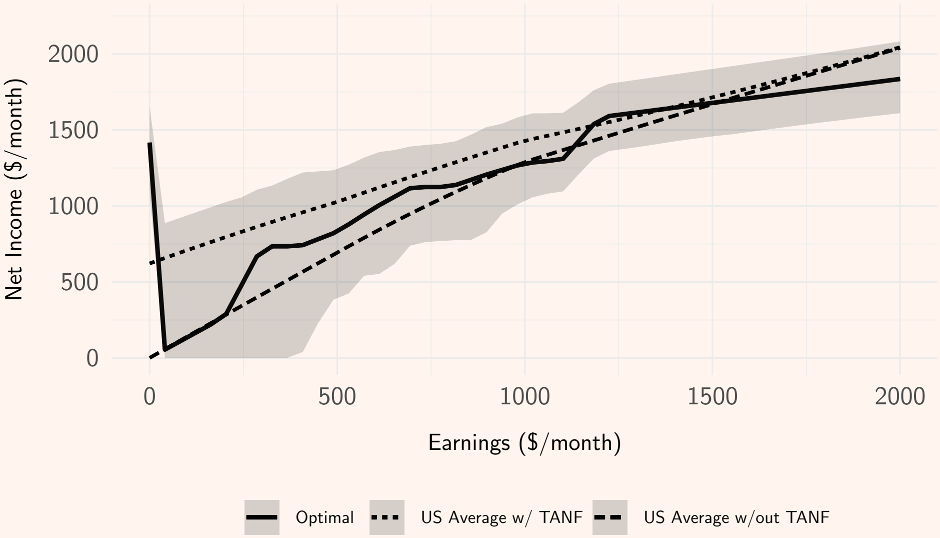
Actual vs Optimal Generosity of Cash Transfers



95% credibility intervals shown

- Overall: 25% difference in overall size
- Big misses for larger households
- Regardless of whether investments public or private

Optimal Policy vs US Average in Year 2000



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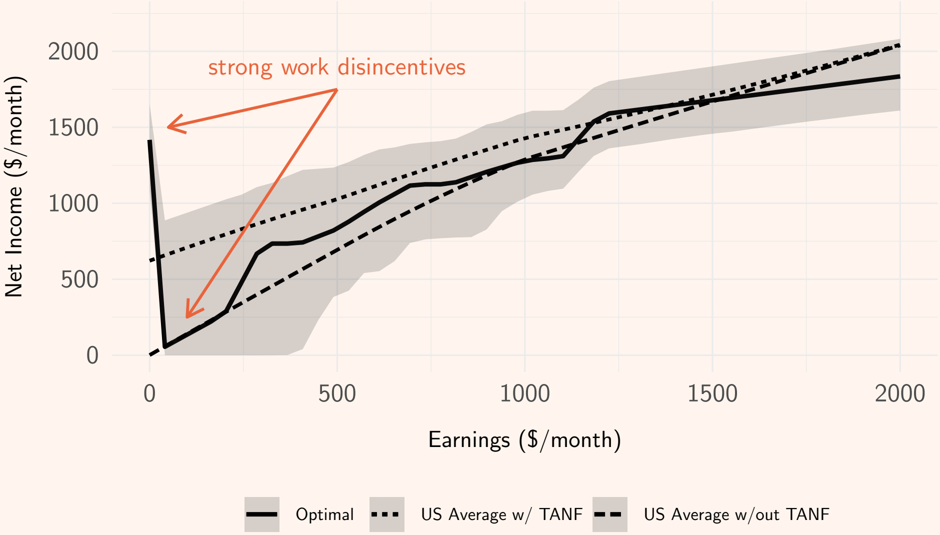
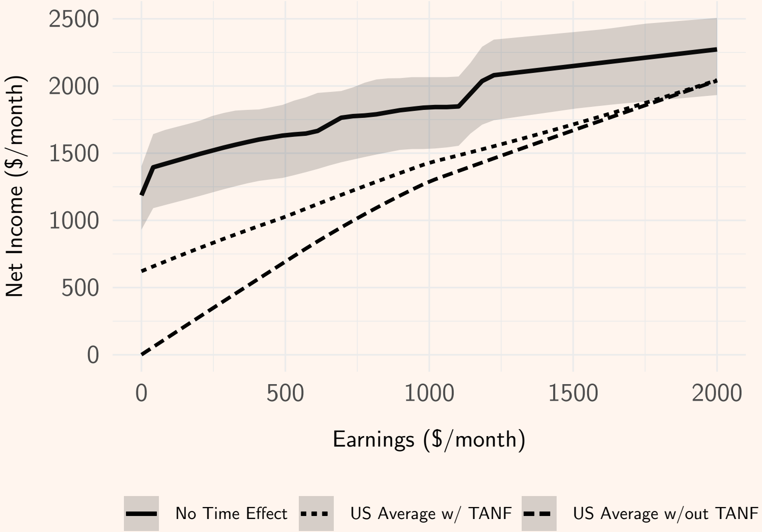
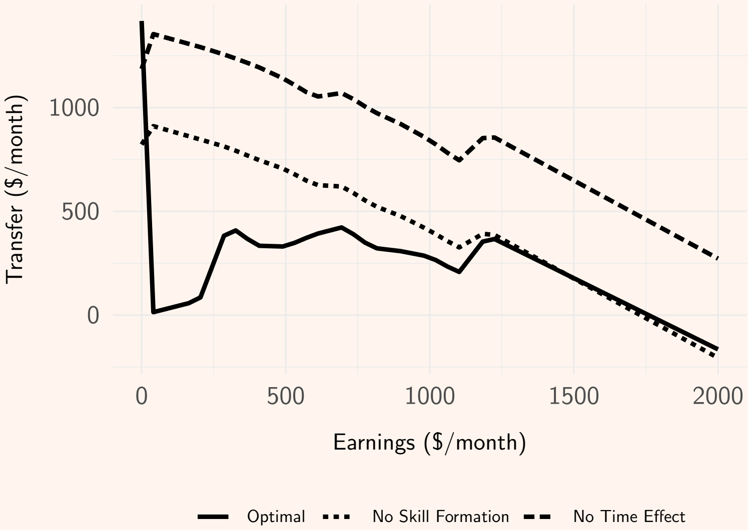


