# Working Hours and the Child Penalty in an Equilibrium Household Search Model

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- Childbirth may lead to specialization within the household. For example:
  - Mothers quit or reduce hours of employment for prolonged periods.
  - Fathers continue working full-time.
- These choices interact with firms' hiring and pay decisions.
- **How do demand and supply forces shape parents' labor market outcomes?**

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- Factors related to workers:
  - human capital,
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  - preference, social norm
- Factors related to firms:
  - statistical and taste-based discrimination in hiring and pay policies.
- Parental leave policies may influence labor supply and demand choices after childbirth.

# This Paper

- **Research questions**: ⏩ Literature
  1. How do labor supply and demand factors shape gender gaps across life stages?
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  - Workers choosing between non-employment, full-time and part-time jobs.
  - Firms adjusting their demand to the household labor supply.

  After estimating the model with microdata, we examine
  - how gender gaps change when specific drivers are equalized across genders
  - effects of counterfactual parental leave policies

# Application: Germany

- Child penalty in labor earnings is large and persistent, mainly driven by hours and wages.
  Kleven et al. 2019 ⏩ figures
- 50% of employed women and 67% of employed mothers work part-time.
  - Part-time employment rises sharply after childbirth ⏩ figures
- Generous parental leave policies. ⏩ Institutional details
- We estimate the equilibrium model using household survey data (GSOEP and IAB-PASS).

# Model

# Firms and Jobs

- Firms with different productivity $p \sim \Gamma(.)$ create jobs with full- or part-time **hours** requirement $h \in \{h^F, h^P\}$.
- Flow output in a filled job is

$$y = p\, s\, h$$

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  - $p$ is the firm's productivity,
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  where
  - $p$ is the firm's productivity,
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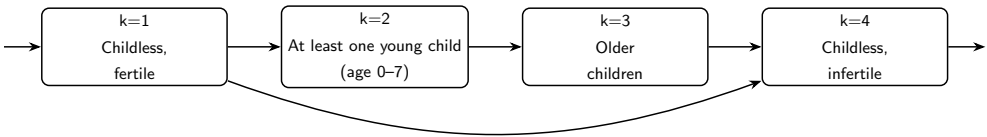
  - $h$ are actual hours worked,
- Firms' perceived output when employing women is $\eta^{f,h} y$ ("taste-based discrimination").
- Firms offer skill-adjusted wages $w^{j,h}$ depending on workers' gender ($j = m, f$) and hours.

# Households: Demographics and Human Capital

- Male and female workers live in single or married households.
- Stochastic, exogenous transitions through demographic states ($k$):

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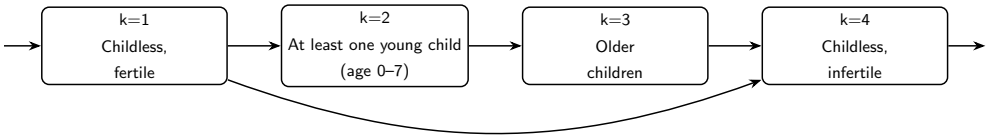


- Stochastic retirement. New households start in $k = 1$.
- Initial human capital $s$ drawn from $\zeta^j(s)$.
- Stochastic accumulation/decumulation of human capital based on employment hours.

# Household Utility

- Utility of gender $j$ given consumption $c_j$ and hours $h_j$, and demographic state $k$

$$u^j(c^j, h^j; k) = \ln c^j + \underbrace{\psi_k^j \frac{(\bar{h} - h^j)^{1-\gamma}}{1-\gamma}}_{\text{Pref for home hours}} + \underbrace{\alpha_k^j \mathbf{1}_{\{h^j > 0\}}}_{\text{Pref for emp.}}$$

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- Married household:

$$U(c, h^m, h^f; k) = \sum_{j=m,f} u^j(c^j, h^j; k)$$

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- Consumption equals income after taxes and transfers (UI benefits and parental allowance).

