Fertility and Family Labor Supply

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Motivation: Dynamics of Labor Supply and Fertility

- When do people work? When do they have children?
- Decisions intereact, yet studied in isolation
- Reforms targetting labour supply (tax cuts, childcare subsidies): additional consequences through fertility impacts
- Reforms targetting fertility (child subsidies): impact labour supply

Key points:

1. Labour market and fertility decisions interact with each other
2. Have life-time consequences

Contribution and Results

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   - Labor supply of men and women
   - Fertility (endogenous number and timing)
   - Life-cycle implications through human capital (and wealth)

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   - Labor supply of men and women
   - Fertility (endogenous number and timing)
   - Life-cycle implications through human capital (and wealth)
   - Labor supply elasticity of women 25% higher due to fertility adjustments
   - Fertility impacts: amplify (or mitigate) gender gaps in later life

Some Related Literature

- **Fertility responses to financial incentives:**
  - **Child subsidies and tax reliefs** (Cohen, Dehejia, & Romanov, 2013; Laroque & Salanié, 2014; Milligan, 2005; Olivetti & Petrongolo, 2017; Rosenzweig, 1999)
  - **Child care costs** (Blau & Robins, 1989; Del Boca, 2002; Mörk, Sjögren, & Svaleryd, 2013)
  - **Wealth** (housing) (Atalay, Li, & Whelan, 2017; Clark & Ferrer, 2019; Daysal, Lovenheim, Siersbæk, & Wasser, in press; Dettling & Kearney, 2014; Lovenheim & Mumford, 2013; Mizutani, 2015).
- **Female labor supply and fertility:** Hotz and Miller (1988); Francesconi (2002); Adda, Dustmann, and Stevens (2017); Eckstein, Keane, and Lifshitz (2019)
- **Long run labor supply elasticities** see e.g. Attanasio, Levell, Low, and Sánchez-Marcos (2018) and surveys by Keane (2011, in press)
- **Gender Gaps and Child Penalties**. Eg. Goldin (2014), Goldin and Katz (2002), Kleven, Landais, and Søgaard (2019)

Outline

1. Empirical Motivation
   - Data
   - Identification Strategy
   - Results

2. Life-Cycle Model
   - Model framework
   - Estimation
   - Simulations
   - Quantifying the Importance of Fertility

Denmark: Some Background

Denmark is an interesting lab and can be seen as a looking glass for other western countries

- Small open economy in Scandinavia
  (3.6 million people in the working-age population in 2008)
- High labour force participation
  (women: 78%, men: 84%, 55-59yo in 2008)
- Taxation at individual level mostly
- High marginal tax rate
  (63% in top bracket, 2008)
- Highly subsidized child care
  (at most 25% in co-payment)
- Generous subsidies for low income and single parents
  (e.g. reduced child care costs)
- Universal and free education (including university)

Data and Sample Selection

- **Use several Danish registers for 2004–2018**
  - Linking household members (married and cohabitating) details
  - Information on income, fertility, wealth etc.
  - Monthly pay-slip information (BFL, from 2010)
    - Aggregate to annual freq.
    - Center around calendar year or childbirth

- **Common sample selection:**
  - Aged 25–60
  - Has a partner (of opposite sex)
  - Discard people who are mainly
    self-employed, student, retired or on disability insurance

- **Two samples:**
  1. tax sample (aged 25–40)
  2. estimation sample (2010–2018, max. 5 years age difference)

Identification Strategy: Tax Variation

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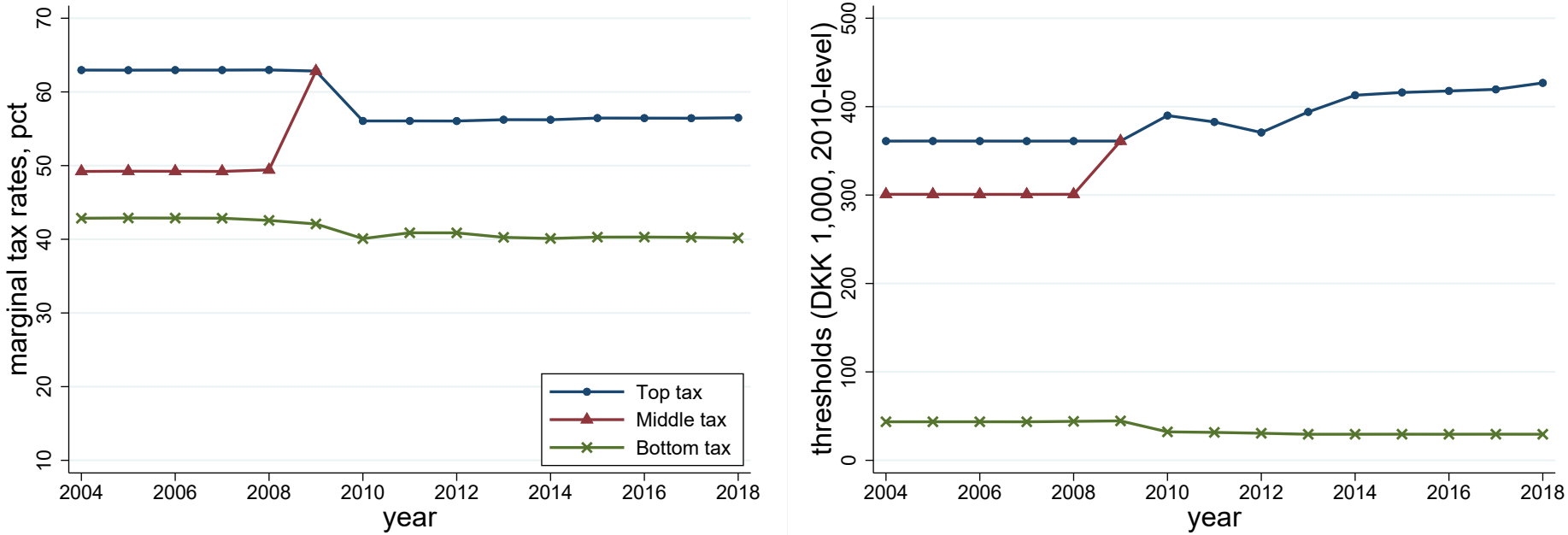
Figure: Danish Tax Variation, 2004–2018 (avg.).



(a) Marginal tax rates.

(b) Thresholds.

Notes: This Figure illustrates the main tax variation in the tax thresholds and marginal tax rates from 2004 through 2018 (averages). Source: Jakobsen and Søgaard (2019).

Identification Strategy: Tax simulator

- **Danish tax simulator** in the spirit of TAXSIM for the US.

  Based on Jakobsen and Søgaard (2019); H. J. Kleven and Schultz (2014).

- **Marginal net-of-tax wage rates**, $1 - \tau_{i,t}$
  - $\tau_{i,t} = \tau_t(z_{i,t}, Z_{i,t})$: marginal tax rate given personal income $z_{i,t}$, characteristics $Z_{i,t}$ (marital status).

- **Mechanical changes** in net of marginal tax wage
  - $\tau^k_{i,t} = \tau_k(z_{i,t}, Z_{i,t})$: marginal tax rate given info at t with time k tax schedule.

- **Recall:** we focus on women and their male partners
  - $\tau_{partner(i,t)}$ is thus the marginal tax rate of the male partner.

Identification Strategy: Regressions

- Estimate equations of the form (ETI literature)

$$\begin{aligned}\Delta_4 N_{i,t} =& \eta_w \Delta_4 \log(1-\tau_{i,t}) + \eta_m \Delta_4 \log(1-\tau_{partner(i,t)}) \\ &+ \gamma_w \Delta_4 \log(y_{i,t}) + \gamma_m \Delta_4 \log(y_{partner(i,t)}) \\ &+ \beta X_{i,t} + g(z_{i,t}) + \varepsilon_{i,t}\end{aligned}$$

where

- $N_{i,t}$: number of children of woman i at time t
- $\Delta_4 x_{i,t}$: four-year forward differences
- $y_{i,t}$: Virtual income
- $X_{i,t}$: year- and age dummies and human capital
- $g(z_{i,t})$ income controls for both partners in base year

- η_w: Compensated elasticity w.r.t **women's** marginal net-of-tax wage
- η_m: Compensated elasticity w.r.t **men's** marginal net-of-tax wage
- γ_w: Income effect w.r.t **women's** marginal net-of-tax wage
- γ_m: Income effect w.r.t **men's** marginal net-of-tax wage

Identification Strategy: 2SLS

- **Endogenous** marginal tax rates

- **Instrument** $\Delta_4 \log(1-\tau_{i,t})$ and $\Delta_4 \log(1-\tau_{partner(i,t)})$ with 4-year mechanical net-of-tax wage changes of each partner

$$\log(1-\tau_{i,t}^{t+4}) - \log(1-\tau_{i,t})$$
$$\log(1-\tau_{partner(i,t)}^{t+4}) - \log(1-\tau_{partner(i,t)})$$

- **Instrument** $\Delta_4 \log(y_{i,t})$ and $\Delta_4 \log(y_{partner(i,t)})$ likewise

details

2SLS Estimation Results: Fertility

	(1)	(2)	(3)
$\Delta_4 \log(1-\tau_{i,t})$, women	-0.035***	-0.023**	-0.023**
	(0.010)	(0.010)	(0.010)
$\Delta_4 \log(y_{i,t})$, women	0.003	0.004*	0.005*
	(0.003)	(0.003)	(0.003)
$\Delta_4 \log(1-\tau_{i,t})$, men	0.008	0.005	0.005
	(0.009)	(0.009)	(0.009)
$\Delta_4 \log(y_{i,t})$, men	0.020**	0.026***	0.028***
	(0.008)	(0.008)	(0.008)
Income dummies	Yes	Yes	Yes
Children dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Hum. cap. controls	No	Yes	Yes
Male partner controls	No	No	Yes
Avg. dep. var. (y, level)	1.522	1.522	1.522
Obs.	2531181	2531181	2531181
First stage F-stat.	27585.8	27869.9	27903.8

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2SLS Estimation Results: Discussion

- **Fertility responds to tax changes**
  1. **Income effect dominates** for men
     (marginal net-of-tax wage of **men** $\uparrow \Longrightarrow$ fertility $\uparrow$)
  2. **Substitution effect dominates** for women
     (marginal net-of-tax wage of **women** $\uparrow \Longrightarrow$ fertility $\downarrow$)

- **Low-income couples** have strongest response table

labor supply responses

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- **Next:**
  - Model joint decision
  - Quantify importance of fertility adjustments for long-run labor supply of men and women

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Model Overview

- Households maximize the expected discounted sum of future utility

- Choose
  - C_t: Consumption
  - $l_{w,t}$: Labor supply, women
  - $l_{m,t}$: Labor supply, men
  - e_t : Fertility effort

- Given states
  - $K_{w,t}$: Human capital, women
  - $K_{m,t}$: Human capital, men
  - A_{t-1}: Wealth
  - n_t: Number of children
  - o_t : Age of youngest child

Labor Supply

- Endogenous labor supply of men and women, $j \in \{m, w\}$:
  - Not working, $l_{j,t} = 0$
  - Part time, $l_{j,t} = 0.75$
  - Full time, $l_{j,t} = 1$

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- Human capital accumulation

$$K_{j,t+1} = [(1 - \delta)K_{j,t} + l_{j,t}]\epsilon_{j,t+1}$$

where $\epsilon_{j,t+1}$ is an iid log-normal mean-one shock.