Optimal Policy: No Time Effect ($\delta_\tau = 0$)



- Set $\delta_\tau = 0$.
- Work subsidies at bottom
- δ_τ has huge effect on optimal shape

Comparison of Transfers



- δ_τ affects shape, work incentives
- δ_x affects generosity, size of work credit

Conclusion

- Lesson: accounting for skill formation makes a big difference when evaluating cash transfers and work incentives
- It's particularly important to get the "employment effect" on skills right. Jury is still out.
  - Also not policy invariant!
- Two big next steps:
  1. Household formation: marriage and cohabitation
  2. Childcare policy

Welfare Reform

Welfare Reform Counterfactual

Exercise: "freeze" policy environment just before PROWRA (1996)

- Think: no time limits, work requirements, EITC expansions

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- Reform $\rightarrow$ sizeable losses in skill for minority of children
  - Average: $1,860 in NPV per kid

Welfare Reform Counterfactual

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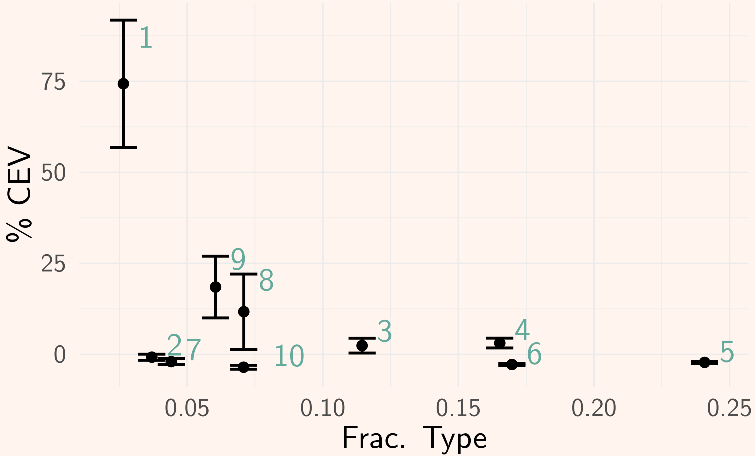
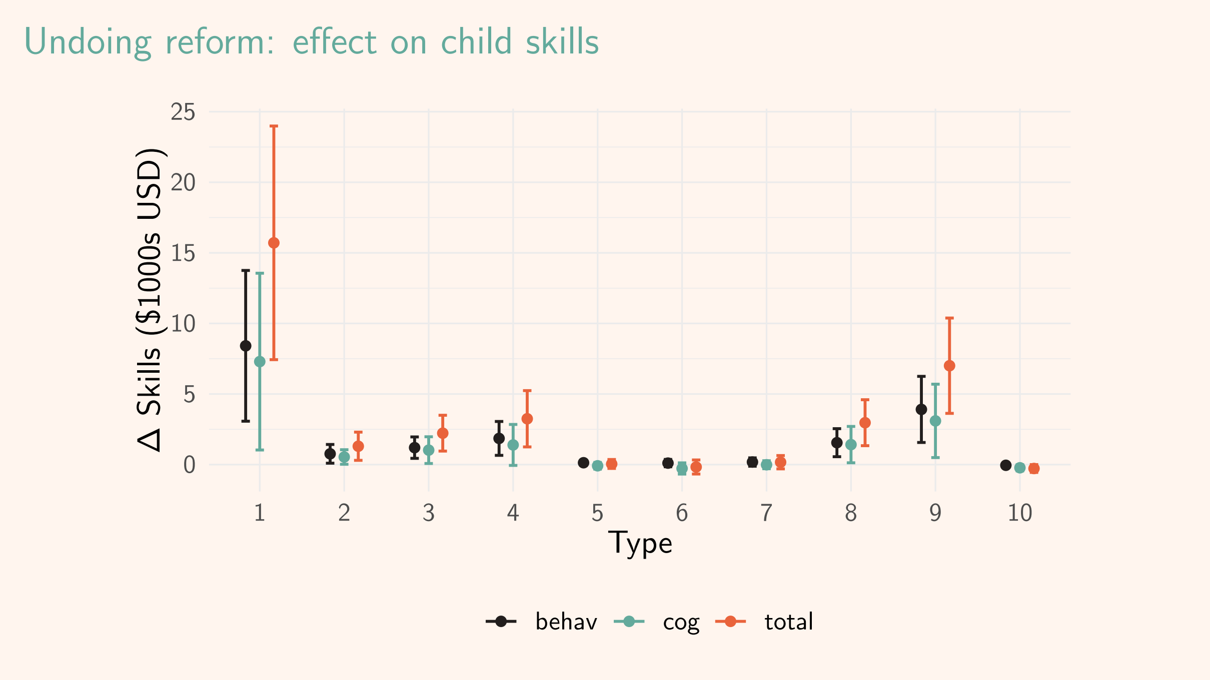
- Think: no time limits, work requirements, EITC expansions
- Reform $\rightarrow$ lots of redistribution over types
- Reform $\rightarrow$ sizeable losses in skill for minority of children
  - Average: $1,860 in NPV per kid
- Getting heterogeneity right matters: ex-ante vs ex-post heterogeneity $\rightarrow$ gains from insurance