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## Firms' job posting decision

- Firms take labor supply $\ell(j, h, w)$ as given.
- Job-posting decision: choose hours $h$ and skill-adjusted hourly wages $\{w^{m,h}, w^{f,h}\}$ to maximize the steady-state flow profit net of job-posting costs:

$$\text{Flow profit} = (p - w^{m,h})\,\ell(m, h, w^{m,h}) + (\eta^{f,h} p - w^{f,h})\,\ell(f, h, w^{f,h})$$

labor supply
firm choice 1
firm choice 2

# Parental Leave

- In state $k = 2$ (young children), each *employed* parent can enter PL.
- PL ends:
  - exogenously at rate $\varphi$,
  - when children grow older (transition into $k = 3$), or
  - endogenously if the parent accepts a new job.
- Upon PL termination:
  - the worker has the right to return to the same job and ask for an hours reduction
  - if $k = 2$, the other parent can choose to enter PL.
- PL allowance:
  - contingent on parental leave,
  - replaces a fraction of previous income up to a threshold.

⏩ Institutional details

# Model Estimation: Data

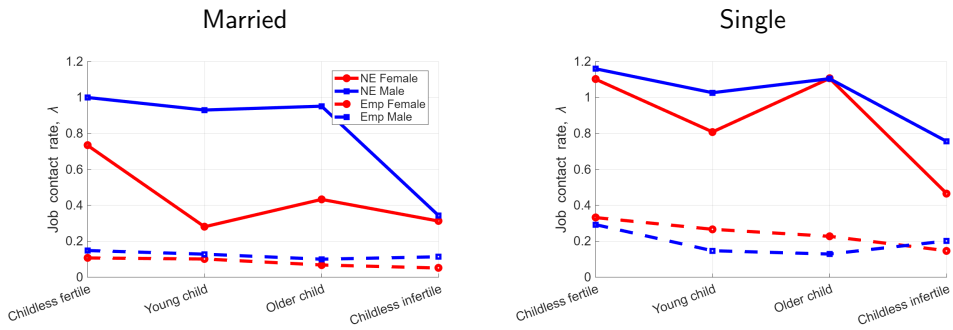
**Household survey data** (2007-2019)

- *German Socio-Economic Panel* ($\sim 30,000$ individuals, $\sim 15,000$ hh)
  Info on household and parenthood status, employment, hours, and wages.

- *Panel Study Labor Market and Social Security (PASS)* ($\sim 10,000$ individuals)
  Info on job search (n. applications, time spent searching).

⏩ Estimation Strategy

# Externally Estimated Parameters: Job Contact Rate




*Source:* Number of job applications in PASS, normalized by the value of non-employed married men in demographic state "childless, fertile" ($k = 1$).

⏩ Demographic Transitions ⏩ Other External Params

# Internally Estimated Parameters

| Parameter | Description | Target | Men | Women |
|---|---|---|---|---|
| *Supply-side* | | | | |
| $\delta(P)$ | Exog. sep. rate from PT | transition from PT to NE | 0.080 | |
| $\delta(F)$ | Exog. sep. rate from FT | transition from FT to NE | 0.006 | |
| $\psi_k^j$ | Preference for home hours | PT share, variation by $(j,k)$ | $0.3^{\dagger}$ | $6.2^{\dagger}$ |
| $\alpha_k^j$ | Preference for employment | NE rate by by $(j,k)$ | $3.7^{\dagger}$ | $3.9^{\dagger}$ |
| $\zeta^j(2)/\zeta^j(1)$ | Initial skill ratio (high/low) | Wage distribution of young, FT | 0.42 | 0.59 |
| $\pi^{P,+}$ | Skill growth rate in PT | Annual wage growth, PT | 0.28 | |
| $\pi^{F,+}$ | Skill growth rate in FT | Annual wage growth, FT | 0.42 | |
| $\pi^{-}$ | Skill depreciation rate in NE | Re-employment wage loss per month of NE | 0.08 | |
| $\Delta^P$ | Offer distribution, PT | Share of PT in all jobs | 0.28 | |
| *Demand-side* | | | | |
| $\bar{\epsilon}^P$ | Fixed cost of posting PT job $\bar{\epsilon}_F = 0$ | Share of PT job offers | 0.23 | |
| $\sigma_\epsilon$ | Scale param. of job-posting cost | Share of PT offers by firm | 0.21 | |
| $\eta^{f,P}$ | Taste discrimination by firms | Wage of women rel. to men, PT | 1 (norm.) | 1.4 |
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$^{\dagger}$ indicates average values.