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- Labor income is

$$Y_{j,t} = w_{j,t} l_{j,t}$$

where wages are

$$\log w_{j,t} = \gamma_{j,0} + \gamma_{j,1} K_{j,t}$$

details

Fertility

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- Imperfect fertility control
- Childbirth next period with probability

$$\wp_t(e_t) = \begin{cases} \overline{\wp}_t & \text{if } e_t = 1 \\ \overline{\wp}_t \underline{\wp} & \text{if } e_t = 0 \end{cases}$$

$\overline{\wp}_t < 1$: biological fecundity (declining in age) details
$\underline{\wp} > 0$: unintended pregnancies

- The age of the youngest, o_t, evolves deterministically details
- Children move out stochastically details

Preferences

- Household preferences are (unitarian)

$$U(C_t, n_t, o_t, l_{w,t}, l_{m,t}) = \lambda u_w(\cdot) + (1-\lambda) u_m(\cdot)$$

- Individual preferences are

$$\begin{aligned} u_j(C_t, n_t, o_t, l_{j,t}) = & \frac{(C_t / \nu(n_t))^{1-\rho}}{1-\rho} \\ & + \sum_{i=1}^{3} \omega_i \mathbf{1}(n_t \geq i) \\ & + \eta_0 e_t \mathbf{1}(o_t = 0) + \eta_1 e_t \mathbf{1}(o_t = 1) \\ & + f_j(l_{j,t}, age_{j,t}) \\ & + q_j(l_{j,t}, n_t, o_t) \mathbf{1}(n_t > 0) \end{aligned}$$

- **Flexible interaction between labor supply and children** in $q_j()$.

details

Institutional environment

- Partnership dissolution is random and absorbing details
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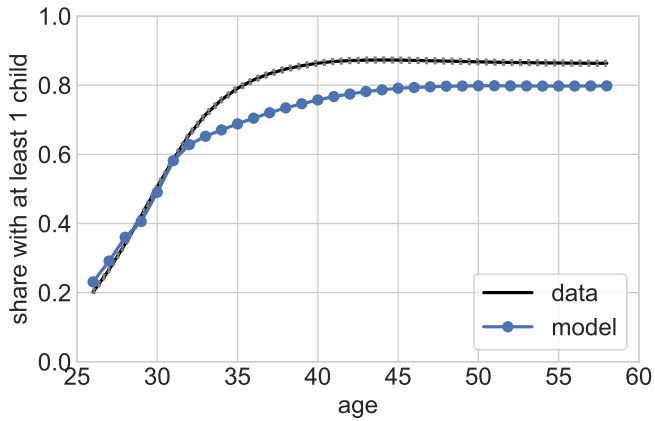
- Partnership dissolution is random and absorbing details
- Retirement is exogenous and absorbing
- Involuntary unemployment risk of 3 percent each year
- Parsimonious versions of the Danish institutions (2010 rules)
  - Labor income tax system
  - Unemployment transfers [fixed amount in model]
  - Child care costs
  - Child benefits details

Estimation: Two steps

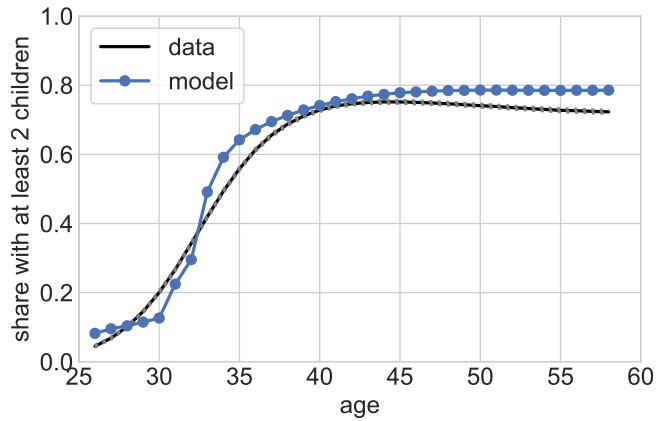
1. **Calibrate** a set of parameters, γ.
   E.g. $\beta = 0.97$, $\rho = 1.5$, and $\lambda = 0.5$.
   - Investigate the **sensitivity** to calibrated parameters (Jørgensen, in press)

2. **Estimate** the remaining 30 parameters, θ.
   E.g. value of children, $\omega_1, \omega_2, \omega_3$ and dis-utility of work, $q(\cdot)$
   - **Simulated Method of Moments**
   - Using estimation sample from 2010 (post-reform)
   - Investigate the "**informativeness**" of estimation moments (Honoré, Jørgensen, & de Paula, 2020)

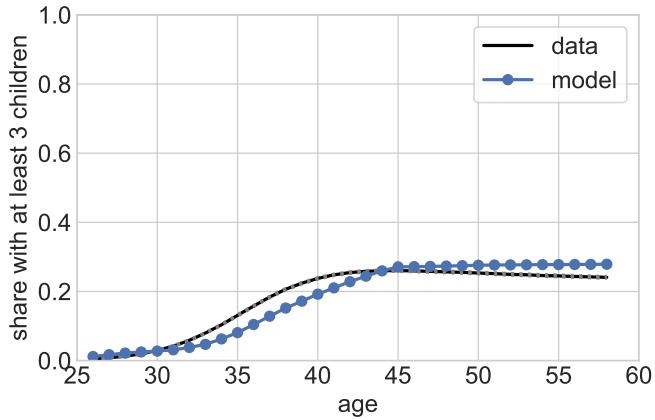
Moments: Children



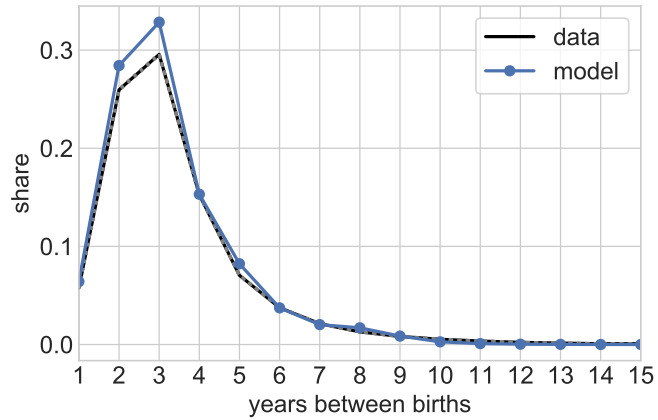
(a) Share with at least 1 child.



(b) Share with at least 2 children.

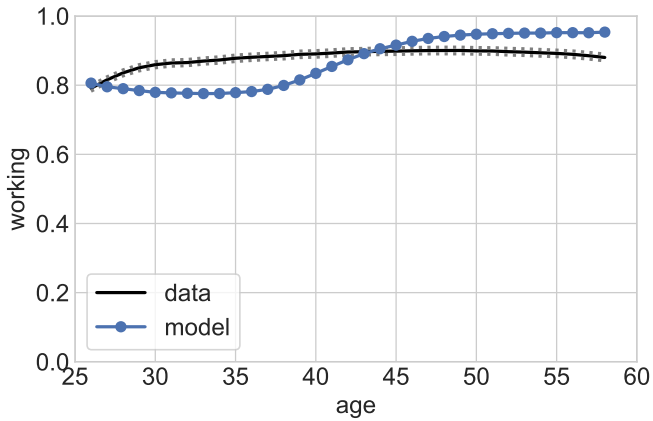


(c) Share with at least 3 children.

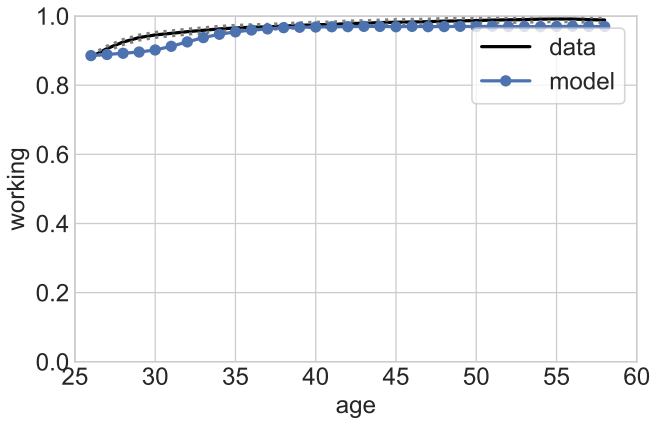


(d) Years between 1st and 2nd birth.

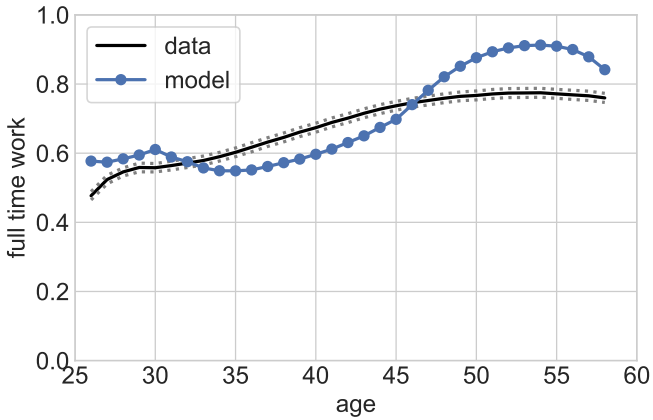
Moments: Labor Supply



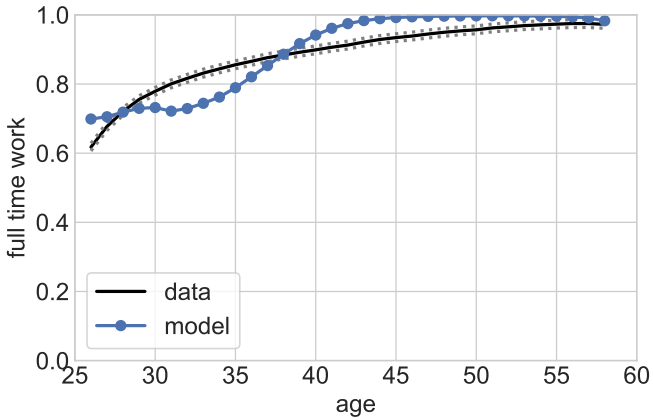
(a) Share Working, Women.



