A Structural Meta-Analysis of Welfare-to-Work Experiments and Their Impacts on Children

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Introduction

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- Want: a method to aggregate this information for policy and prediction
  - Experiments are costly, would like cheaper alternative to evaluate counterfactual policies
  - Design future experiments more effectively
- This paper: estimates a structural model using experimental outcomes, exploiting differences in design to identify key parameters.
  - Application: welfare reform experiments in the United States

A Simple Description of Methodology

- Let $\mathbf{Y}_k$ be vector of statistics from experiment or study k $(k = 1, ..., K)$

- Let γ index a class of models that predicts population values:

$$n_k^{1/2}(\mathbf{Y}_k - \mathbf{m}_k(\gamma)) \to_d \mathcal{N}(0, \Omega_k)$$

- γ can be estimated by minimum distance:

$$\hat{\gamma} = \arg\min(\mathbf{Y} - \mathbf{m}(\gamma))'\mathbf{W}(\mathbf{Y} - \mathbf{m}(\gamma))$$

- This is a way to aggregate information from experiments/studies.

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Traditional meta-analysis:

- $\mathbf{Y}_k$ are mean impacts, $\mathbf{m}_k$ is linear model
- Single parameter of interest: Average Treatment Effect (α)
- Population framework: $\alpha_k \sim F(\alpha)$, differences across experiments is nuisance variation
- $\hat{\alpha}$ is a weighted average, or can be estimated with Bayesian methods (Rubin 1981, Meager 2019)
- α *may* not be policy parameter of interest (Heckman 1992)

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Structural meta-analysis:

- γ now define policy invariant primitives (preferences, technology, etc)
- Differences in design and setting useful for identification
- Outcomes articulated for full range of counterfactuals

  Todd & Wolpin (2005), Attanasio, Meghir & Santiago (2011), Duflo, Hanna & Ryan (2012), Rodriguez (2018)
- Can apply same frequentist or Bayesian methods

Application: Welfare Reform

- Have results from multiple RCT evaluations of welfare-to-work programs in the US.
    - Compile averages from publicly available reports more info

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  - Benefit formulae (generosity and work incentives)
  - Time limits on participation
  - Work requirements
  - Child care subsidies
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- Four crucial design choices:
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  - Child care subsidies
- Exploit variation in these choices to identify key parameters
- Highlighted counterfactuals of interest:
  - $1,000 unconditional transfer to households
  - A policy reform with only work requirements
  - Key outcome: impact on academic and behavioral outcomes of children

Application: Welfare Reform

Results from highlighted counterfactuals:

- \$1,000 transfer $\rightarrow$ 2-3% s.d. increase in academic and behavioral outcomes
  - About one third of prominent estimates: Duncan, Morris & Rodrigues (2011), Dahl & Lochner (2012)
  * Akee, Copeland, Costello & Simeonova (2018)

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- No significant impact of work requirements

- No evidence of negative impact of non-maternal care.
  - Bernal (2008), Agostinelli & Sorrenti (2018), Mullins (2019)

Model

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- Environment:
  - Agent is single mother, endowed with $L = 112$ hours per week.
  - Site k, treatment arm j, time t
  - Investment period is $T = 17$ years.

- Choices:
  - Participate in welfare, $A \in \{0, 1\}$
  - Work, $H \in \{0, 1\}$
  - If $H = 1$, choose formal care ($F = 1$) or informal care ($F = 0$)
  - Divide hours at home into housework q, and time with child, τ.
  - Spend x in money investments on child, C on private consumption.

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

$$\begin{array}{c} \text{child skills} \\ \text{welfare remaining} \end{array} \quad \begin{array}{c} \text{work} \\ \text{welfare} \\ \text{childcare} \\ \text{investment} \\ \text{child skills} \end{array} \mapsto \begin{array}{c} \text{child skills} \\ \text{welfare remaining} \end{array}$$

show me math

Value today	$=$	Payoff today	$+$	$\beta \times$ Value tomorrow
		work		
child skills welfare remaining		welfare childcare investment	$\mapsto$	child skills welfare remaining
		child skills		

show me math

Preferences:

$$u_k(C, d, \theta; \mathcal{R}) = \alpha_C \log(C) + \alpha_\theta \log(\theta) - \alpha_{H,k} H + \alpha_{F,k} F - \mathcal{R} A[\alpha_{R,k}(1 - H) + \alpha_{R2,k} H] + \epsilon_d$$

ϵ_d is nested logit, variances $(1, \sigma_H, \sigma_F)$.