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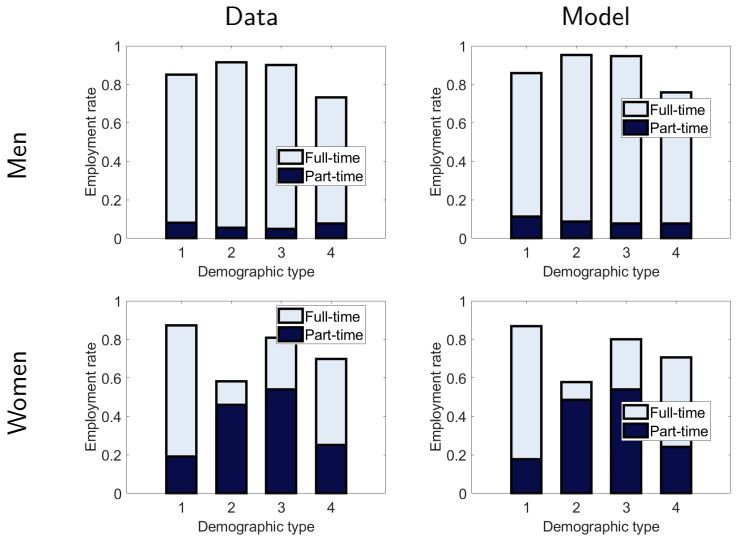
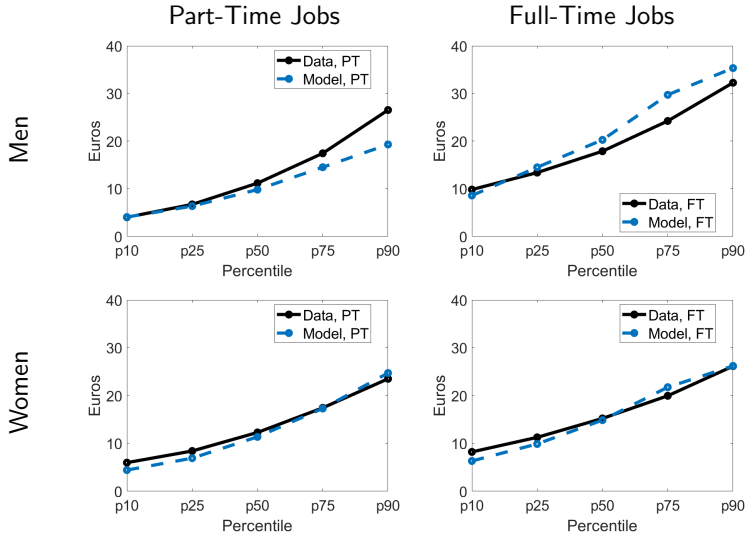
# Model Fit: Employment and Hours




Demographic types:

1. Childless, fertile
2. With young children
3. With older children
4. Childless, infertile

# Model Fit: Wage Distribution




wages at entry
others

# Results

# Unpacking Drivers of Gender Gaps

Recompute gender gaps under counterfactual scenarios that **eliminate gender differences and discrimination**:

**Legend:** = equalised between men and women • actual Eqm. equilibrium.

| | Worker | | | Firm | |
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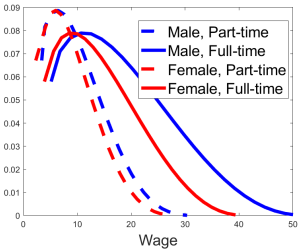
| **Gender-neutral firms** | • | • | • | | = |

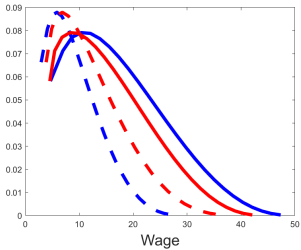
# Wage Offer Distributions (pdf)

## Benchmark




## Gender-Neutral Workers

(Gender diff. due to **taste disc**.)