(b) Share Working, Men.

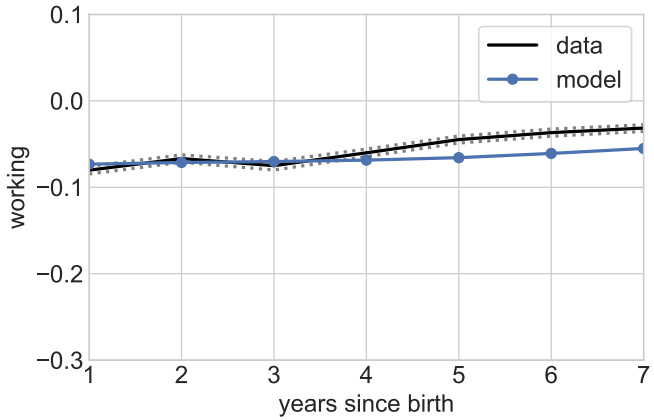


(c) Full time when working, Women.

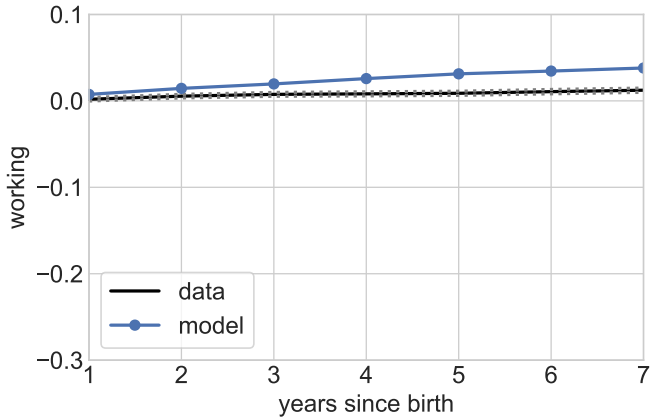


(d) Full time when working, Men.

Moments: Labor Supply around Child Arrival



(a) Share Working, Women.



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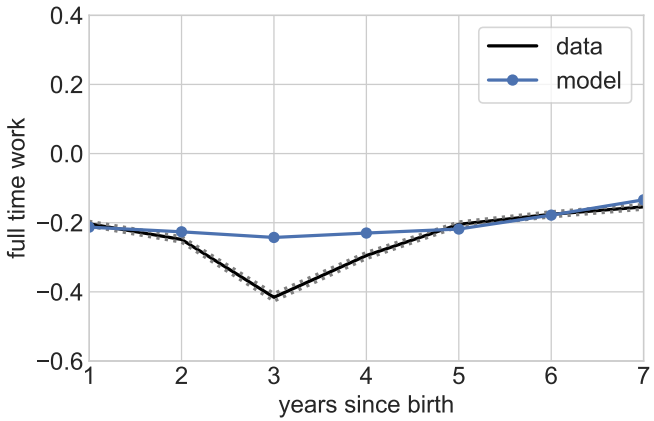

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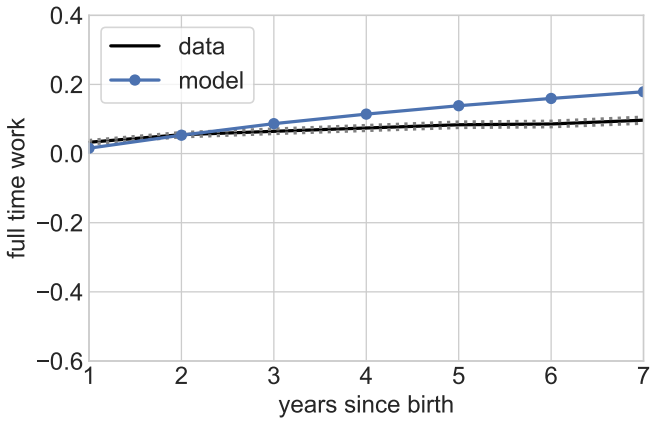
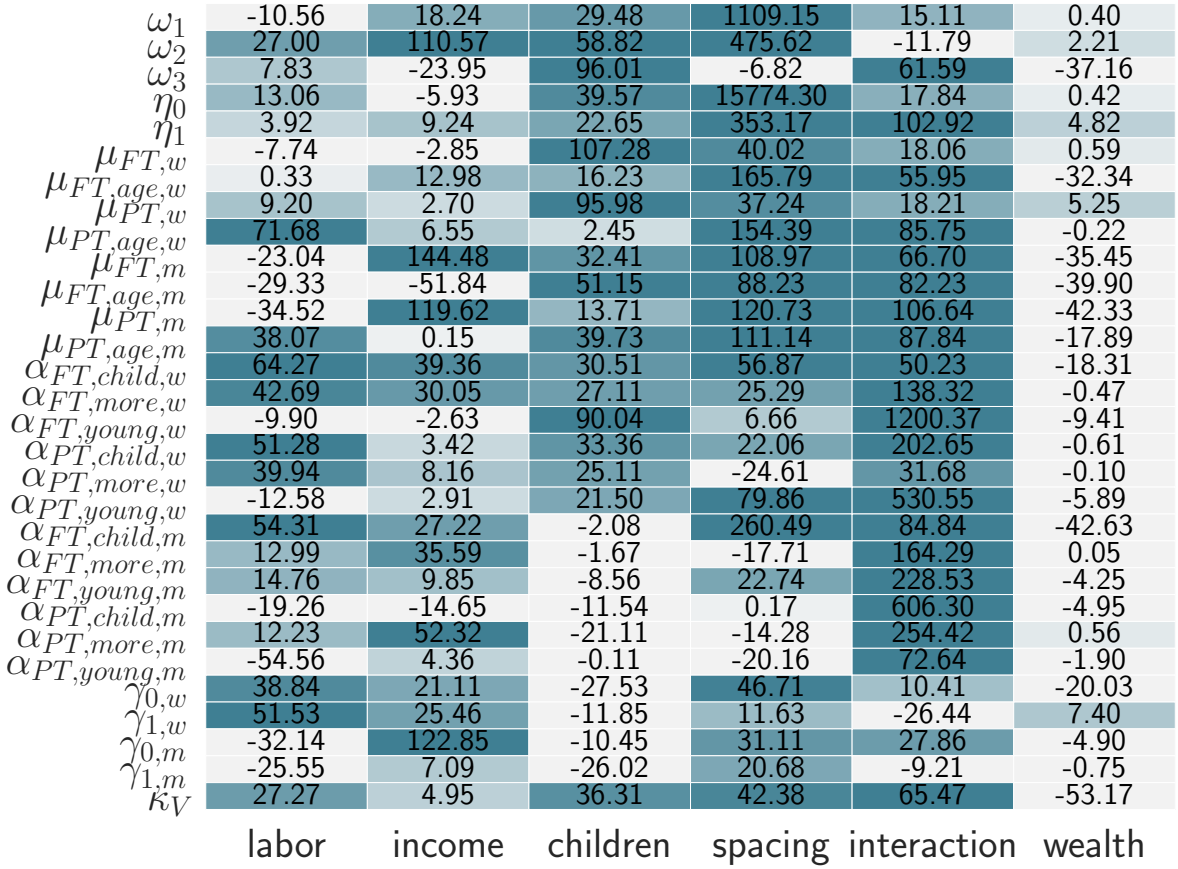


(d) Full time, Men.

- Need to model and measure parental leave

Informativeness of Estimation Moments



(based on Honoré, Jørgensen, & de Paula, 2020) details

- Labor market outcomes around childbirths (group 5)
  Informs non-seperability in labor market work and children ($\alpha_{.,child,.}$, $\alpha_{.,more,.}$ and $\alpha_{.,young,.}$).

Estimation Results

- **Non-separability** between children and dis-utility of work
  - number of children $\uparrow \Longrightarrow$ marginal dis-utility of work $\uparrow$

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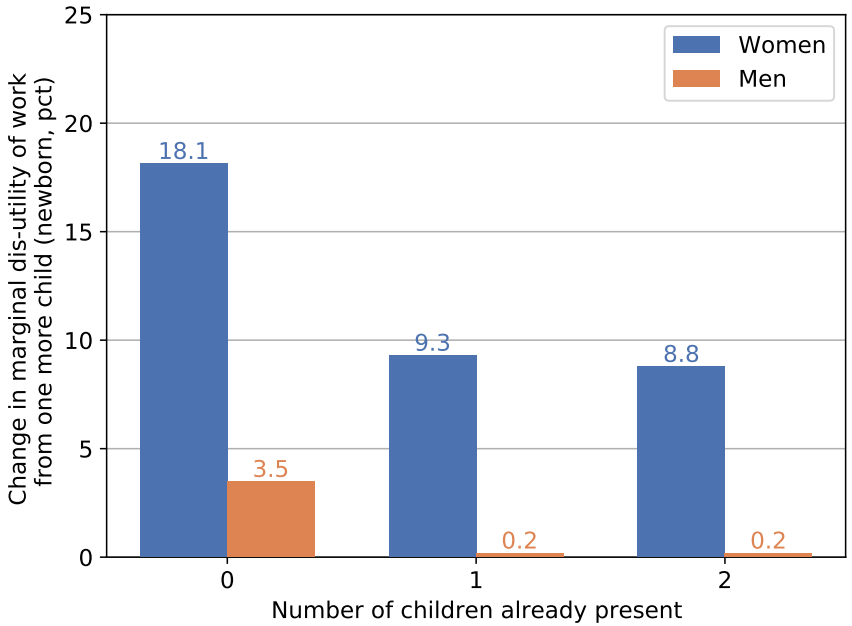
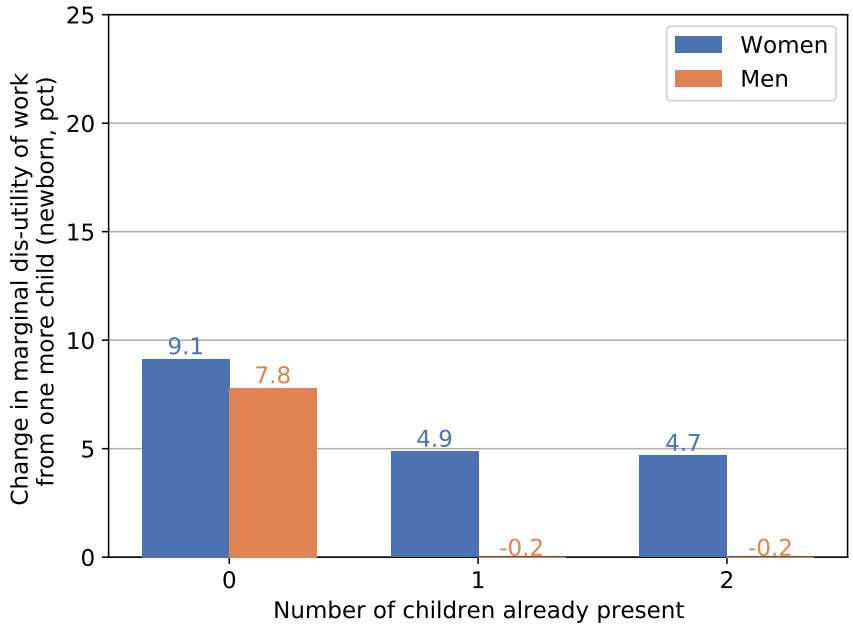
- **Non-separability** between children and dis-utility of work
  - number of children ↑ $\Longrightarrow$ marginal dis-utility of work ↑

Figure: Change in Marginal Dis-Utility from Work from Additional Children.



