Career Costs of Children

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Plan for today

- Dynamic Labor supply w. HC and **children**
  Adda, Dustmann and Stevens (2017): "The Career Costs of Children"

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- **Reading guide:**
  1. What are the main *research questions*?
  2. What is the *(empirical) motivation*?
  3. What are the central *mechanisms in the model*?
  4. What is the *simplest model* in which we could capture these?

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- Dynamic Labor supply w. HC and **children**
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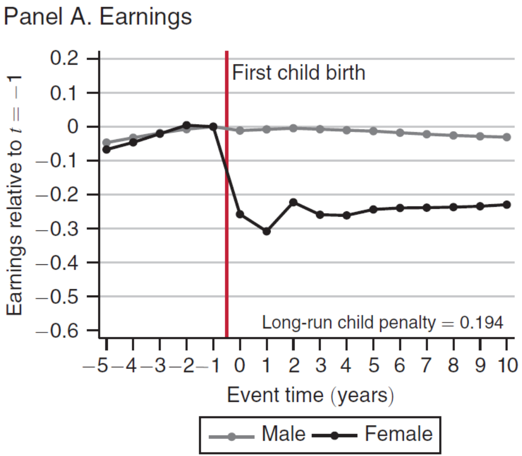
- **Reading guide:**
  1. What are the main *research questions*?
     - How **costly** are children for careers over the life cycle?
     - How does pro-fertility **reforms** affect completed fertility?
  2. What is the *(empirical) motivation*?
  3. What are the central *mechanisms in the model*?
  4. What is the *simplest model* in which we could capture these?

Empirical Motivation: I

- "Child penalty" (Kleven, Landais and Søgaard, 2019)



Empirical Motivation: II

TABLE 1
DESCRIPTIVE STATISTICS, BY OCCUPATION

	Routine	Abstract	Manual	Whole Sample
Initial occupation	25.0%	44.8%	30.3%	100%
Occupation of work	25.4%	52.7%	21.9%	
A				
Annual occupational transition rates:				
If in routine last year	97.9%	1.5%	.5%	
If in abstract last year	.7%	99.0%	.2%	
If in manual last year	.9%	.8%	98.3%	
B				
Log wage at age 20	3.598	3.742	3.470	3.634
	(.297)	(.301)	(.386)	(.337)
Log wage growth, at potential experience = 5 years	.0485	.0551	.0450	.0510
	(.187)	(.156)	(.196)	(.175)
Log wage growth, at potential experience = 10 years	.0181	.0240	.0152	.0208
	(.187)	(.206)	(.223)	(.206)
Log wage growth, at potential experience = 15 years	.00995	.0147	.0127	.0133
	(.206)	(.195)	(.211)	(.200)
C				
Total work experience after 15 years	11.55	12.81	12.14	12.34
	(3.273)	(2.624)	(2.880)	(2.909)
Full-time work experience after 15 years	10.32	11.92	10.86	11.29
	(3.907)	(3.348)	(3.570)	(3.617)
Part-time work experience after 15 years	1.229	.889	1.274	1.056
	(2.187)	(1.828)	(2.125)	(1.997)
D				
Total log wage loss, after interruption = 1 year	−.0968	−.147	−.105	−.121
	(.560)	(.636)	(.633)	(.613)
Total log wage loss, after interruption = 3 years	−.152	−.253	−.223	−.216
	(.604)	(.639)	(.619)	(.625)
E				
Age at first birth	27.27	28.39	25.94	27.56
	(4.138)	(3.783)	(3.517)	(3.943)

Empirical Motivation: III

- **Selection** into family friendly occupations
  $\rightarrow$ correlation $\neq$ causation!
  $\rightarrow$ we need a model!

- **Short run** effects of pro-fertility reforms on labor supply are substantial
  Reduced form evidence
  Long run effects: “need” a model!