	$K = 2$	$K = 10$
CEV:	7.47%	3.35%

Undoing reform: welfare effects



- Lots of redistribution
- Reform → big losses for small fraction of population, small gains for majority
- What determines losses/gains? graph



Undoing reform: effect on child skills
Δ Skills ($1000s USD)
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
Type
behav
cog
total

Motivating Facts

(1) Time and money matter for skill development

(2) Skills shape life-cycle outcomes

(3) Increasing skills/economic resources in childhood has large long-run benefits

go back

Motivating Facts

(1) Time and money matter for skill development

Duncan, Morris, and Rodrigues (2011); Dahl and Lochner (2012); Akee, Copeland, Costello, and Simeonova (2018); Bernal and Keane (2010, 2011)

(2) Skills shape life-cycle outcomes

Cunha, Heckman, and Schennach (2010); Heckman, Stixrud, and Urzua (2006); Heckman, Pinto, and Savelyev (2013)

(3) Increasing skills/economic resources in childhood has large long-run benefits

Heckman, Hyeok, Pinto, Peter, Moon, Savelyev, and Yavitz (2010); García, Heckman, Leaf, and Prados (2020); Bailey, Sun, and Timpe (2021); Kline and Walters (2016); Chetty, Friedman, Hilger, Saez, Schanzenbach, and Yagan (2011); Hoynes, Schanzenbach, and Almond (2016); Aizer, Eli, Ferrie, and Lleras-Muney (2016); Bailey, Hoynes, Rossin-Slater, and Walker (2020)

go back

Model

Demographics

- Time discrete, indexed by t
- Each mother m endowed with a fixed sequence of births (B_m)
- Problem ends when last child matures ($T_m = \max(B_m) + 18$)
- Children characterized by cognitive and behavioral skills:

$$\theta_{m,f,t} = [\theta_{m,f,t,C}, \theta_{m,f,t,B}]$$

Model

$$\text{Value today} \quad = \quad \text{Payoff today} \quad + \quad \beta \times \text{Value tomorrow}$$

$$\left\{ \begin{matrix} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{matrix} \right\} \quad , \quad \begin{pmatrix} \text{work} \\ \text{welfare} \\ \text{investment} \\ \text{child skills} \end{pmatrix} \quad \mapsto \quad \left\{ \begin{matrix} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{matrix} \right\}$$

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Model

$$\text{Value today} = \text{Payoff today} + \beta \times \text{Value tomorrow}$$

$$\left\{ \begin{array}{c} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies } (R_{m,t}) \end{array} \right\}, \begin{pmatrix} \text{work} \\ \text{participation} \\ \text{investment} \\ \text{child skills} \end{pmatrix} \mapsto \left\{ \begin{array}{c} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{array} \right\}$$

