# 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 question*s?

  2. What is the *(empirical) motivation*?

  3. What are the central *mechanisms in the model*?

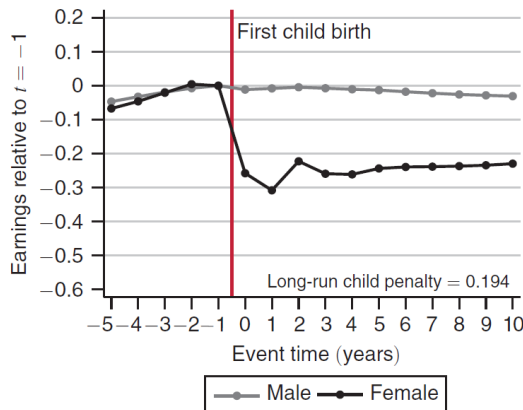  4. What is the *simplest model* in which we could capture these?

## Plan for today

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

- **Reading guide:**

  1. What are the main *research question*s?
     - 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)

Panel A. Earnings

**Introduction**
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Model and Mechanisms
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Simulation Results
○○○○

Simple Model
○○○○

References

# 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)

  $l_t \in \{\text{OLF}, \text{U}, \text{PT}, \text{FT}\}$: 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**, $\Omega_t$:

  $l_{t-1}$ 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

  $Y_t$: 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.

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

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

- $age_{t+1}^M = \frac{1}{2} + age_t^M$

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

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

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

$$\text{s.t.}$$

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

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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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- **Discuss:** What is good/bad about this model for the research purpose?

# Recursive Formulation, working + conceiving

- Value of **W**orking ($l_t \in \{PT, FT\}$) 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 $\delta$)
$\phi_0(o_t, l_t)$: job-offer prob.
$Emax_t = \mathbb{E}_t[\max\{V_{t+1}^W + \eta_{t+1}^W, V_{t+1}^U + \eta_{t+1}^U, V_{t+1}^O + \eta_{t+1}^O\}]$
$\widetilde{Emax} = ...$ Also choose between leaving and staying (see p. 331).

## Recursive Formulation, working + not conceiving

- Value of **W**orking ($l_t \in \{PT, FT\}$) 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)

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

[but also extreme value taste-shocks in utility wrt. conceiving]

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## 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)

$$u_{it} = \frac{(c_{it}/\bar{c})^{(1-\gamma c)} - 1}{1 - \gamma c} \exp\left[\gamma_{PT}^1 I_{l_{it}=PT} + (\gamma_U^1 + f_i^L) I_{l_{it}=U}\right.$$
$$\left. + (\gamma_{\mathrm{OLF}}^1 + f_i^L) I_{l_{it}=\mathrm{OLF}}\right] \exp\left(\gamma_{NC} I_{n_{it}>0}\right)$$
$$+ \left[\gamma_N^1(f_i^C) I_{n_{it}=1} + \gamma_N^2(f_i^C) I_{n_{it}=2}\right] \cdot \exp\left(\gamma_{NH} I_{n_{it}>0 \& h_{it-1}}\right)$$
$$\cdot \exp(\gamma_U)^{I_{l_{it}=U}} \cdot \exp\left(\gamma_{\mathrm{OLF}} + \gamma_{A,\mathrm{OLF}}^1 I_{\mathrm{age}_{it}^e \in [0,3]}\right.$$
$$\left. + \gamma_{A,\mathrm{OLF}}^2 I_{\mathrm{age}_{it}^e \in [4,6]} + \gamma_{A,\mathrm{OLF}}^3 I_{\mathrm{age}_{it}^e \in [7,9]}\right)^{I_{l_{it}=\mathrm{OLF}}}$$
$$\cdot \exp\left(\sum_{i=1}^{3} \gamma_{i,PT} I_{o_{it}=i_s} + \gamma_{A,PT}^1 I_{\mathrm{age}_{it}^e \in [0,3]}\right.$$
$$\left. + \gamma_{A,PT}^2 I_{\mathrm{age}_{it}^e \in [4,6]} + \gamma_{A,PT}^3 I_{\mathrm{age}_{it}^e \in [7,9]}\right)^{I_{l_{it}=PT}}$$
$$\cdot \exp\left(\sum_{i=1}^{3} \gamma_{i,W} I_{o_{it}=i_s}\right)^{I_{l_{it}=PT,FT}} + \eta_{it}^C b_{it} + \eta_{it}^{NC}(1 - b_{it}).$$

Introduction
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Model and Mechanisms
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Simulation Results
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Simple Model
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References

# 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) |

Note.—The occupations is defined as a function of skills which are more abstract,

# Outline

1 Model and Mechanisms

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## 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.

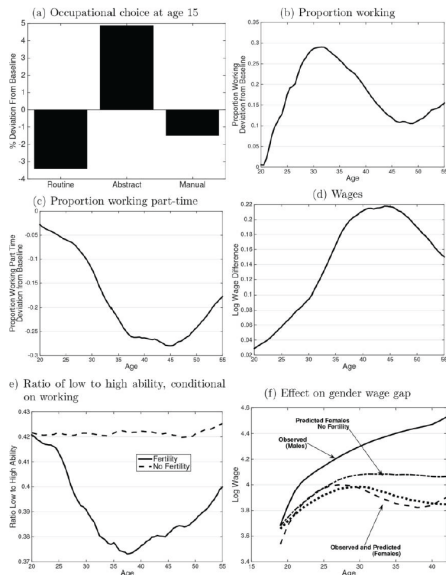## Simulation Results: Career Costs of Children



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.
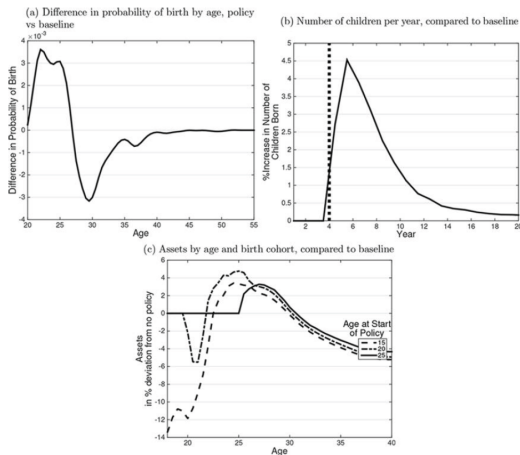
# Counterfactual reform: Pro-fertility



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.

# Outline

# 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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- **Bellman equation**

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

$$\text{s.t.}$$

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

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

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

Extending our simple model

- **Endogenous** wages (as before)

$$w_t = w \left(1 + \alpha k_t\right)$$

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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

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

- See notebook...

# Next Time

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

- **Literature:**
  Borella, De Nardi and Yang (2023): "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

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