Outline

1. Model and Mechanisms
2. Simulation Results
3. Simple Model

Model Overview

- **Choices:**
  $b_t \in \{0, 1\}$: fertility, try to conceive a child
  $c_t \in (0, \overline{M}]$: consumption (household)
  $o_t \in \{1, 2, 3\}$: occupation of women (effect end of period)
  $l_t \in \{\mathrm{OLF}, \mathrm{U}, \mathrm{PT}, \mathrm{FT}\}$: labor supply of women (effect end of period)
  (and o_0 initial occupation/education)

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  (and o_0 initial occupation/education)
- **States**, Ω_t:
  l_{t-1} and o_{t-1}: Past labor market
  A_{t-1} : wealth, no borrowing
  $h_{t-1} \in \{0, 1\}$: presence of husband last period
  age_t^M: age of woman
  x_t: human capital of women
  n_t: number of children
  age_t^K: age of youngest child
  Υ_t: preference and income shocks (see e.g. p.331)
  $f = (f^P, f^F, f^L, f^C)$: heterogeneity
  (productivity, fertility, taste for leisure, taste for children)

Model Overview

Key mechanisms:

1. **Early life occupational choices** (age 15) locks in on fertility effects
   - **Family friendliness** differs across occupations
     Wage level/growth
     Costs of temporary leave (atrophy)
     Offer probabilities
     Amenities (utility value)
2. **Human capital** leads to persistent effects of early life behavior
3. **Endogenous fertility** trades of timing of children and career

State Transitions, $\Omega_{t+1} \sim \Gamma(\Omega_t, b_t, c_t, o_t, l_t)$

- l_t and o_t are choices.

$$A_t = (1+r)A_{t-1} + net(GI_t; h_t, n_t) \\ - c_t - \kappa(age_t^M, n_t)\mathbf{1}(n_t > 0, l_t \in \{\mathrm{PT}, \mathrm{FT}\})$$

  where GI_t is gross household income (next slide)
- h_t is random and function of age_t^M, x_t, f^C.
  Husbands earnings are exogenous function of women's characteristic
- $age_{t+1}^M = \frac{1}{2} + age_t^M$

$$x_{t+1} = \begin{cases} x_t + 1 & \text{if } l_t = \mathrm{FT} \\ x_t + \frac{1}{2} & \text{if } l_t = \mathrm{PT} \\ x_t \rho(x_t, o_t) & \text{else} \end{cases}$$

  where $\rho(x_t, o_t)$ is deprecation rate.
- $n_{t+1} = n_t + 1$ with prob. $\pi(age_t^M, f^C)\mathbf{1}(b_t = 1)$. Else $n_{t+1} = n_t$.
- $age_{t+1}^K = \frac{1}{2} + age_t^K$ if $n_{t+1} = n_t$ else $age_{t+1}^K = 0$

State Transitions, Gross Income

- Never write up the gross income. This is my take.
- Gross household income is (note timing)

$$GI_t = w_t l_{t-1} + \mathbf{1}(h_t = 1) earn_t^h + \text{benefits...}$$

- Husbands earnings are exogenous

$$earn_t^h = \alpha_0^h + \alpha_1^h age_t^M + \alpha_2^h (age_t^M)^2 + \alpha_P^h f^P + \eta_t^h$$

- Wages of women are Mincer-type

$$\log w_t = f^P + a_0(o_t) + a_X(o_t) x_t + a_{XX}(o_t) x_t^2 + \eta_t$$

Recursive Formulation

- **Bellman equation** is

$$V_t(\Omega_t) = \max_{b_t, c_t, o_t, l_t} u(\bullet) + \beta \mathbb{E}_t[V_{t+1}(\Omega_{t+1})]$$

s.t.

$$\Omega_{t+1} \sim \Gamma(\Omega_t, b_t, c_t, o_t, l_t)$$

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  Split up the different discrete choices. See their appendix.
  I will illustrate how the fertility choice is made (conditional on o_t, l_t)

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- **Implemented "sequentially"**
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  I will illustrate how the fertility choice is made (conditional on o_t, l_t)
- **Discuss:** What is good/bad about this model for the research purpose?