Preferences:

$$U_{m,t}(c, l, d, \theta, \epsilon) = \alpha_C \log(c) + \alpha_l \log(l) + \alpha_{\theta,m} \sum_f \log(\theta_f) - \alpha_{H,m} \mathbf{1}\{H_d > 0\} - \alpha_{A,m} P_d - \alpha_R R_{m,t} P_d \mathbf{1}\{H_d = 0\} + \epsilon_d$$

ϵ_d is iid nested logit, variances $(1, \sigma_H)$. go back

Model

$$\text{Value today} \quad = \quad \text{Payoff today} \quad + \quad \beta \times \text{Value tomorrow}$$

$$\left\{\begin{array}{c} \text{births } (B_m) \\ \text{child skills} \\ \text{wages } (W_{m,t}) \\ \text{welfare use } (\omega_{m,t}) \\ \text{policies } (Z_{m,t}) \end{array}\right\}, \quad \left(\begin{array}{c} \text{work} \\ \text{participation} \\ \text{investment} \\ \text{child skills} \end{array}\right) \mapsto \left\{\begin{array}{c} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{array}\right\}$$

Resource constraints:

$$c + \sum_f x_f \leq H_d W_{m,t} + \text{transfers}$$

$$l + \sum_f \tau_f + H_d \leq 112$$

$$\text{transfers} \leftarrow (B_m, \underbrace{Z_{A,m,t}, Z_{F,m,t}, Z_{m,T,t}, \Omega_{m,t}}_{Z_{m,t}}, \omega_{m,t}, H_d W_{m,t}, P_d)$$

go back

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$$\text{Value today} \quad = \quad \text{Payoff today} \quad + \quad \beta \times \text{Value tomorrow}$$

$$\left\{ \begin{array}{c} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{array} \right\} , \left(\begin{array}{c} \text{work} \\ \text{participation} \\ \text{investment} \\ \text{child skills} \end{array} \right) \mapsto \left\{ \begin{array}{c} \text{births} \\ \text{child skills} \\ \text{wages} \\ \text{welfare use} \\ \text{policies} \end{array} \right\}$$

Technology/Dynamics:

Wages: $\log(W_{m,t}) = \gamma_{0,m} + \gamma_{1,m} Age_{m,t} + \varepsilon_{m,t}$

$\varepsilon_{m,t+1} \sim \Pi_W(\cdot | \varepsilon_{m,t})$

Cobb-Douglas shares: $(\delta_{\tau,j}, \delta_{x,j}, \delta_{\theta,C,j}, \delta_{\theta,B,j})$

Welfare use: $\omega_{m,t+1} = \omega_{m,t} + P_d \mathbf{1}\{\Omega_{m,t} < \infty\}$

go back

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go back

Solution/Empirical Content

We get four useful solution properties

State:

$$(\text{policies}, \text{births}, \text{welfare use}, \text{wages}, \text{skills})$$

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(policies, births, welfare use, wages, skills)

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(3) Recursive coefficients on utility:

$$\tilde{\alpha}_{C,m}(\boldsymbol{a}) = \alpha_C + \alpha_{\theta,m} \sum_{a \in \boldsymbol{a}} \Gamma_{x,a}(\boldsymbol{\delta}), \qquad \tilde{\alpha}_{l,m}(\boldsymbol{a}) = \alpha_C + \alpha_{\theta,m} \sum_{a \in \boldsymbol{a}} \Gamma_{\tau,a}(\boldsymbol{\delta})$$

that build in dynamics of investment problem

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that build in dynamics of investment problem

(4) Linear investment rules: $x_{m,f,t} = \phi_m(a_{m,f,t}, \boldsymbol{a}_{m,t}) Y_{m,t}$

Identification/Estimation

Data - PSID-CDS

Panel Study of Income Dynamics:

- Panel of work, income, program participation, fertility, and marriage.
- Select: women who are unmarried at time of first birth

Child Development Supplement (1997,2002,2007):

- Cognitive skills (Woodcock-Johnson Letter Word and Applied Problems)
- Behavioral skills (externalizing and internalizing behaviors)
- Earnings and criminal behavior in young adulthood

go back

The Effect of Skills on Economic Resources

$$\mathcal{Y}(\theta) = \gamma_{\mathcal{Y},0} + \gamma_{\mathcal{Y},C} \log(\theta_C) + \gamma_{\mathcal{Y},B} \log(\theta_B)$$

Skill	Earnings	Crime	Total
Cognitive	$\gamma_{E,C} = \$93,000$	$\gamma_{CR,C} = 0$	$\gamma_{\mathcal{Y},C} = \$93,000$
Behavioral	$\gamma_{E,B} = \$47,500$	$\gamma_{CR,B} = \$9,000$	$\gamma_{\mathcal{Y},B} = \$55,500$
Source	CPS + CDS	Heckman et al. (2013) + CDS	