Value today	=	Payoff today	+	$\beta \times$ Value tomorrow
child skills welfare remaining		work welfare childcare investment child skills	$\mapsto$	child skills welfare remaining

show me math

Resource constraint:

$$C + x + p_{F,kj} F + w_q(\tau + 30H) \leq Y_{kjt}(A, H) + w_q L$$

Value today	$=$	Payoff today	$+$	$\beta \times$ Value tomorrow
		work		
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show me math

Technology:

$$\theta_{t+1} = I_t^{\delta_{I,t}} \theta_t^{\delta_\theta}, \qquad I_t = \mathcal{I}_t(\tau, x, \kappa), \ \kappa = H + F$$

- Let $g_{\kappa,t} I_t$ be solution to cost-minimization problem, $\kappa \in \{0, 1, 2\}$
- Marschak (1953): sufficient to estimate prices $(g_{0,t}, g_{1,t}, g_{2,t})$

Key Model Parameters

Parameter	What it determines show me math
Preferences	
Coefficient on consumption (α_C)	Response of participation to program generosity

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Log-relative price of investment ($\hat{g}_1, \hat{g}_2$)	Effect on child outcomes of non-maternal care
Cobb-Douglas share on investment (δ_I)	Effect on child outcomes of increase in income
Cobb-Douglas share on skills (δ_θ)	Persistence of effects on child outcomes

Identification

- Identification follows from understanding of these key relationships
  - Example: Wage elasticity of LFP (σ_H) identified by experimental variation in work incentives, time variation in wages.

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- Analytical solution provides transparent identification analysis (see paper)
- Analogy: rank condition in linear IV (separate variation in treatment components)
- Site-specific parameters identified by control group means

Estimation - Data

- Public reports - means of LFP, participation, rates of paid child care use & OOP child care costs, across treatment groups, $\mathbf{X}_k$ for site k.

- Standard deviations $\hat{\mathbf{s}}_k$ imputed or inferred from effect sizes

$$\frac{X_{k,i} - \mathbf{m}_{k,i}(\gamma)}{\hat{s}_{k,i}} \sim \mathcal{N}(0,1)$$

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$$\frac{X_{k,i} - \mathbf{m}_{k,i}(\gamma)}{\hat{s}_{k,i}} \sim \mathcal{N}(0,1)$$

- Vector of treatment effects for academic outcomes ($M_{A,k}$)
  - Parental rating of school achievement, grade repetition, Woodcock-Johnson

- Vector of treatment effects for behavioral outcomes ($M_{B,k}$)
  - Behavioral problems index, positive behaviors, suspension

- Measurement of treatment effect at site k, treatment j:

$$\Delta\overline{M}_{Z,k,j,l} = \lambda_{Z,j}\Delta\mathbb{E}[\log(\theta)|k,j] + \zeta_{Z,k,j,l},\ \ Z \in \{A,B\}$$

Estimation - Procedure

- Have global (γ_G), and site specific (γ_k) parameters

- Follow meta-analysis literature (Rubin 1981, Meager 2019) and estimate Bayesian hierarchical model:

$$p(\gamma|X, M) \propto \prod_{k=1}^{K} \phi(X_k, M_k|s_{M,k}, s_{X,k}, \gamma_G, \gamma_k) p(\gamma_k|\gamma_H) p(\gamma_H, \gamma_G)$$

  Where:

  - Use loose priors

  - $\phi(\cdot|s, \gamma)$ is normal density with mean implied by model solution given γ and standard deviation s.