(a) From not working to part time.



(b) From part time to full time.

estimates details sensitivy

Implications: Three Questions

1. Wage changes affect fertility: what are the long-run implications for human capital, within couple inequality?
2. How much do fertility responses amplify labour supply elasticities?
3. What are the impacts of child subsidies on long-run inequality?

1. Simulations: Life-Cycle Elasticities

Unanticipated Permanent wage increases (Life-Cycle Marshallian) details

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Unanticipated Permanent wage increases (Life-Cycle Marshallian) details

	Participation		Hours		Wage at 55		Child	Comp.
Age	Women	Men	Women	Men	Women	Men	birth	fertility
			A. Elasticities w.r.t. wages of women					
26	1.34	-0.10	1.54	-0.40	1.64	-0.15	-1.17	-0.72
30	0.95	-0.08	1.04	-0.25	1.48	-0.10	-0.58	-0.28
35	0.82	-0.02	0.84	-0.12	1.39	-0.05	-0.40	-0.07
40	0.57	-0.00	0.59	-0.04	1.27	-0.02	-0.17	-0.01
45	0.31	-0.00	0.35	-0.02	1.13	-0.01	–	–
50	0.21	-0.00	0.24	-0.02	1.05	-0.00	–	–
avg.	0.54	-0.02	0.60	-0.10	1.24	-0.04	-0.37	-0.11
			B. Elasticities w.r.t. wages of men					
26	-0.81	0.31	-1.26	0.44	-0.56	1.14	3.12	1.89
30	-0.42	0.16	-0.80	0.23	-0.40	1.08	3.28	1.56
35	-0.37	0.03	-0.64	0.06	-0.32	1.03	2.32	0.42
40	-0.28	0.00	-0.52	0.02	-0.25	1.01	3.94	0.23
45	-0.11	0.00	-0.29	0.01	-0.12	1.00	–	–
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40	0.57	-0.00	0.59	-0.04	1.27	-0.02	-0.17	-0.01
45	0.31	-0.00	0.35	-0.02	1.13	-0.01	–	–
50	0.21	-0.00	0.24	-0.02	1.05	-0.00	–	–
avg.	0.54	-0.02	0.60	-0.10	1.24	-0.04	-0.37	-0.11
B. Elasticities w.r.t. wages of men								
26	-0.81	0.31	-1.26	0.44	-0.56	1.14	3.12	1.89
30	-0.42	0.16	-0.80	0.23	-0.40	1.08	3.28	1.56
35	-0.37	0.03	-0.64	0.06	-0.32	1.03	2.32	0.42
40	-0.28	0.00	-0.52	0.02	-0.25	1.01	3.94	0.23
45	-0.11	0.00	-0.29	0.01	-0.12	1.00	–	–
50	-0.03	0.00	-0.16	0.00	-0.04	1.00	–	–
avg.	-0.25	0.06	-0.48	0.09	-0.21	1.03	3.46	0.46

1. Long Run Implications

1. **Meaningful labor market responses**
   (Attanasio, Levell, Low, & Sánchez-Marcos, 2018)
2. **Impact of fertility adjustments:**
   - Wages of **men** $\uparrow$
     $\Longrightarrow$ fertility $\uparrow$
     $\Longrightarrow$ women's labor supply $\downarrow$
     $\Longrightarrow$ long run wage (at 55) of women $\downarrow$
   - Wages of **women** $\uparrow$
     $\Longrightarrow$ fertility $\downarrow$
     $\Longrightarrow$ women's labor supply $\uparrow$
     $\Longrightarrow$ long run wage (at 55) of women $\uparrow$

- Consistent with reduced form results

2. Quantifying how Fertility Amplifies Labor Supply Responses

- How important are **fertility adjustments for labor supply responses**?

2. Quantifying how Fertility Amplifies Labor Supply Responses

- How important are **fertility adjustments for labor supply responses**?

- We quantify this through counterfactual simulations
  - How different are labor supply elasticities if fertility cannot adjust?

2. Quantifying how Fertility Amplifies Labor Supply Responses

- **5% permanent (unanticipated) increase in wage rate**
  - Life-cycle Marshallian elasticity

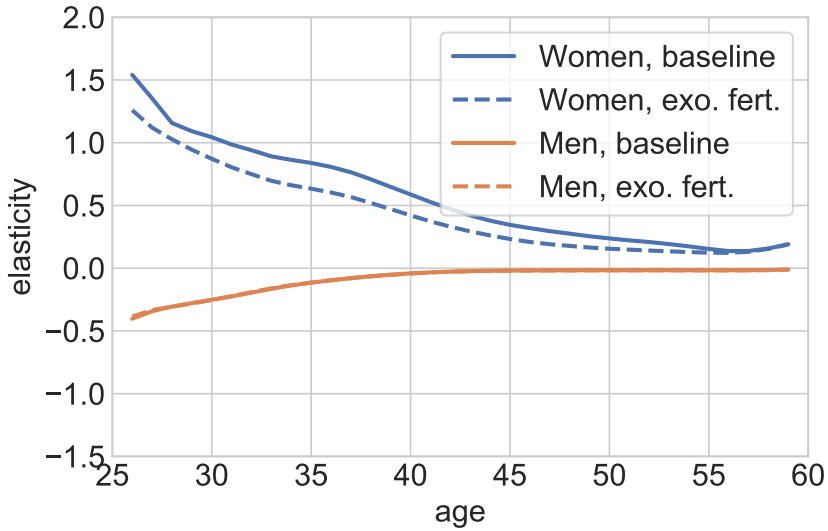
We simulate effect of wage increase from 2 models:

1. **baseline model**, with endogenous fertility

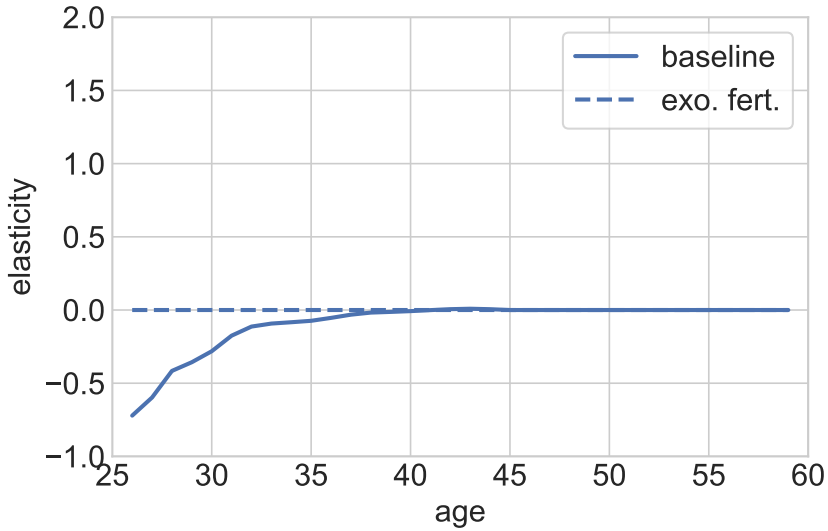
2. **exogenous fertility**, where couples cannot choose fertility
   - **Expect children to arrive *probabilistically***
     based on realized fertility from the baseline model details

2. Quantifying how Fertility Amplifies Labor Supply Responses

- Permanent unanticipated increased wages of **women**



(a) Hours.

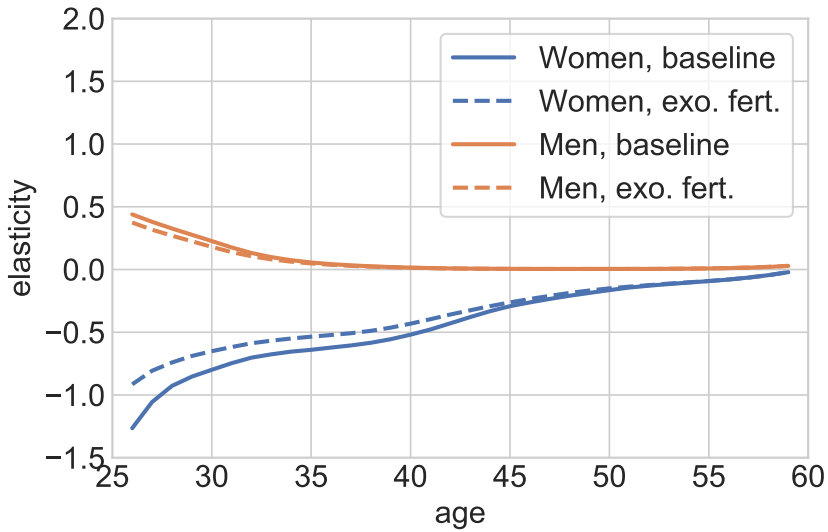


(b) Number of children.

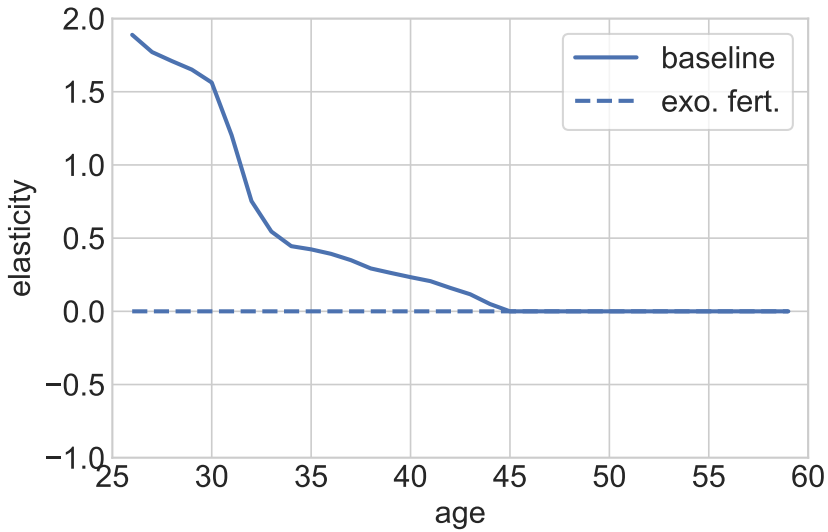
- Wages ↑ $\Longrightarrow$ Fertility ↓ $\Longrightarrow$ labor supply responsiveness ↑
- **Larger long-run Marshall elasticity** when fertility can adjust
  - $\sim$ 22% of labor response is due to fertility adjustments
  - both from the extensive and intensive fertility margin

2. Quantifying how Fertility Amplifies Labor Supply Responses

- Permanent unanticipated increased wages of **men**



(c) Hours.