## No-Taste Discrimination

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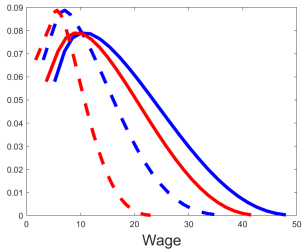
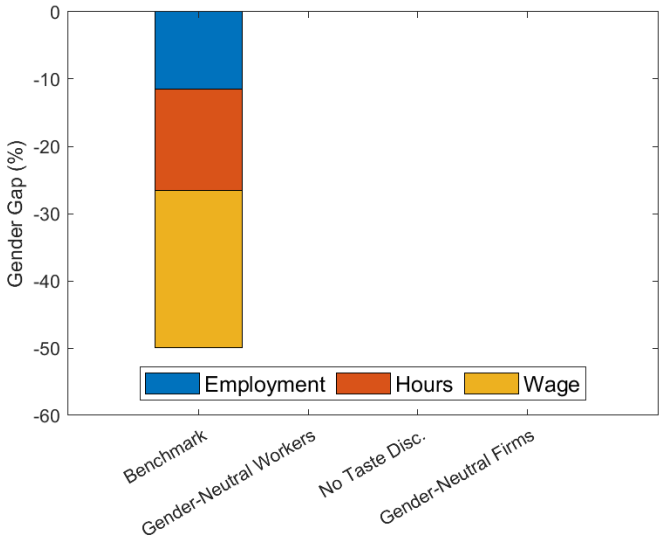



⏩ Hours Offer

# Drivers of the Earnings Gender Gap




Gender gap: % difference between women and men.

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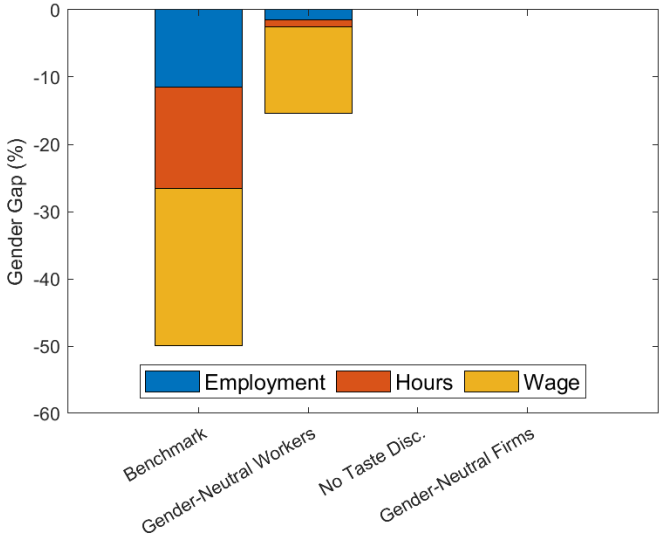


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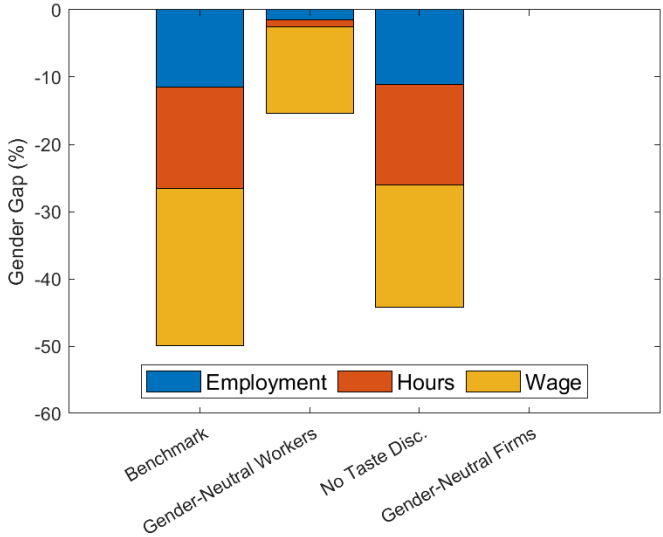