Review: Important Parameters

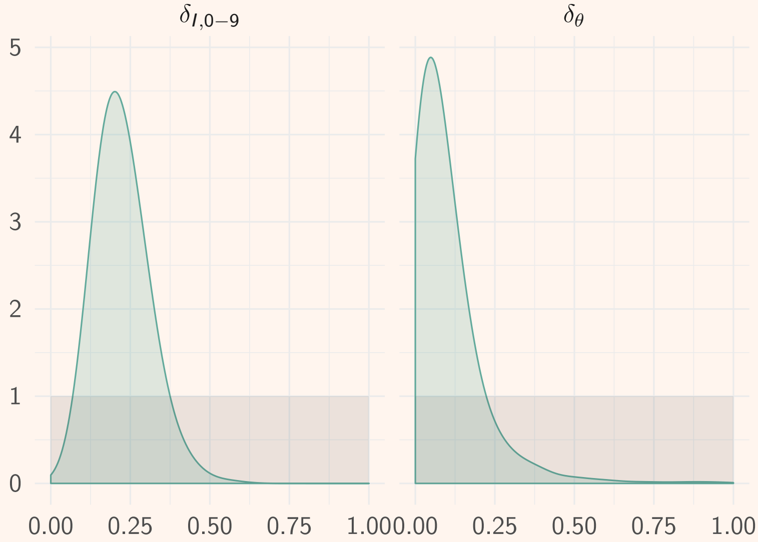
Child outcomes:

$$\mathbb{E}_{kjt}\log(\theta_{t+1}) = \delta_{I,t}\Big[\log(Y_{kjt}(H,A) + w_q(L-30H)) - \hat{g}_{\kappa,t}\Big] + \delta_\theta \mathbb{E}_{kjt}\log(\theta_t)$$

Important parameters are:

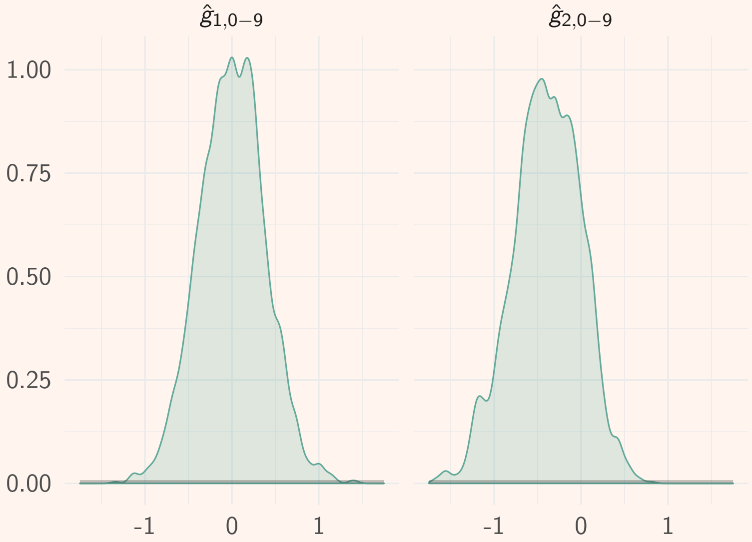
- δ_I: important of resources in household
- δ_θ: persistence of impacts
- $(\hat{g}_{1,t}, \hat{g}_{2,t})$: log-relative investment prices under different care arrangements

Estimates - effect of aggregate investment (with persistence)



- 1% increase in resources $\rightarrow$ 0.22% increase in skills.
- Note very low persistence.
- Caveat: this parameter hard to identify with these data.