(d) Number of children.

- **Small difference** in the behavior of men
- **Fertility is important for cross-effects:**
  - Effect of men's wages on women larger when fertility can adjust
  - Larger reduction in long run offer wage of women ~20 percent

3. Child Subsidy

- Introduce unconditional cash transfer at childbirth
- Baseline model and alternative exogenous fertility model

	Participation		Hours		Wage at 55		Child	Comp.
	Women	Men	Women	Men	Women	Men	birth	fertility
A. Baseline model								
3000	-2.23	0.03	-2.23	0.13	-0.53	0.02	4.97	3.66
9000	-3.08	0.11	-3.21	0.34	-0.87	0.05	12.29	9.11
B. Alternative exogenous fertility model								
3000	-0.14	-0.02	-0.15	-0.03	-0.03	-0.01	0.00	0.00
9000	-0.26	-0.04	-0.24	-0.12	-0.07	-0.02	0.00	0.00

- Substantial human capital losses when fertility adjusts to child subsidy
- Government budget in worse position

Conclusions

- **Fertility reacts to financial incentives**
  - Marginal wage rises for women decrease fertility
  - Marginal wage rises for men increase fertility

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- **Labor Supply Responses**
  - Use a life-cycle model of joint labour supply and fertility
  - Different fertility responses impact human capital and gender inequality later in life
  - Labor supply responses for women to (permanent) wage changes are amplified when fertility can also adjust: 25% higher

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  - "Fertility Multiplier"

Conclusions

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Extra Slides

Definition of partnership

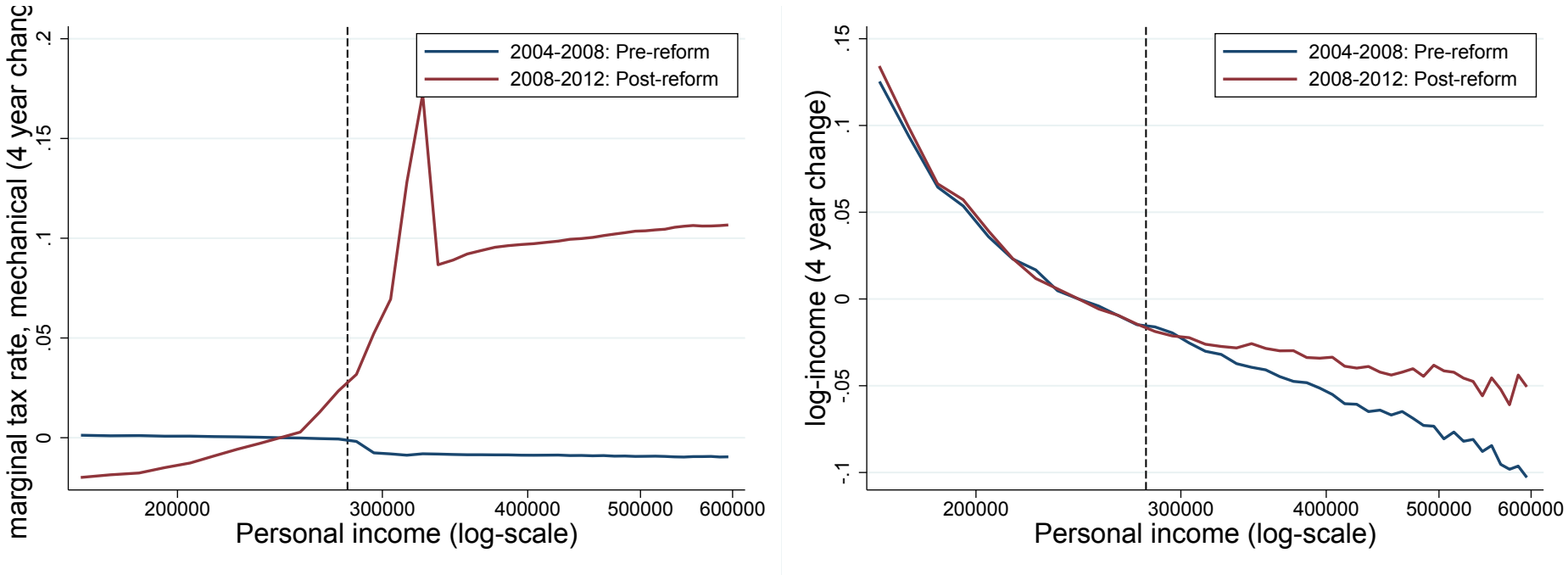
- Official definition of Statistics Denmark.
  https://www.dst.dk/da/Statistik/dokumentation/Times/cpr-oplysninger/familier-og-husstande/familie-type

- Either
  1. Legally married
  2. Living with a person with shared custody over a child (share legal address)
  3. Living with one other person of opposite sex with an age difference less than 15. (share legal address and both at least 16 years old)

back

Details on Instrument

Figure: Verification: 4-year differences across the income distribution.



(a) Mechanical tax change. (b) Log income.

Notes: This figure illustrates the tax variation and the plausibility of the variation in generating exogeneous variation.

back

First-stage Results, $\Delta_4 \log(1-\tau_{i,t})$, Women

	(1)	(2)	(3)
$\Delta_4 \tau^m_{i,t}$, women	0.428***	0.426***	0.426***
	(0.002)	(0.002)	(0.002)
$\Delta_4 \log(y^m_{i,t})$, women	0.010***	0.010***	0.010***
	(0.000)	(0.000)	(0.000)
$\Delta_4 \tau^m_{i,t}$, men	0.019***	0.019***	0.019***
	(0.001)	(0.001)	(0.001)
$\Delta_4 \log(y^m_{i,t})$, men	0.028***	0.027***	0.027***
	(0.001)	(0.001)	(0.001)
Income dummies	Yes	Yes	Yes
Children dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Hum. cap. controls	No	Yes	Yes
Male partner controls	No	No	Yes
Avg. dep. var. (y, level)			
Obs.	2531181	2531181	2531181
First stage F-stat.			

First-stage Results, $\Delta_4 \log(y_{i,t})$, Women

	(1)	(2)	(3)
$\Delta_4 \tau^m_{i,t}$, women	0.037***	0.037***	0.037***
	(0.004)	(0.004)	(0.004)
$\Delta_4 \log(y^m_{i,t})$, women	-0.024***	-0.024***	-0.023***
	(0.001)	(0.001)	(0.001)
$\Delta_4 \tau^m_{i,t}$, men	0.068***	0.068***	0.071***
	(0.003)	(0.003)	(0.003)
$\Delta_4 \log(y^m_{i,t})$, men	0.306***	0.306***	0.304***
	(0.008)	(0.008)	(0.008)
Income dummies	Yes	Yes	Yes
Children dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Hum. cap. controls	No	Yes	Yes
Male partner controls	No	No	Yes
Obs.	2531181	2531181	2531181

First-stage Results, $\Delta_4 \log(1-\tau_{i,t})$, Men

	(1)	(2)	(3)
$\Delta_4 \tau^m_{i,t}$, women	0.015***	0.013***	0.014***
	(0.001)	(0.001)	(0.001)
$\Delta_4 \log(y^m_{i,t})$, women	0.008***	0.009***	0.008***
	(0.000)	(0.000)	(0.000)
$\Delta_4 \tau^m_{i,t}$, men	0.407***	0.407***	0.406***
	(0.001)	(0.001)	(0.001)
$\Delta_4 \log(y^m_{i,t})$, men	0.006***	0.005***	0.006***
	(0.001)	(0.001)	(0.001)
Income dummies	Yes	Yes	Yes
Children dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes
Hum. cap. controls	No	Yes	Yes
Male partner controls	No	No	Yes
Obs.	2531181	2531181	2531181

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Age dummies	Yes	Yes	Yes
Hum. cap. controls	No	Yes	Yes
Male partner controls	No	No	Yes
Obs.	2531181	2531181	2531181

2SLS Results by Income

back

	income $\in [50, 350]$ (1)	income $\in (350, 600]$ (2)	less skilled (3)	high skilled (4)
$\Delta_4 \log(1-\tau_{i,t})$, women	-0.030***	-0.048	-0.048***	-0.019
	(0.010)	(0.038)	(0.015)	(0.013)
$\Delta_4 \log(y_{i,t})$, women	0.005*	0.009	0.002	0.003
	(0.003)	(0.016)	(0.003)	(0.004)
$\Delta_4 \log(1-\tau_{i,t})$, men	0.007	0.004	0.038***	-0.026*
	(0.010)	(0.027)	(0.012)	(0.014)
$\Delta_4 \log(y_{i,t})$, men	0.048***	0.040***	0.000	0.025**
	(0.016)	(0.010)	(0.013)	(0.011)
Income dummies	Yes	Yes	Yes	Yes
Children dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Age dummies	Yes	Yes	Yes	Yes
Hum. cap. controls	Yes	Yes	Yes	Yes
Male partner controls	Yes	Yes	Yes	Yes
Avg. dep. var. (y, level)	1.526	1.496	1.664	1.372
Obs.	2205258	325923	1299908	1231273
First stage F-stat.	19869.3	1996.9	11197.1	15910.2

back

2SLS Results: Labor Supply

back

	Women (1)	Men (2)
$\Delta_4 \log(1-\tau_{i,t})$, women	0.213***	0.111***
	(0.015)	(0.013)
$\Delta_4 \log(y_{i,t})$, women	-0.016***	0.003
	(0.005)	(0.003)
$\Delta_4 \log(1-\tau_{i,t})$, men	-0.004	0.200***
	(0.015)	(0.014)
$\Delta_4 \log(y_{i,t})$, men	0.006	-0.019
	(0.011)	(0.016)
Income dummies	Yes	Yes
Children dummies	Yes	Yes
Year dummies	Yes	Yes
Age dummies	Yes	Yes
Hum. cap. controls	Yes	Yes
Male partner controls	Yes	Yes
Avg. dep. var. (y, level)	5.454	5.728
Obs.	2316021	2396584

Details on Part Time back

- The part time value of $l_{PT} = 0.75$ is motivated by
  - Statistics Denmark's definition of part time in work experience statistics
  - Close to typical hours in Denmark
    - A normal full-time week is 37 hours in Denmark
    - part time is typically 30 or 32 hours per week ($81\% - 87\%$ of the full-time hours)
- The value affects the human capital accumulation process and the wage/income process
- Utility function is independent of the exact value
- Results are not overly sensitive to this choice.