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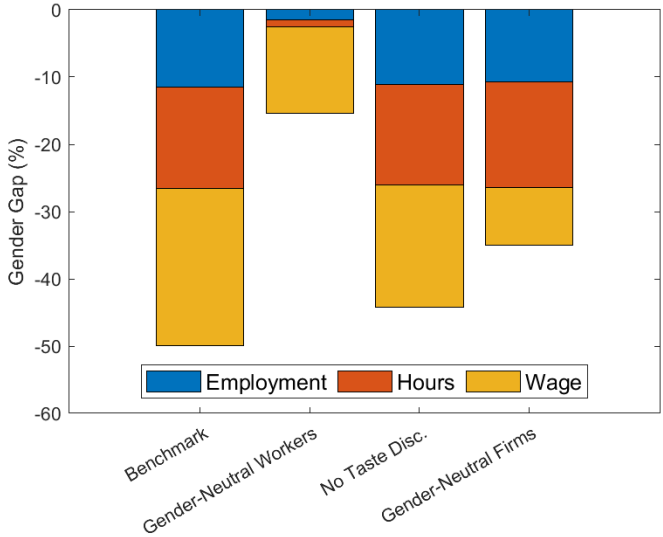


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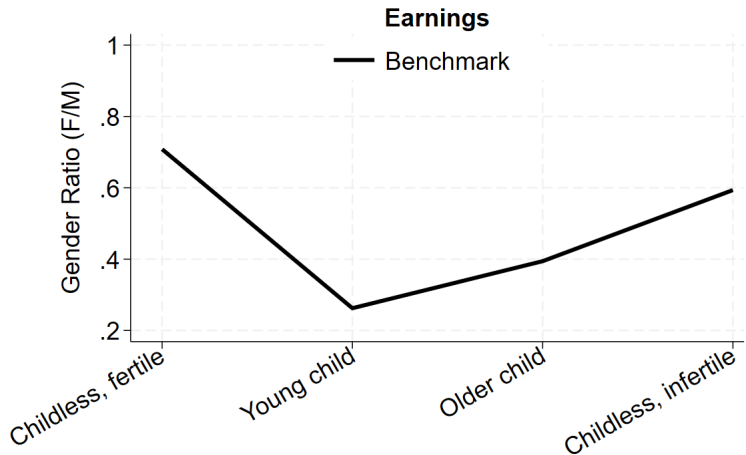
# The Gender Earnings Inequality Varies Across Life Stages



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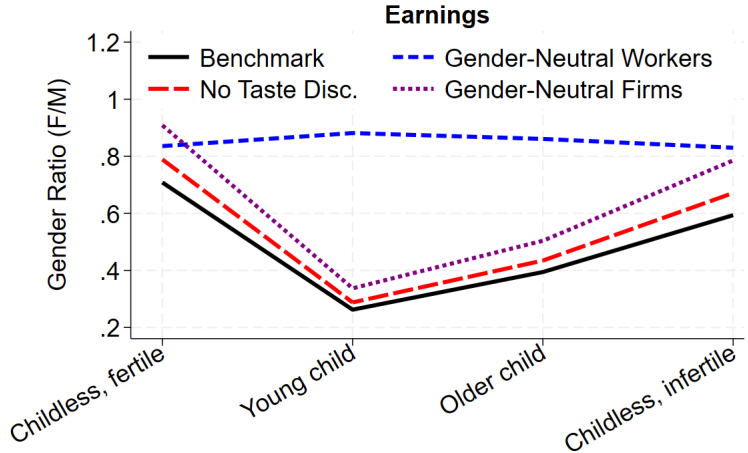