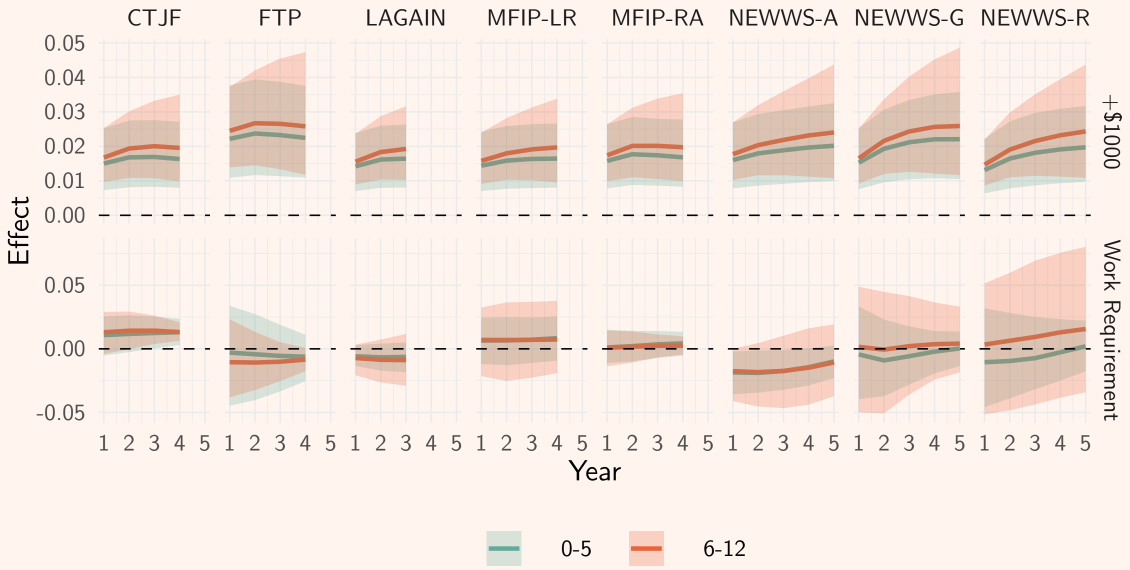
Estimates - relative investment prices



- $\hat{g} < 0$ implies form of care more effective than time at home.
- Only mild evidence that paid care better than unpaid.
- Paid care not good proxy for formality?

Time for counterfactuals

Child impacts for two counterfactuals



Summarizing Findings

We just saw:

- An extra \$1000/year leads to $\approx$ 2-3% of s.d. increase in academic and behavioral outcomes.
- Smaller than some non-experimental benchmarks in literature.
- No evidence of persistence.
- No evidence for negative impact of nonmaternal care.

Summarizing Findings

We just saw:

- An extra \$1000/year leads to $\approx$ 2-3% of s.d. increase in academic and behavioral outcomes.
- Smaller than some non-experimental benchmarks in literature.
- No evidence of persistence.
- No evidence for negative impact of nonmaternal care.

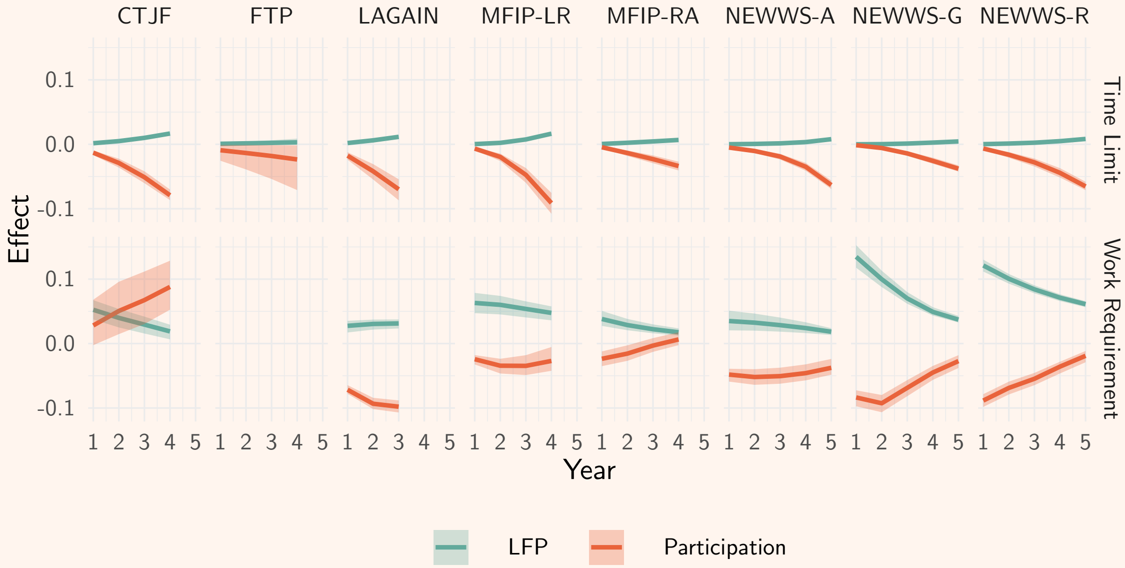
Some other counterfactuals of interest:

- Time limits vs work requirements see it
- Useful labor supply elasticities and price elasticities of care use see it
- Estimates of discounting see it