Recursive Formulation, working + conceiving

- Value of **W**orking ($l_t \in \{\mathrm{PT}, \mathrm{FT}\}$) and **C**onceiving ($b_t = 1$)

$$
\begin{aligned}
V^{W,C}(\Omega_t) = \max_{c_t} & \, u(c_t, \bullet) + \pi(age_t^M, f^C)\beta\mathbb{E}_t[V^{L_w}(\Omega_{t+1}^P)] \\
& + \delta(1 - \pi(age_t^M, f^C))\beta\mathbb{E}_t[V^U(\Omega_{t+1})] \\
& + (1-\delta)(1 - \pi(age_t^M, f^C))(1 - \phi_0(o_t, l_t))\beta Emax_t \\
& + (1-\delta)(1 - \pi(age_t^M, f^C))\phi_0(o_t, l_t)\beta \widetilde{Emax_t}
\end{aligned}
$$

where
$V^{L_w}(\Omega_{t+1}^P)$: value of parental leave
$V^U(\Omega_{t+1})$: value of unemployment (w. prob δ)
$\phi_0(o_t, l_t)$: job-offer prob.
$Emax_t = \mathbb{E}_t[\max\{V_{t+1}^W + \eta_{t+1}^W, V_{t+1}^U + \eta_{t+1}^U, V_{t+1}^O + \eta_{t+1}^O\}]$
$\widetilde{Emax_t} = \ldots$ Also choose between leaving and staying (see p. 331).

Recursive Formulation, working + not conceiving

- Value of **W**orking ($l_t \in \{\text{PT}, \text{FT}\}$) and **N**ot **C**onceiving ($b_t = 0$)

$$\begin{aligned} V^{W,NC}(\Omega_t) = & \max_{c_t} u(c_t, \bullet) \\ & + \delta\beta\mathbb{E}_t[V^U(\Omega_{t+1})] \\ & + (1-\delta)(1-\phi_0(o_t, l_t))\beta Emax_t \\ & + (1-\delta)\phi_0(o_t, l_t)\beta \widetilde{Emax_t} \end{aligned}$$

- **Fertility choice** is then (conditional on k/working)

$$b_t^\star(k) = \arg\max\{V^{k,C}(\Omega_t), V^{k,NC}(\Omega_t)\}$$

Estimation Results

- **Simulated method of moments (SMM)**
  Weighting matrix: diagonal, inverse of variance of empirical moments.
  763 moments (Table 2)
- **Estimate 88 parameters** (allowing for unobserved types)

$$
\begin{aligned}
u_{it} = \frac{(c_{it}/\bar{c})^{(1-\gamma c)}-1}{1-\gamma c} & \exp\Big[\gamma^1_{PT} I_{l_{it}=PT} + (\gamma^1_U + f^L_i) I_{l_{it}=U} \\
& + (\gamma^1_{\mathrm{OLF}} + f^L_i) I_{l_{it}=\mathrm{OLF}}\Big] \exp\Big(\gamma_{NC} I_{n_{it}>0}\Big) \\
& + \Big[\gamma^1_N(f^C_i) I_{n_{it}=1} + \gamma^2_N(f^C_i) I_{n_{it}=2}\Big] \cdot \exp\Big(\gamma_{NH} I_{n_{it}>0 \& h_{it=1}}\Big) \\
& \cdot \exp(\gamma_U)^{I_{l_{it}=U}} \cdot \exp\Big(\gamma_{\mathrm{OLF}} + \gamma^1_{A,\mathrm{OLF}} I_{\mathrm{age}^\kappa_{it}\in[0,3]} \\
& + \gamma^2_{A,\mathrm{OLF}} I_{\mathrm{age}^\kappa_{it}\in[4,6]} + \gamma^3_{A,\mathrm{OLF}} I_{\mathrm{age}^\kappa_{it}\in[7,9]}\Big)^{I_{l_{it}=\mathrm{OLF}}} \\
& \cdot \exp\left(\sum_{i_o=1}^{3} \gamma_{i_o,PT} I_{o_{it}=i_o} + \gamma^1_{A,PT} I_{\mathrm{age}^\kappa_{it}\in[0,3]} \right. \\
& \left. + \gamma^2_{A,PT} I_{\mathrm{age}^\kappa_{it}\in[4,6]} + \gamma^3_{A,PT} I_{\mathrm{age}^\kappa_{it}\in[7,9]}\right)^{I_{l_{it}=PT}} \\
& \cdot \exp\left(\sum_{i_o=1}^{3} \gamma_{i_o,W} I_{o_{it}=i_o}\right)^{I_{l_{it}=PT,FT}} + \eta^C_{it} b_{it} + \eta^{NC}_{it}(1 - b_{it}).
\end{aligned}
$$