- PSID-CDS shows effect of skills on earnings/crime in young adulthood
- Use auxiliary data to extrapolate over life-cycle
- Use coefficients for anchoring skills (NPV of 1sd)

go back

Panel data + policy variation gives us identification

Grouped heterogeneity ($k(m) \in \{1, 2, ..., K\}$):

$$(\alpha_{\theta,m}, \mu_{\theta,m}, \alpha_{H,m}, \alpha_{A,m}, \gamma_{0,m}, \gamma_{1,m}) = (\alpha_{\theta,k(m)}, \mu_{\theta,k(m)}, \alpha_{H,k(m)}, \alpha_{A,k(m)}, \gamma_{0,k(m)}, \gamma_{1,k(m)})$$

In two stages:

(1) Panel + policy variation → indirect utility (Bonhomme et al., 2016; Kasahara and Shimotsu, 2009)

(2) Use Z_m as instruments to get $\boldsymbol{\delta}$ (strict IV)

(2a) Use X_m as instruments to get $\boldsymbol{\delta}$ (model IV)

go back

Panel data + policy variation gives us identification

Grouped heterogeneity ($k(m) \in \{1, 2, ..., K\}$):

$$(\alpha_{\theta,m}, \mu_{\theta,m}, \alpha_{H,m}, \alpha_{A,m}, \gamma_{0,m}, \gamma_{1,m}) = (\alpha_{\theta,k(m)}, \mu_{\theta,k(m)}, \alpha_{H,k(m)}, \alpha_{A,k(m)}, \gamma_{0,k(m)}, \gamma_{1,k(m)})$$

In two stages:

(1) Panel + policy variation → indirect utility (Bonhomme et al., 2016; Kasahara and Shimotsu, 2009) ← MLE via E-M

(2) Use Z_m as instruments to get $\boldsymbol{\delta}$ (strict IV) ← GMM

(2a) Use X_m as instruments to get $\boldsymbol{\delta}$ (model IV) ← GMM

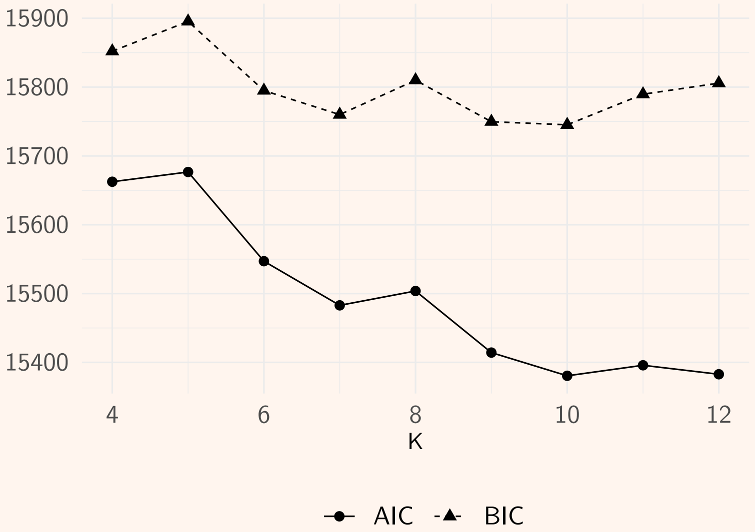
go back

Landscape of Government Assistance back

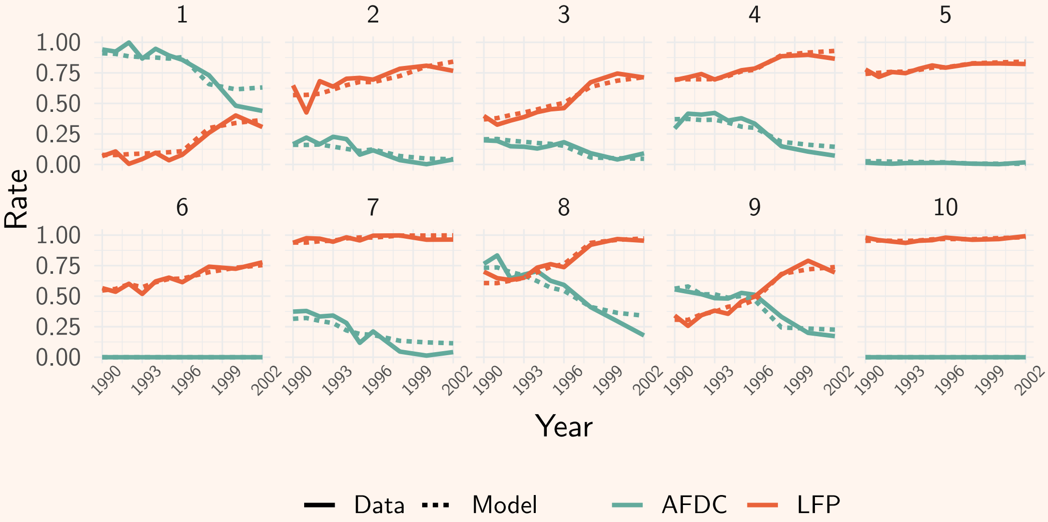
- Welfare:
  - Aid to Families with Dependent Children (AFDC)
  - 1996: Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA)
  - $\Rightarrow$ Temporary Assistance for Needy Families (TANF)
  - $\approx$ \$20b, 2015
  - **Time limits**, benefit restructuring
- Taxes:
  - Earned Income Tax Credit (EITC)
  - Several expansions through 90s
  - $\approx$ \$60b, 2015
- Food Stamps
  - Supplemental Nutrition Assistance Program (SNAP)
  - $\approx$\$70b, 2015