Conclusion

- Current method is useful way to use public data...
- Important extension: disaggregated data for individual heterogeneity
- Auxiliary data from public panel (SIPP,PSID,NLSY,CPS)
  - Potentially deal more explicitly with sample selection issues
  - External validity
  - Long-run outcomes
- General agenda for structural work

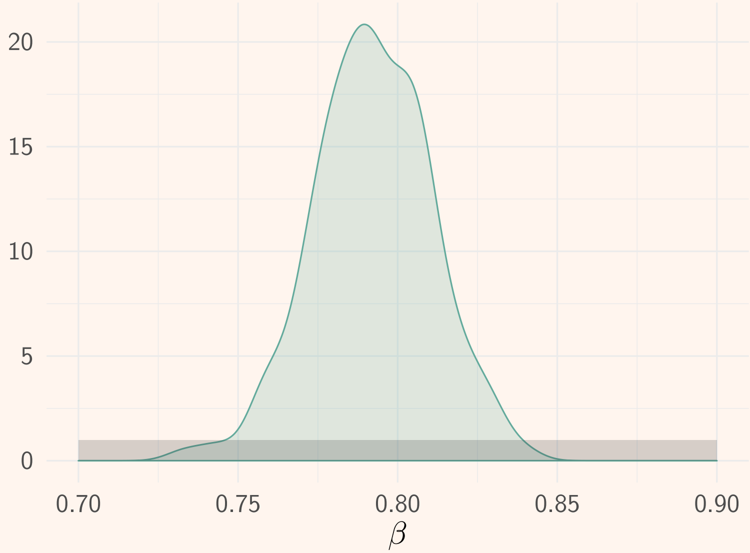
Thanks!



CTJF
FTP
LAGAIN
MFIP-LR
MFIP-RA
NEWWS-A
NEWWS-G
NEWWS-R
Time Limit
Work Requirement
Effect
0.1
0.0
-0.1
1 2 3 4 5
Year
LFP
Participation

Estimates - Discounting

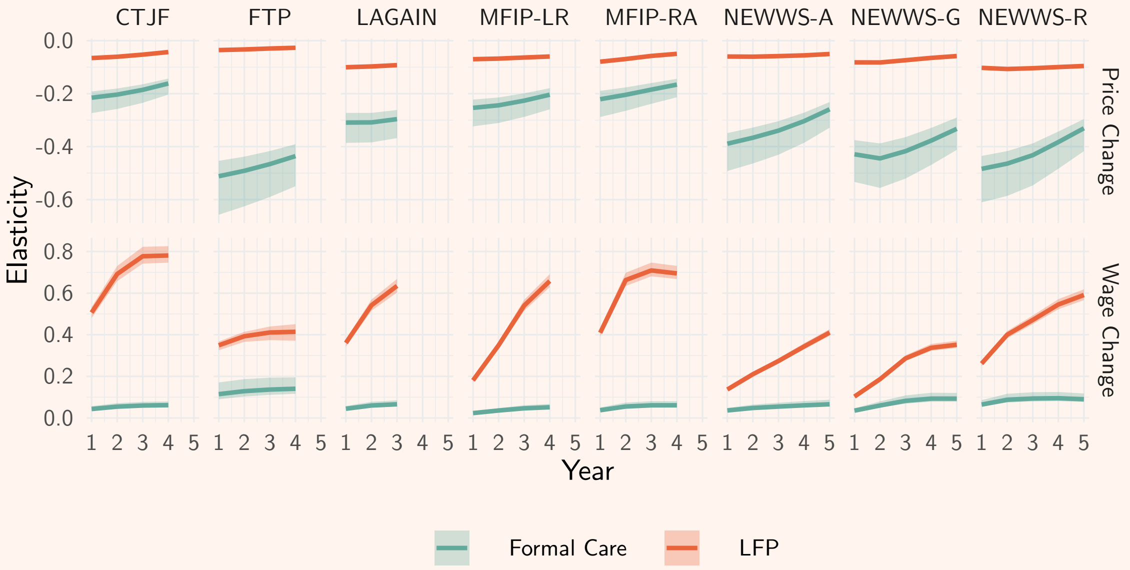
go back



- Time limits precisely identify β
- Some evidence that welfare participants exhibit time inconsistency (Chan 2017)