Details on the Age of Youngest

back

- The age of the youngest child aged 0–6, o_t, evolves as

$$o_{t+1} = \begin{cases} 0 & \text{if } b_{t+1} = 1 \\ o_t + 1 & \text{if } b_{t+1} = 0 \text{ and } o_{t+1} \in \{0, 1, 2, 3, 4, 5\} \\ o_t & \text{if } b_{t+1} = 0 \text{ and } o_t \in \{6+\} \\ NC & \text{if } b_{t+1} = 0 \text{ and } o_t \in \{NC\}. \end{cases} \tag{1}$$

Details on the Fertility Process back

- The number of children evolves as

$$n_{t+1} = n_t + b_{t+1}(e_t) - x_{t+1} \tag{2}$$

where x_{t+1} refers to a child moving out, as is given by

$$x_{t+1} = \begin{cases} 1 & \text{with probability } q_t(n_t, o_t) \\ 0 & \text{with probability } 1 - q_t(n_t, o_t) \end{cases} \tag{3}$$

- Children can move out once the fertile period ends at T_f
- x_{t+1} is a realization of a Binomial distribution with

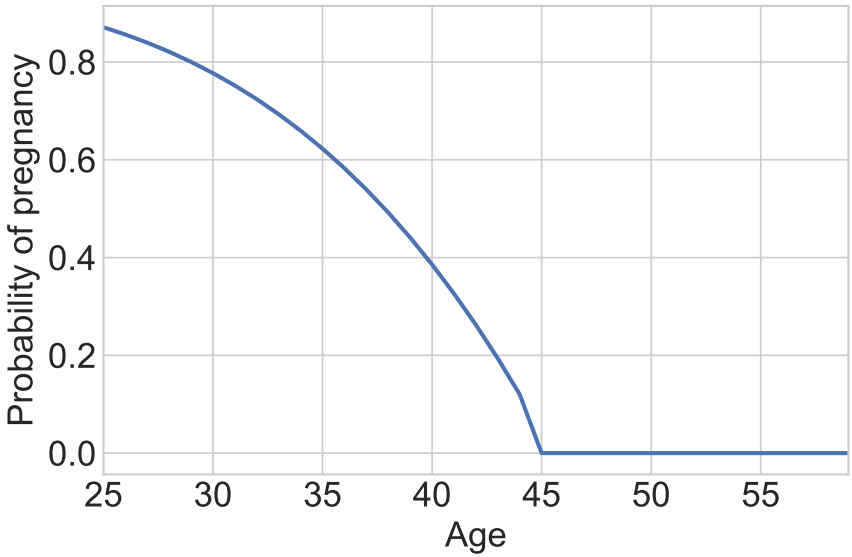
$$q_t(n_t, o_t) = \begin{cases} P_{bin}(1, p_x | n_t - o_t) & \text{if } n_t > 0,\ t > T_f \text{ and } o_t \in \{6+\} \\ 0 & \text{else} \end{cases}$$

where

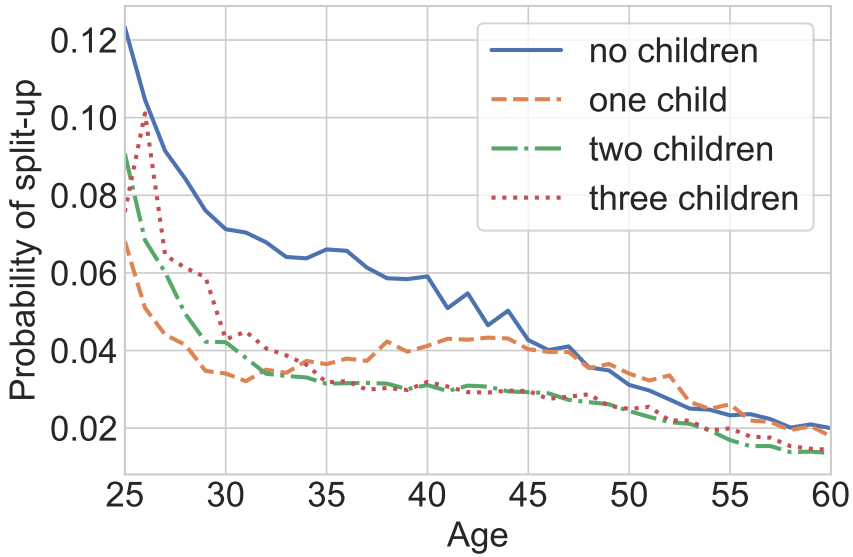
$$P_{bin}(1, p_x | n) = \frac{n!}{(n-1)!} p_x (1 - p_x)^{n-1}$$

Details on Fertility and Partnership Dissolution

back



(c) Biological Fecundity, $\overline{\wp}_t$.



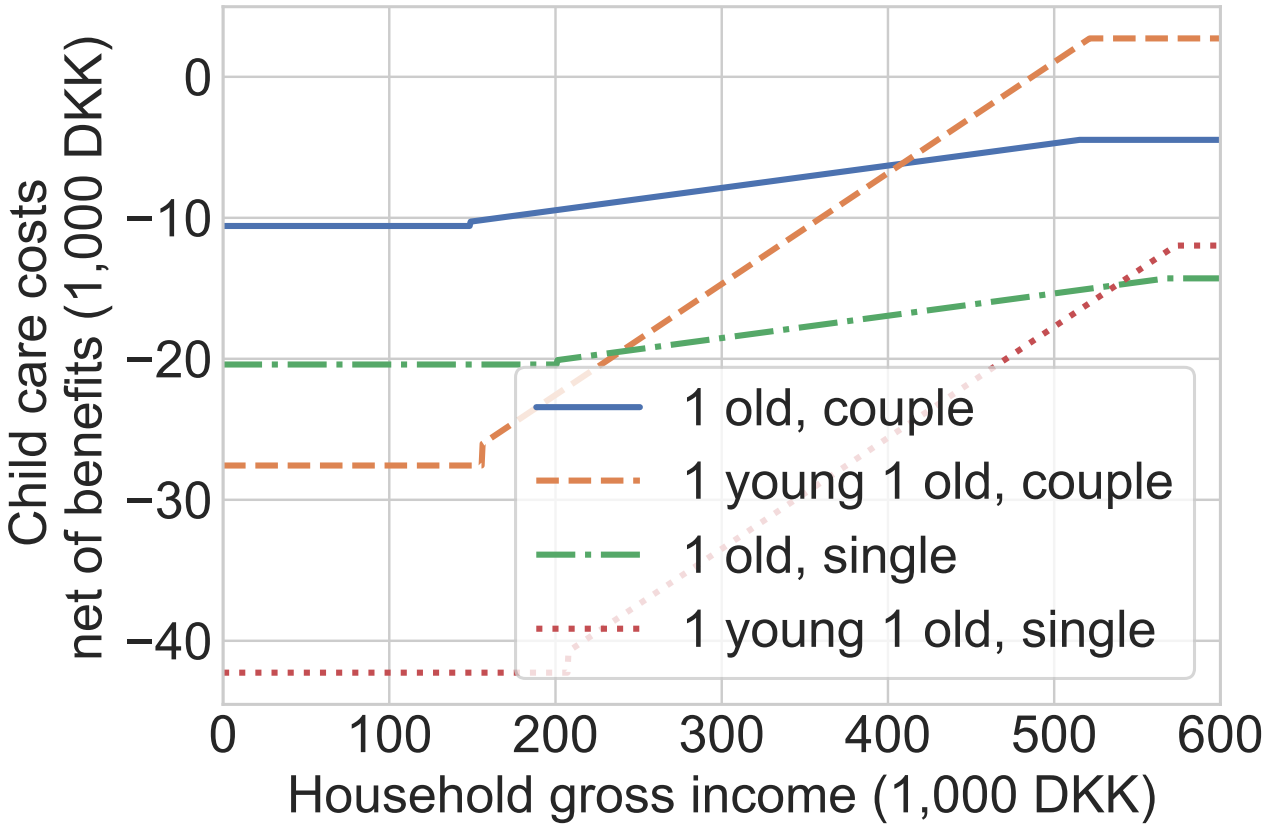
(d) Partnership Dissolution Probabilities.

Figure: Biological Fecundity and Dissolution Probabilities.

Notes: Figure 4 shows in panel (a) the biological fecundity, $\overline{\wp}_t$, based on Leridon (2004). Panel (b) shows the probability of partnership dissolution as a function of the age of the woman and the existing number of children, based on Danish register data.

Details on Child Costs and Transfers back

Figure: Costs net of Benefits, $\mathcal{C}(n_t, o_t, Y_t, s_t)$.



Details on Preferences back

- We let the dis-utility from the amount of labor market work depend on the number of children and the age of the youngest child through

$$q_j(\bullet) = \mu_{PT,j}\mathbf{1}(l_{j,t} = l_{PT})\left[\alpha_{PT,child,j} + \alpha_{PT,more,j}(n_t - 1) + \alpha_{PT,young,j}\mathbf{1}(o_t \leq 3)\right]$$
$$+\mu_{FT,j}\mathbf{1}(l_{j,t} = 1)\left[\alpha_{FT,child,j} + \alpha_{FT,more,j}(n_t - 1) + \alpha_{FT,young,j}\mathbf{1}(o_t o_t \leq 3)\right]$$

  where $l_{j,t} = 0$ is the reference alternative.
- All parameters are relative to the baseline dis-utility of work from

$$f_j(l_{j,t}, age_{j,t}) = \mu_{PT,j}\mathbf{1}(l_{j,t} = l_{PT})\left[1 + \mu_{PT,age,j}(age_{j,t} - 25)\right]$$
$$+ \mu_{FT,j}\mathbf{1}(l_{j,t} = 1)\left[1 + \mu_{FT,age,j}(age_{j,t} - 25)\right]$$