Heterogeneity

back

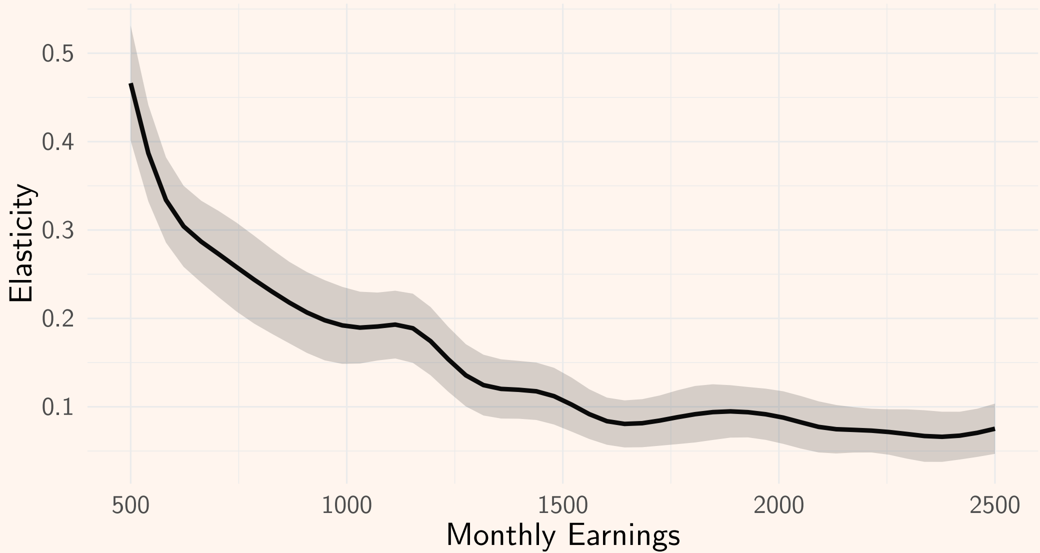


Model Fit back



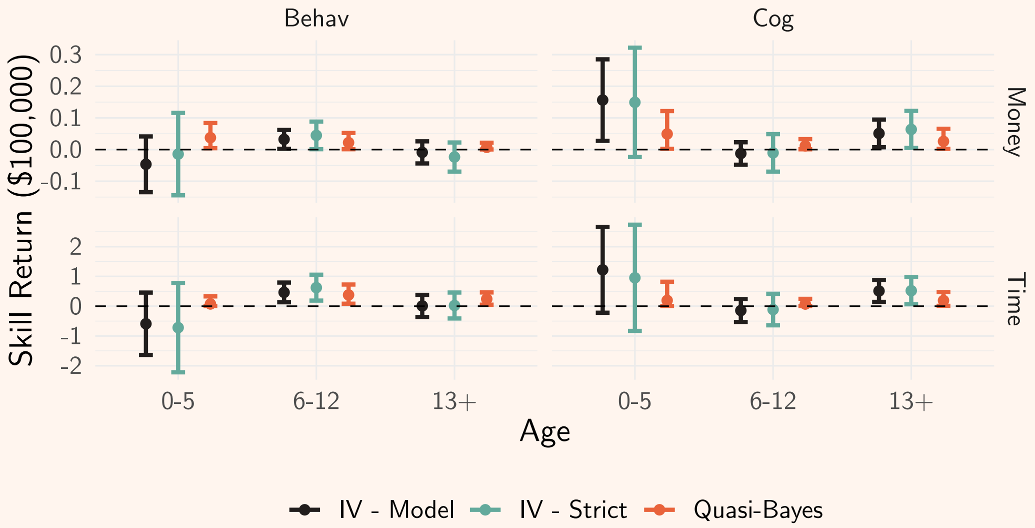
Elasticities

back



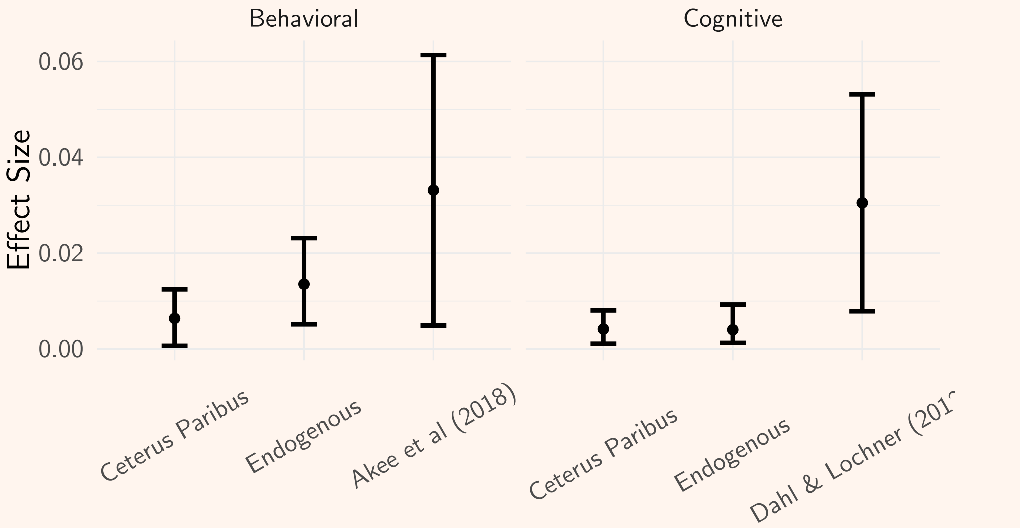
Production Estimates

back



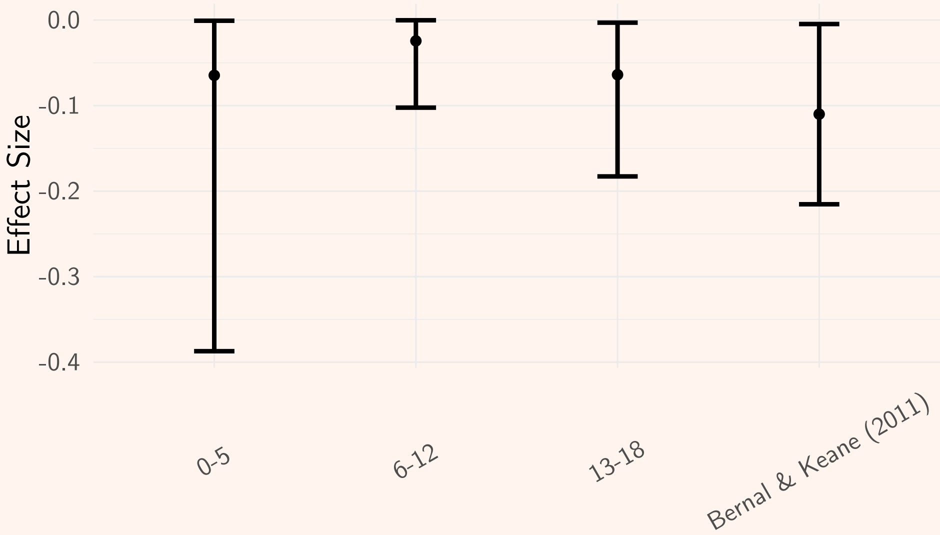