Estimates - Price and Wage Elasticities

go back



Model - Full

Dynamic program:

$$V_{kjt}(\theta_t, \omega_t) = \mathbb{E} \max_{I_t, d_t} \{u_k(C_t, d, \theta_t; \mathcal{R}_{kj}) + \epsilon_d + \beta V_{kjt+1}(\theta_{t+1}, \omega_{t+1})\}$$

Subject to:

$$U(C, d, \theta) = \alpha_C \log(C) + \alpha_\theta \log(\theta) - \alpha_{H,k} H - \alpha_{A,k} A + \alpha_{F,k} F + \epsilon_d$$
$$\theta_{t+1} = I_t^{\delta_{I,t}} \theta_t^{\delta_\theta}, \qquad I_t = \mathcal{I}_t(\tau, x, H, F)$$
$$C + x + p_{F,kj} F + w_q(\tau + 30H) \leq Y_{kjt}(A, H) + w_q L$$

too much math!!!

Model - Specifying Technology

- Work with dual:

$$e(I, H, F) = \min_{\tau, x} w_q \tau + x \qquad \text{s.t. } \mathcal{I}_t(\tau, x, H, F) \geq I$$

- Linear expenditure function:

$$e(I, H, F) = g_{\kappa,t} I_t, \qquad \kappa = H + F \in \{0, 1, 2\}$$

- Marschak (1953): sufficient to estimate prices $(g_{0,t}, g_{1,t}, g_{2,t})$, subject to policy invariance.

- Note interpretation of prices

Model - Budgets (Control Group Example)

$$Y_{k0t}(A,H) = E_{kt}H + A \cdot [\text{AFDC}_{kt}(E_{kt}H) + \text{SNAP}_t(E_tH)]$$
$$\text{AFDC}_{kt}(E) = \max\{B_k(n,y) - (1-0.33)\max\{E-120,0\},0\}$$

- $B_k(n,y)$ is benefit standard for family size n in year y
- Fixed earnings disregard of \$120/month
- Variable earnings disregard of 33% of monthly earnings
- Treatments will modify these parameters, affecting incentives.

Model - Work Requirements and Time Limits

- Let $\mathcal{R}_{kj}$ indicate whether a work requirement applies:

  $$u_k(C,d,\theta;\mathcal{R}) = \alpha_C \log(C) + \alpha_\theta \log(\theta) - \alpha_{H,k} H + \alpha_{F,k} F - \mathcal{R} A[\alpha_{R,k}(1-H) + \alpha_{R2,k} H] + \epsilon_d$$

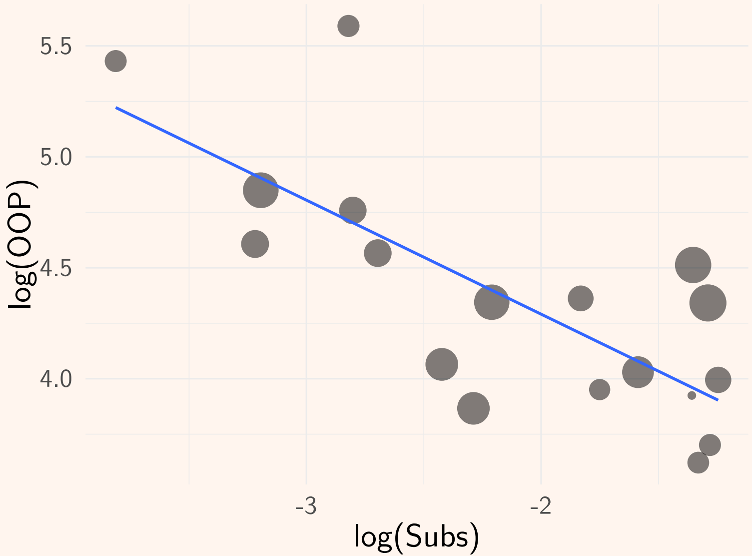
- Let Ω be the number of periods of welfare use permitted. For control groups, $\Omega = \infty$.

- Let ω track the number of periods remaining:

  $$\omega_{t+1} = \omega_t - A_t$$

- When $\omega = 0$, eligible for food stamps only.

Model - Child Care Subsidies



- No explicit change in subsidy formula.
- Administrative expansion
- Estimate to get price, $p_{F,kj}$, of formal care.