Parameter Estimates

back

Parameter		estimate	se
Utility from children.			
ω_1	Value of having at least one child	11.698	(0.012)
ω_2	Value of having at least two children	13.002	(0.006)
ω_3	Value of having at least three children	9.591	(0.015)
η_0	Value of fertility effort when child aged 0 present	-0.064	(0.000)
η_1	Value of fertility effort when child aged 1 present	-0.015	(0.000)
Utility from market work, $f_w(\bullet)$ and $f_m(\bullet)$. Relative to not working.			
$\mu_{FT,w}$	Value of full time work, women	-0.511	(0.001)
$\mu_{FT,age,w}$	Value of full time work wrt. age, women (pct)	-2.060	(0.005)
$\mu_{PT,w}$	Value of part time work, women	-0.269	(0.000)
$\mu_{PT,age,w}$	Value of part time work wrt. age, women (pct)	-2.701	(0.006)
$\mu_{FT,m}$	Value of full time work, men	-0.670	(0.001)
$\mu_{FT,age,m}$	Value of full time work wrt. age, men (pct)	-1.966	(0.006)
$\mu_{PT,m}$	Value of part time work, men	-0.372	(0.001)
$\mu_{PT,age,m}$	Value of part time work wrt. age, men (pct)	-2.170	(0.008)
Utility from market work w. children, $q_w(\bullet)$ and $q_m(\bullet)$. Relative to not working.			
$\alpha_{FT,child,w}$	Value of full time work with children, women (pct)	11.394	(0.037)
$\alpha_{FT,more,w}$	Value of full time work with children, women (pct)	5.603	(0.031)
$\alpha_{FT,young,w}$	Value of full time work with young children, women (pct)	2.486	(0.029)
$\alpha_{PT,child,w}$	Value of part time work with more children, women (pct)	14.222	(0.064)
$\alpha_{PT,more,w}$	Value of part time work with more children, women (pct)	6.705	(0.060)
$\alpha_{PT,young,w}$	Value of part time work with young children, women (pct)	3.909	(0.073)
$\alpha_{FT,child,m}$	Value of full time work with children, men (pct)	5.363	(0.017)
$\alpha_{FT,more,m}$	Value of full time work with children, men (pct)	-0.005	(0.011)
$\alpha_{FT,young,m}$	Value of full time work with young children, men (pct)	0.033	(0.022)
$\alpha_{PT,child,m}$	Value of part time work with more children, men (pct)	3.451	(0.047)
$\alpha_{PT,more,m}$	Value of part time work with more children, men (pct)	0.157	(0.041)
$\alpha_{PT,young,m}$	Value of part time work with young children, men (pct)	0.026	(0.054)
Wage equations.			
$\gamma_{0,w}$	Wage: constant, women	0.773	(0.001)
$\gamma_{1,w}$	Wage: human capital, women	0.085	(0.000)
$\gamma_{0,m}$	Wage: constant, men	0.771	(0.001)
$\gamma_{1,m}$	Wage: human capital, men	0.103	(0.000)
Miscellaneous.			
κ_V	Retirement: value function adjustement	0.519	(0.004)

Change in the Marginal Dis-Utility of Work back

- We denote the marginal dis-utility of work as

$$\Delta_{PT} U_j(n,o) = -q_j(PT,n,o) + q_j(NT,n,o)$$
$$\Delta_{FT} U_j(n,o) = -q_j(FT,n,o) + q_j(PT,n,o)$$

- The *change* in the marginal dis-utility from having another child is

$$\Delta_l(n) = \frac{\Delta_l U_j(n+1,0) - \Delta_l U_j(n,6+)}{\Delta_l U_j(n,6+)} \cdot 100$$

  for $l \in \{PT, FT\}$, measured in percentage changes.

- Assumes that previous children were 6+ years old

Informativeness of Estimation Moments back

- Based on M_4 in Honoré et al. (2020)
- The percentage change in the asymptotic variance of elements of $\hat{\theta}$ from removing groups of moments in $g(\theta)$

$$I_k = \text{diag}(\tilde{\Sigma}_k - \Sigma) \, / \, \text{diag}(\Sigma) \cdot 100 \tag{4}$$

where

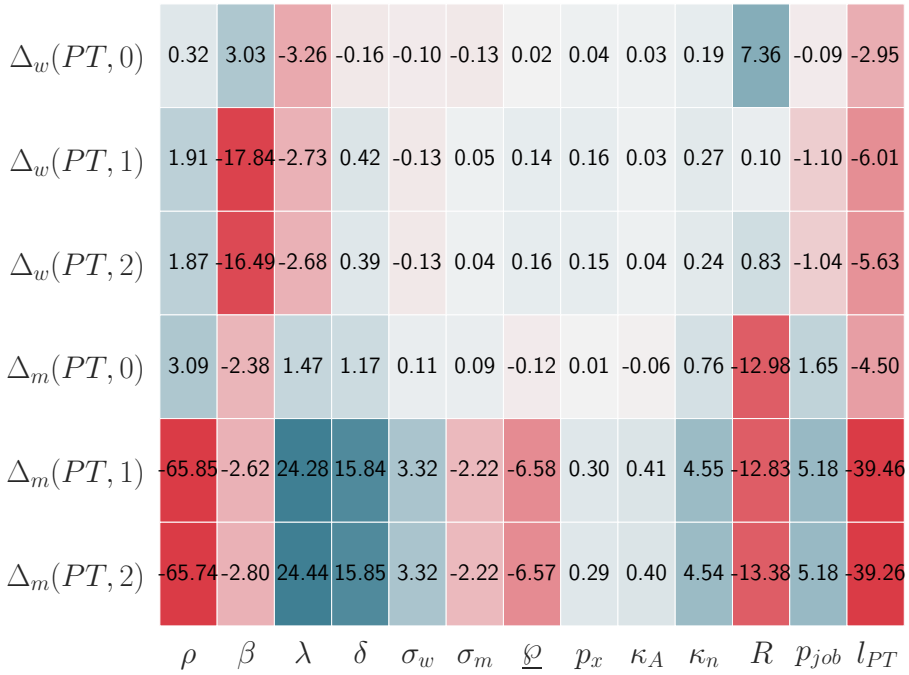
$$\tilde{\Sigma}_k = (G'\tilde{W}_k G)^{-1} G'\tilde{W}_k S \tilde{W}_k G (G'\tilde{W}_k G)^{-1}$$
$$\tilde{W}_k = W \odot (\iota_k \iota_k')$$

and $\odot$ is element-wise multiplication and ι_k is a $J \times 1$ vector with ones in all elements except the kth *group* of moments being zeros.

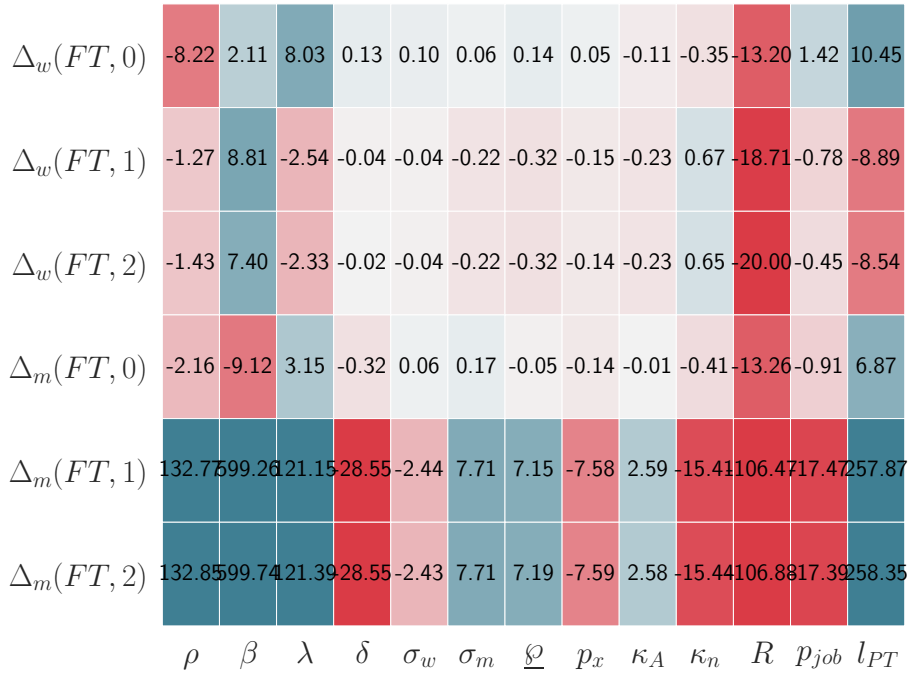
1. Share working and the share working full time conditional on working, split by age and gender.
2. Average labor income when working, split by age and gender.
3. Share with at least 1, 2 or 3 children, split by age.
4. Distribution of years between first and second childbirths.
5. Share working and share working full time after first and second childbirth, split by gender.
6. Average wealth split by age.

Sensitivity: Change in the Marginal Dis-Utility of Work

back



(a) Part Time.



(b) Full Time.

Sensitivity: Change in the Marginal Dis-Utility of Work

back

- Based on the approximation (Jørgensen, in press)

$$\frac{\partial \hat{\boldsymbol{\theta}}}{\partial \boldsymbol{\phi}'} \approx -(G'WG)^{-1}G'D$$

in which
$G = \frac{\partial g(\hat{\boldsymbol{\theta}}|\boldsymbol{\phi})}{\partial \hat{\boldsymbol{\theta}}'}$
$D = \frac{\partial g(\hat{\boldsymbol{\theta}}|\boldsymbol{\phi})}{\partial \boldsymbol{\phi}'}$

- We calculate

$$\begin{aligned}\frac{d\Delta_j(l,n)}{d\boldsymbol{\phi}'} &= \frac{\partial \Delta_j(l,n)}{\partial \boldsymbol{\theta}'}\frac{\partial \boldsymbol{\theta}}{\partial \boldsymbol{\phi}'} \\ &\approx -\frac{\partial \Delta_j(l,n)}{\partial \boldsymbol{\theta}'}(G'WG)^{-1}G'D\end{aligned}$$

and report elasticities

Simulation Details back

- Simulate 500,000 synthetic households from age 25 through 60
- Initialize all households as couples with zero net wealth and the empirical joint distribution of number of children, age of youngest and human capital.
- The effect at age t of a wage increase is

$$\Delta y_t = y_t - \tilde{y}_t$$

where $y_t = n_t^{-1} \sum_i y_{i,t}$ is the average simulated optimal outcome under the baseline estimated model and $\tilde{y}_t^{(s_1:s_2)} = n_t^{-1} \sum_i \tilde{y}_{i,t}^{(s_1:s_2)}$ is the average simulated optimal outcome under the counterfactual setting in which wages are scaled by μ percent in periods s_1 through s_2.