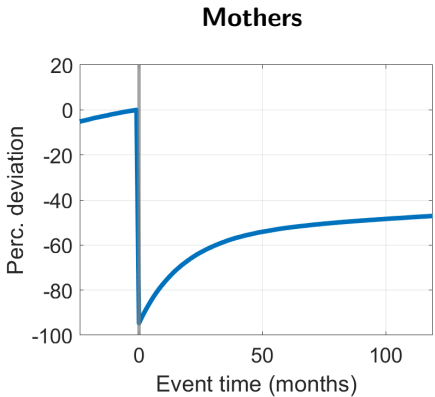

Employment, Hours, and Wage Gap

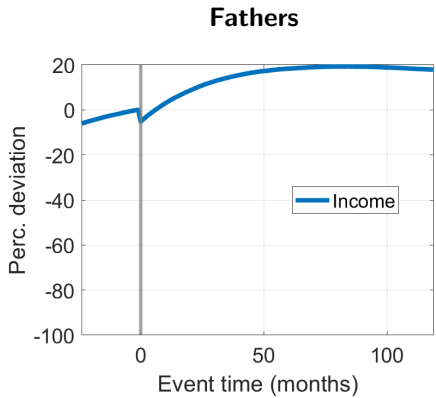
# Parental Leave Take-Up

- Mothers:
  - **77%** of married mothers take PL for an average of **18 months**.
  - Take-up **increases in own hours of work** prior to childbirth.

- Fathers:
  - **16%** of married fathers take PL for an average of **2.7 months**.
  - Many take PL after wife's PL expires.

# Earnings Change After Childbirth




⏩ Child Penalty in the Data ⏩ Earnings Gap after Childbirth ⏩ Earnings Gap after Childbirth: Supply-Side Factors

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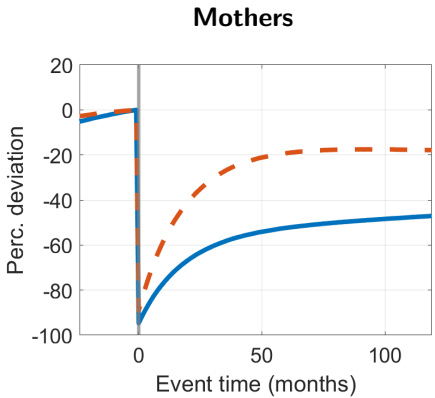


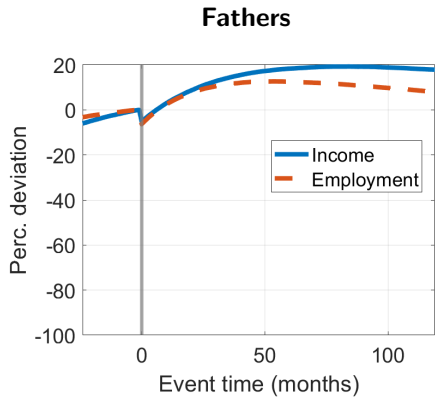


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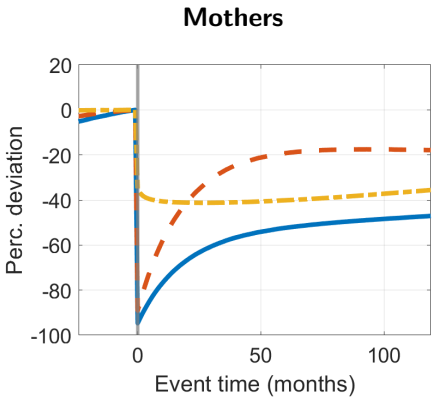