MDRC's Welfare to Work Experiments

- 5 experiments, welfare recipients randomly assigned:
  - Family Transition Program, Minnesota Family Investment Program, National Evaluation of Welfare-to-work Strategies, Jobs First, LA Greater Avenues for Independence
  - 1991-1999
- Data compiled from publicly available reports

  Bloom, Kemple, Morris, Scrivener, Verma, and Hendra (2000), Bloom, Scrivener, Michalopoulos, Morris, Hendra, Adams-Ciardullo, Walter (2002), Freedman, Knab, Gennetian, and Navarro (2000), Gennetian and Miller (2000), Hamilton, Freedman, Gennetian, Michalopoulos, Walter, Adams-Ciardullo, and Gassman-Pines (2001), Miller, Knox, Gennetian, Dodoo, Hunter, and Redcross (2000)

Other things to know

Some other things you should know about these experiments:

- Treatment randomly assigned to applicants (both new and those for re-certification)
- Slightly more complicated for NEWWS and LA-GAIN (part of assignment to existing JOBS program).
- No significant impacts on hours, wages, fertility. Minimal impact on marital status.

go back

Identification of Production Parameters

Let Δ denote the difference operator between treatment j and control outcomes:

$$\mathbb{E}\Delta \log(\theta_{t+1}) = \delta_{I,t}\Big(\sum_D \Delta P_{kjt,D}\big[\log(Y_{k0t}(H,A) + w_q(L-30H)) - \hat{g}_{\kappa,t}\big]$$

$$P_{kjt,D}\Delta \log(Y_{kt}(H,A))\Big) + \delta_\theta \mathbb{E}\Delta \log(\theta_t)$$

where $\hat{g}_{\kappa,t} = \log(g_{\kappa,t}/g_{0,t})$ is the relative log-price under formal and informal care.

too much math!!!

Identification of Preferences I

Let $\rho_{kjt}(\omega) = P[A = 1 | k, j, t, \omega]$. When no time limit applies:

$$\log\left(\frac{\rho_{kjt}(\infty))}{1 - \rho_{kjt}(\infty))}\right) = \alpha_{C,t} \log\left(\frac{Y_{kjt}(0,1) + w_q L}{w_q L}\right) - \sigma_H \log\left(\frac{1 - P_{H,t}(1)}{1 - P_{H,t}(0)}\right) - \mathcal{R}_{kj}\alpha_{R,k} - \alpha_{H,k}$$

And under time limits:

$$\log\left(\frac{\rho_{kjt}(\omega)}{1 - \rho_{kjt}(\omega)}\right) - \log\left(\frac{\rho_{kjt}(\infty)}{1 - \rho_{kjt}(\infty)}\right) = \beta\left[\log\left(\frac{\rho_{kjt+1}(\omega)}{1 - \rho_{kjt+1}(\omega - 1)}\right) - \log\left(\frac{\rho_{kjt+1}(\infty)}{1 - \rho_{kjt+1}(\infty)}\right)\right]$$

Parameters identified by levels and treatment responses.

Identification of Preferences II

Fixing the choice of A, formal care use:

$$\log\left(\frac{P_{F,kjt}(A)}{1-P_{F,kjt}(A)}\right)=\sigma_F^{-1}\left[\alpha_{C,t}\log\left(\frac{Y_{kjt}(1,A)+w_q(L-30)-p_{F,k}}{Y_{kjt}(1,A)+w_q(L-30)}\right)+\alpha_{F,k}-\Gamma_t(\hat{g}_{2,t}-\hat{g}_{1,t})\right]$$

Work:

$$\log\left(\frac{P_{H,kjt}(A)}{1-P_{H,kjt}(A)}\right)=\sigma_H^{-1}\left[\alpha_{C,t}\log\left(\frac{Y_{kjt}(1,A)+w_q(L-30)-p_{F,k}}{Y_{kjt}(0,A)+w_qL}\right)-\alpha_{H,k}\right.$$
$$\left.+A\mathcal{R}_{kj}(\alpha_{R,k}-\alpha_{R2,k})+\alpha_{F,k}-\Gamma_t(\hat{g}_{2,t}-\hat{g}_{1,t})-\sigma_F\log(P_{F,kjt}(A))\right]$$

Parameters identified by levels and treatment responses.