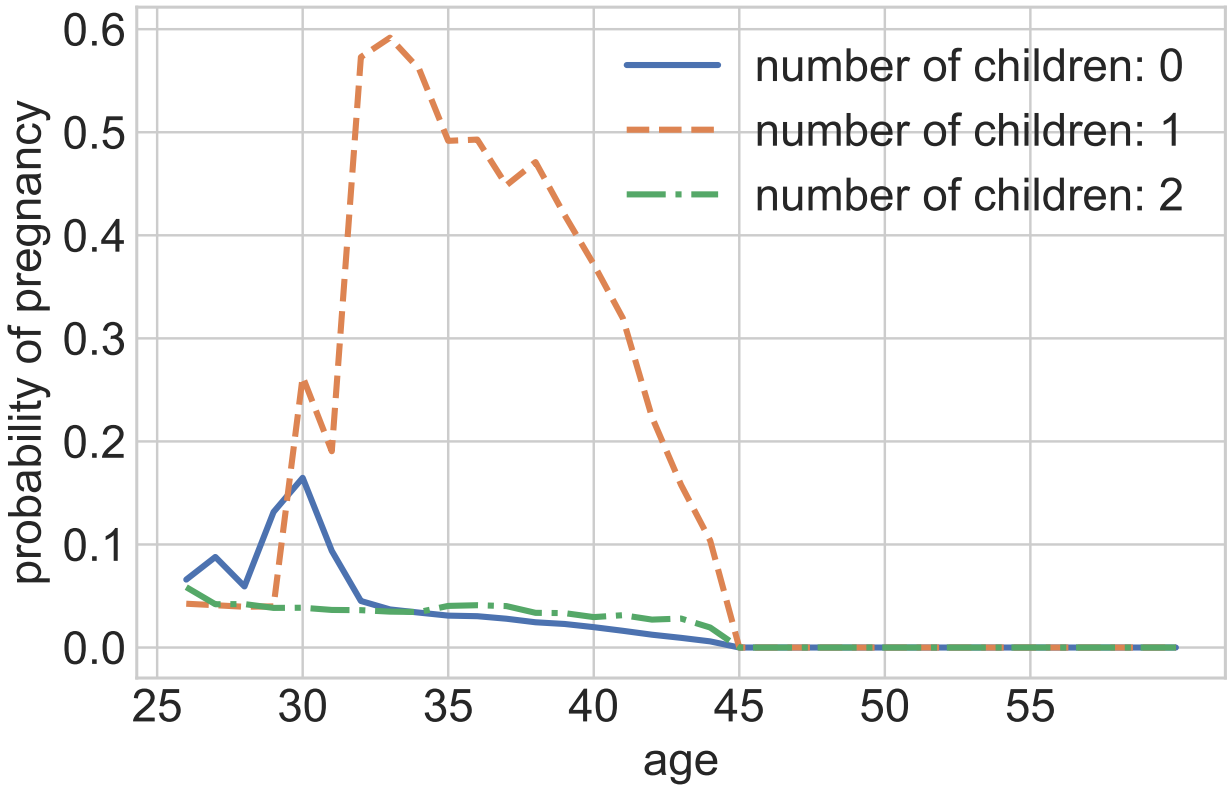
- Formally, wages in the alternative model are given as

$$\tilde{w}_{i,t}^{(s_1:s_2)} = \begin{cases} (1+\mu) w_{i,t} & \text{if } s_1 \leq t \leq s_2 \\ w_{i,t} & \text{else.} \end{cases}$$

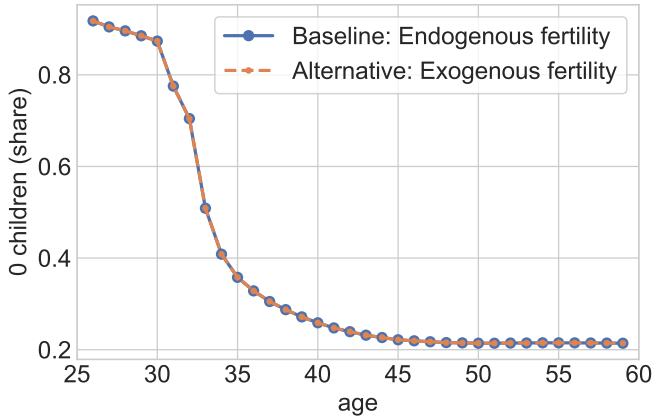
Unless otherwise explicitly stated, we use a five percent increase, $\mu = 0.05$.

Simulated Birth Probabilities back

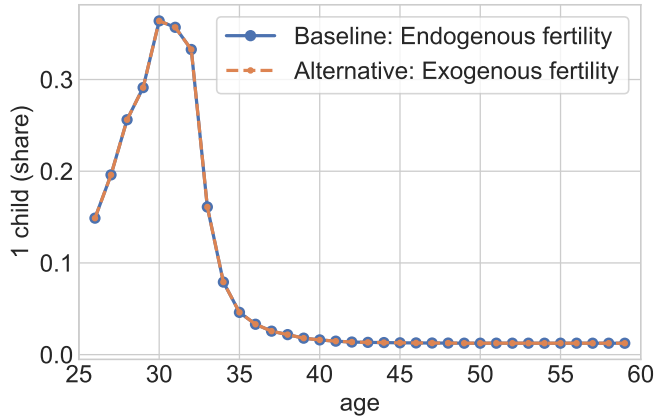
Figure: Realized Simulated Pregnancy Probabilities.



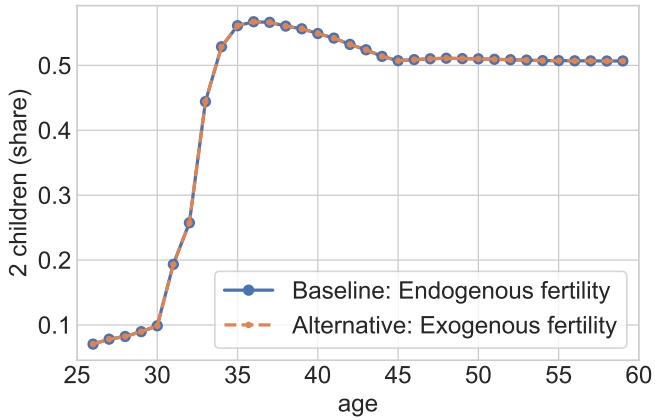
Baseline and Alternative Model Simulations back



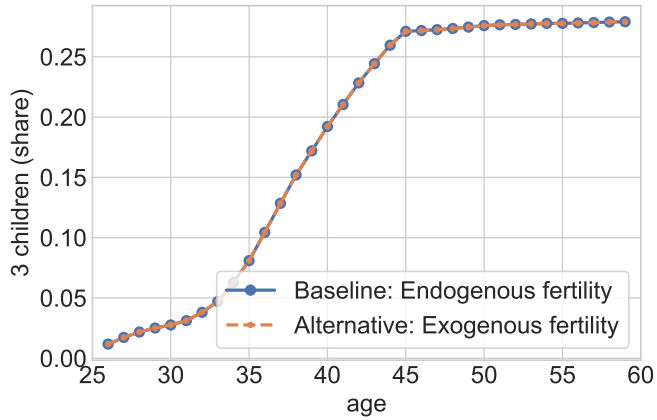
(a) Share without children.



(b) Share with one child.



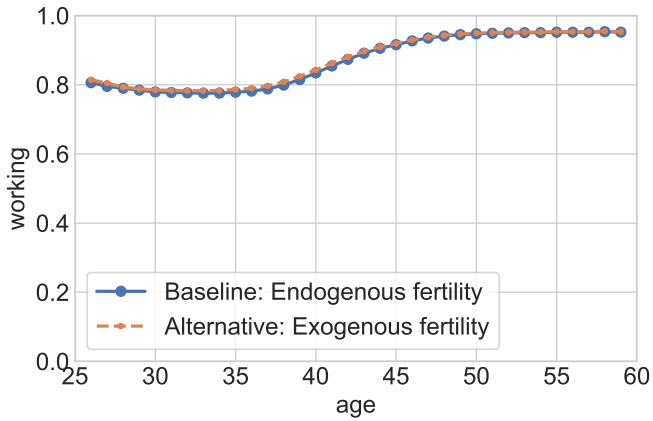
(c) Share with two children.



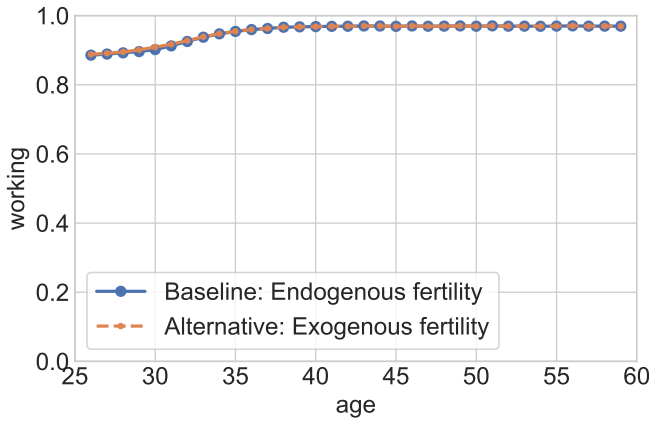
(d) Share with three children.

Baseline and Alternative Model Simulations

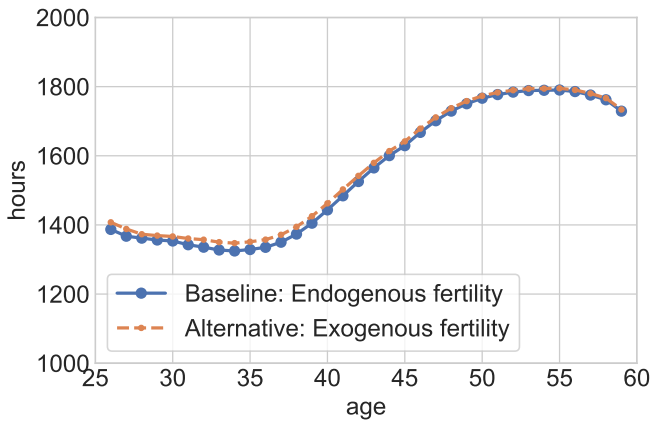
back



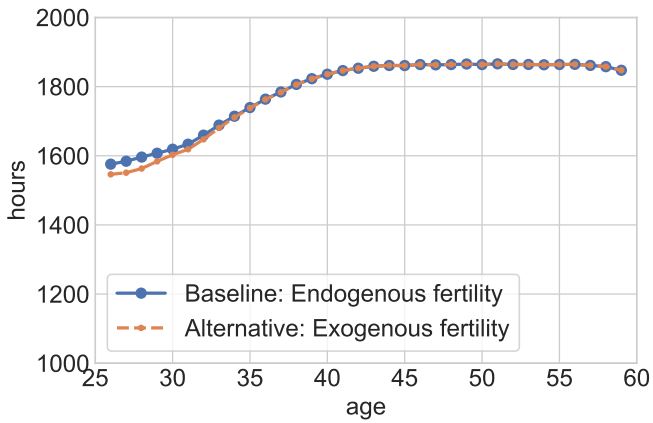
(e) Share Working, Women.



(f) Share Working, Men.



(g) Hours, Women.



(h) Hours, Men.

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