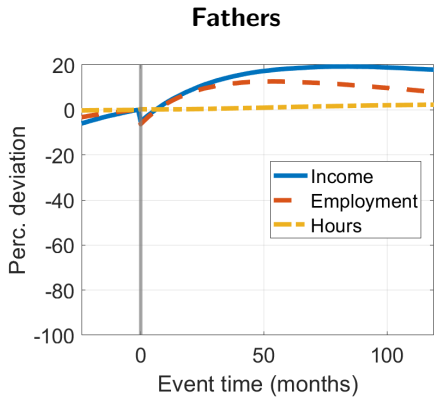


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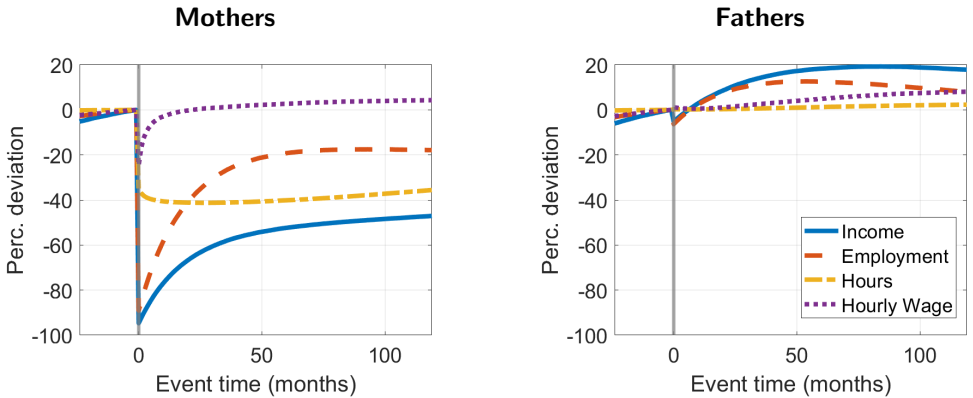


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# Conclusions

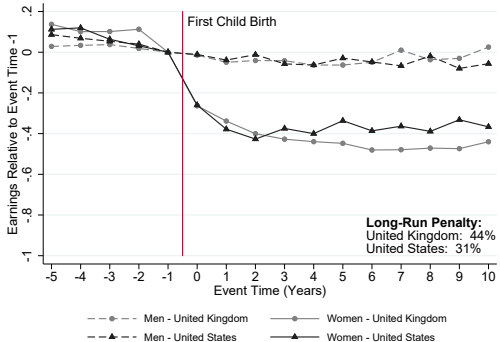
- New equilibrium household-search model to study drivers of child-related gender gaps.
- Decomposition of gender gaps:
  - Worker-related factors are responsible for gender gaps in employment and hours.
  - Taste and statistical discrimination both lead to gender wage gap, but no life-cycle changes.
  - Men sort into more productive firms, especially post-childbirth. ⏩ Sorting
- Parental leave policy: ⏩ counterfactual PL
  - PL causes a sharp decline in female earnings, with persistence driven by reduced hours.
  - Shorter PL increases fathers' uptake and helps narrow gender gaps right after childbirth.

# Back-up Slides

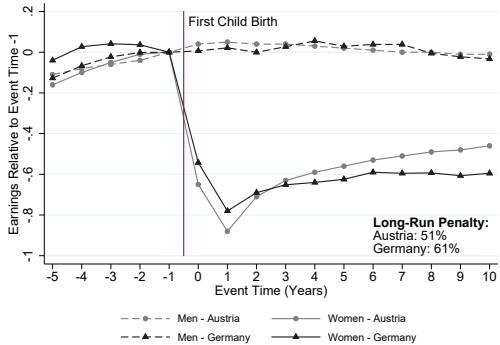
# Child Penalty in Earnings

**Child-penalty is larger in German-speaking countries.**

English-Speaking Countries




German-Speaking Countries




Source: Kleven et al. (2019).

Back: Application

# Contribution to the Literature

- **Joint labor supply choices of couples and economic policies**

  e.g. Guner, Kaygusuz, Ventura (2012, 2020), Hannusch (2018), Bick and Fuchs-Schündeln (2018)

  → we consider firms' choices on hiring and wages under labor market frictions.

- **Joint household search model with endogenous job creation and wage setting**

  e.g. Dey and Flinn (2008); Guler, Guvenen, Violante (2012); Flabbi and Mabli (2018); Fang and Shephard (2019)

  → we explicitly consider firm decisions, working hours and gender gaps.

- **Life-cycle gender earnings gap using structural models**

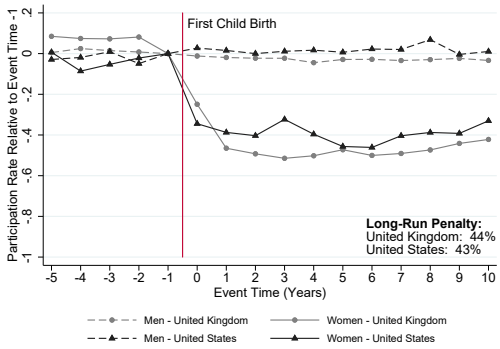
  e.g. Adda, Dustmann, Stevens (2017); Morchio and Moser (2023); Xiao (2021); Amano-Patino, Baron, Xiao (2020)

  → we explicitly consider joint career choices of couples and part-time jobs.