Estimation Results

TABLE 3
OCCUPATION-SPECIFIC PARAMETERS

Parameter	Routine	Abstract	Manual
	A. Atrophy Rates Parameters (Annual Depreciation Rates)		
At 3 years of uninterrupted work experience	−.06%	−.11%	−.03%
	(1e−5%)	(2e−5%)	(2e−5%)
At 6 years of uninterrupted work experience	−.50%	−6.90%	−3.45%
	(.11%)	(.17%)	(.24%)
At 10 years of uninterrupted work experience	−.61%	−2.65%	−3.08%
	(14.2%)	(.01%)	(.18%)
	B. Wage Equation Parameters		
Log wage constant	3.39	3.6	3.32
	(.0038)	(.0054)	(.0059)
Years of uninterrupted work experience	.1	.09	.123
	(3.3e−05)	(3.6e−05)	(.0001)
Years of uninterrupted work experience, squared	−.00382	−.0021	−.00463
	(3e−06)	(4.1e−06)	(6.4e−06)
	C. Amenity Value of Occupations		
Utility of work if children	0	−.056	−.014
		(.001)	(.0005)
Utility of part-time work if children	0	−.42	−.08
		(.003)	(.007)

Outline

Simulation Results: Career Costs of Children

- **Career costs of children**
  NPV difference in income of women
  between baseline and alternative model
- **Alternative model:** no children (known by all)

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TABLE 6
CAREER COST OF CHILDREN: PERCENTAGE LOSS IN NET PRESENT VALUE OF INCOME AT AGE 15, WITH AND WITHOUT FERTILITY

	Percentage Loss Compared to Baseline
Total cost	−35.3%
	A. Oaxaca Decomposition of Total Cost
Labor supply contribution	−27%
Wage contribution	−8.5%
	B. Oaxaca Decomposition of Wage Contributions
Contribution of atrophy	−1.8%
Contribution of other factors	−6.7%
Contribution of occupation	−1.6%
Contribution of other factors	−7%

NOTE.—The career costs are evaluated using simulations and comparing the estimated model with a scenario in which the woman knows ex ante that she cannot have children. The costs are computed as the net present value of female incomes, including all wages, unemployment benefits, and maternity benefits in the calculations. The discount factor is set to 0.95 annually. Initial occupation is the one in the no-fertility scenario.

Simulation Results: Career Costs of Children

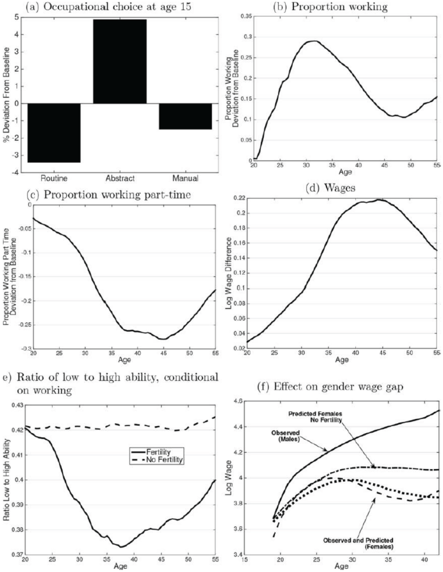

FIG. 3.—Effect of no fertility. The different panels display the difference in outcomes between a baseline scenario and one in which a woman knows that she is infertile.