Benchmarking Production Estimates

back



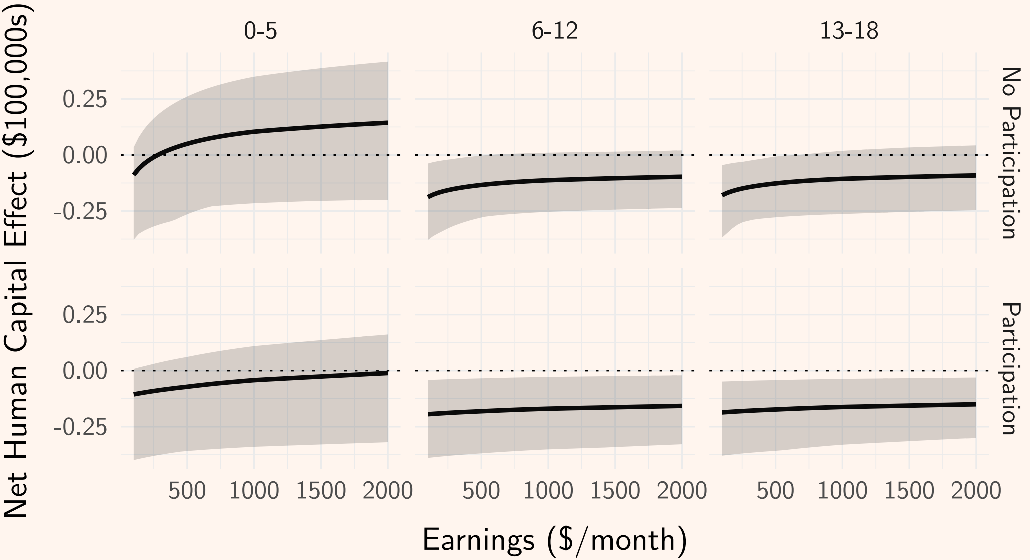
Benchmarking Production Estimates

back



Net Effect of Employment

back



Returns to Experience back

υ is difference between observed and model predicted wage:

Specification:

$$\upsilon_{m,t} = \beta_0 + \beta_1 \text{Exp}_{m,t} + \epsilon_{mt}$$

	(1)	(2)	(3)
Exp	-0.001	0.002	-0.00005
	(0.001)	(0.001)	(0.001)
Individual FE	-	✓	✓
Age FE	-	-	✓
Observations	6,058	6,058	6,058
R^2	0.0001	0.0002	0.015
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$		

Sibling Pair Test of Investment back

Specification:

$$\log(\tau^o_{mkt}) = \mu_{mt} + \gamma_{a_{kt}} + \beta_1 \text{LW}_{mkt} + \beta_2 \text{BPE}_{mkt} + \epsilon_{mkt}$$

	Active Time		Total Time	
	OLS	IV	OLS	IV
LW	0.002	−0.065	0.017	0.001
	(0.040)	(0.079)	(0.027)	(0.049)
BPE	−0.008	−0.017	−0.002	−0.014
	(0.012)	(0.024)	(0.009)	(0.017)
Age Dummies	✓	✓	✓	✓
Mother × Year FE	✓	✓	✓	✓
Observations	1,463	1,437	1,549	1,522
R^2	0.100	0.086	0.073	0.061

Regression Test of Substitution Patterns back

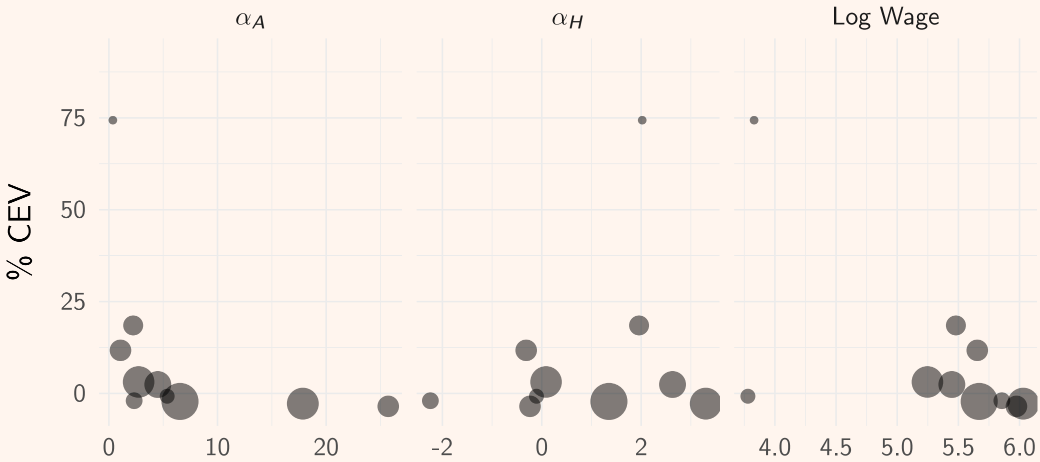
Specification:

$$\upsilon_{\phi,m,t} = \beta_0 + \beta_1 \log(Y_{m,t}) + \beta_2 \log(112 - H_{m,t}) + \epsilon_{m,t}$$

	(1)	(2)
$\log(Y_{m,t})$	0.004	0.037
	(0.011)	(0.033)
$\log(112 - H_{m,t})$	-0.137	-0.412
	(0.129)	(0.427)
Observations	1,237	1,237
Mother FE	-	✓
R^2	0.007	0.031
Note:		$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Undoing reform: effect on welfare

back



Optimal Tax Formulae

First best allocations:

$$\boldsymbol{y}^*(e) = \mathbb{E}[\boldsymbol{w}(s,e)|e, d=1]$$

Optimal shape:

$$\boldsymbol{y}(e) = \boldsymbol{y}^*(e) + \frac{\mathbb{E}\left[\eta(s,e)\left(e + \boldsymbol{y}(0) - \boldsymbol{y}^*(0) + \mathcal{D}(s,e)\right)|e, d=1\right]}{1 + \mathbb{E}[\eta(s,e)|e, d=1]}$$

Work credit is $\lim_{e\to 0} \boldsymbol{y}(e) - \boldsymbol{y}(0)$:

$$\text{work credit} = \frac{\boldsymbol{w} - \boldsymbol{y}(0) + \lim_{e\to 0} \mathbb{E}[\eta(s,e)\mathcal{D}(s,e)|e, d=1]}{1 + \lim_{e\to 0} \mathbb{E}[\eta(s,e)|e, d=1]}$$

go back

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