Counterfactual reform: Pro-fertility

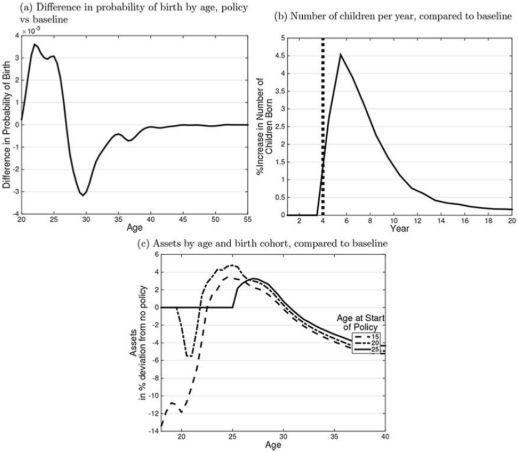

FIG. 4.—Effect of child premium. Panel a shows the effect of the policy (cash transfer of €6,000 at birth) by age on the probability of giving birth, comparing the policy to the baseline. In the policy scenario, women learn at age 15 about the policy. Panel b depicts the aggregate effect of the policy, by year, in an overlapping generation economy. The graph aggregates each year the behavior of women aged 15–60. Each year a new cohort of 15-year-olds enters the economy and the cohort who is 60 exits. The policy starts in year 4. Panel c displays the percentage change in assets as a function of age, compared to a baseline without transfer. The birth cohort who is 15 at the start of the policy can adjust right away their behavior. The cohorts who are 20 or 25 when the policy starts do not anticipate the policy.

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Extending our simple model

- **We can extend** the simple dynamic model of Keane (2016)
  Random arrival of a child, $n_t \in \{0, 1\}$
  Dis-utility from work depend on children

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  Random arrival of a child, $n_t \in \{0,1\}$
  Dis-utility from work depend on children
- **Bellman equation**

$$V_t(n_t, a_t, k_t) = \max_{c_t, h_t} \frac{c_t^{1+\eta}}{1+\eta} - \beta(n_t)\frac{h_t^{1+\gamma}}{1+\gamma} + \rho \mathbb{E}_t[V_{t+1}(n_{t+1}, a_{t+1}, k_{t+1})]$$

s.t.

$$n_{t+1} = \begin{cases} n_t + 1 & \text{with prob. } p(n_t) \\ n_t & \text{with prob. } 1 - p(n_t) \end{cases}$$

$$a_{t+1} = (1+r)(a_t + (1-\tau_t)w_t h_t - c_t)$$

$$k_{t+1} = k_t + h_t$$

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$$p(n_t) = \begin{cases} p_n & \text{if } n_t = 0 \\ 0 & \text{if } n_t = 1 \end{cases}$$

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  such that *original model is nested* if $\beta_1 = 0$.
- **Expected value** is

$$\begin{aligned} \mathbb{E}_t[V_{t+1}(n_{t+1}, a_{t+1}, k_{t+1})] &= p(n_t)\,V_{t+1}(n_t + 1, a_{t+1}, k_{t+1}) \\ &\quad + (1 - p(n_t))\,V_{t+1}(n_t, a_{t+1}, k_{t+1}) \end{aligned}$$

- See notebook...

Next Time

- **Next time:** Labor supply of couples.
  Remember: Assignment!

- **Literature:**
  Borella, De Nardi and Yang (forthcoming): "Are Marriage-Related Taxes and Social Security Benefits Holding Back Female Labor Supply?"
  - **Read** before lecture.
    Focus on "working-stage of couples" and removal of joint taxation
  - **Reading guide:**
    Section 1: Introduction. Read
    Section 2+3: Taxation of Couples in the US (short). *Motivation, key*.
    Section 4: Model. *Key*, but complex. Get the idea. Focus on "working-stage of couples". Think about how children enter.
    Section 5: Estimation. Skim.
    Section 6: "Validation", short. Labor supply elasticities, read.
    Section 7: Counterfactual simulations. Key - Read with focus on 7.1.
    Section 8: Sensitivity/robustness. Can drop.

References I

ADDA, J., C. DUSTMANN AND K. STEVENS (2017): "The Career Costs of Children," *Journal of Political Economy*, 125(2), 293–337.

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