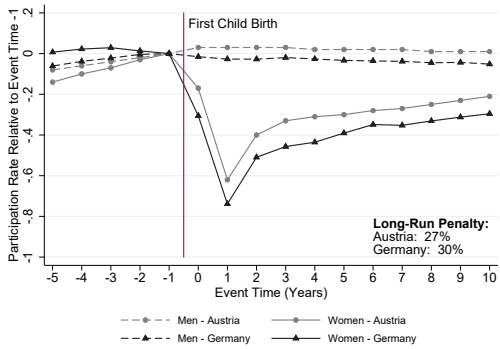
Back

# Child Penalty in LM Participation

English-Speaking Countries




German-Speaking Countries

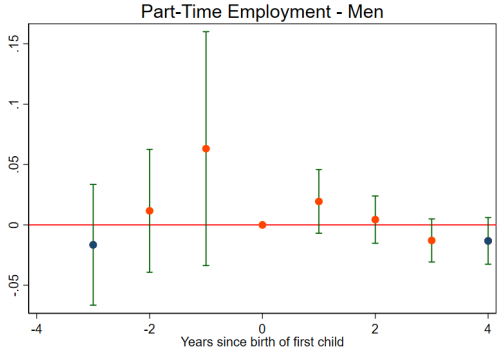


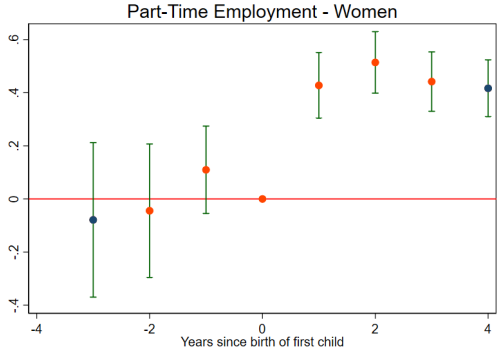

Source: Kleven et al. (2019).

Back: Application

# Part-Time Employment: Men vs. Women

**Women increase part-time employment after childbirth (PASS data).**




Back: Application

# Institutional Details in Germany

- Key features of parental leave policies in Germany after 2007:
  - **Job protection**: parents on parental leave are protected from layoffs and have the right to return to their previous employment.
  - **Duration:** Each parent can take up to 36 months of parental leave before the 8th birthday, of which up to 24 months can be taken after the 3rd birthday.
  - **Parental allowance**: monetary benefit for parents on parental leave (12-14 months, 67% of previous earnings, capped at 1,800 euros).
  - **Mothers and fathers** enjoy the same parental leave rights.
- Legally guaranteed right to request part-time work.

Back: Application Back: Model

# Data

- German Socio-Economic Panel (GSOEP, 2007-2019): $\sim 30,000$ individuals ($\sim 15,000$ hh)
  - Info on household and parenthood status
  - Info on employment status, hours, and wages
- Panel Study Labor Market and Social Security (PASS, 2007-2019): $\sim 12,000$ individuals
  - Info on job search, number of applications and time spent searching
- Externally calibrated parameters
  - demographic transition rates, search intensity, weekly hours, and policy parameters

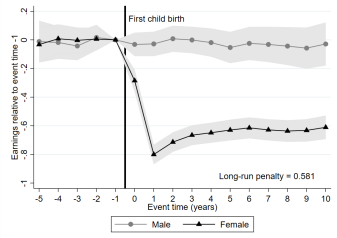
⏩ external calibration

⏩ back

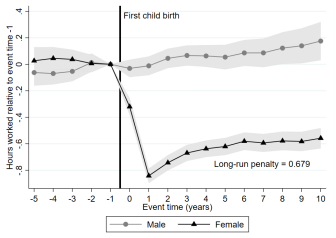
# Child Penalty: Data Estimates

Comparing workers with and without kids

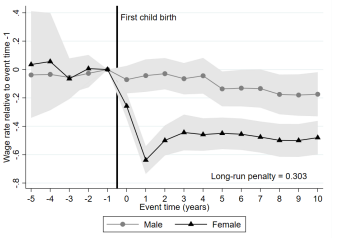
Earnings




Hours Worked




Wage




Source: GSOEP (2009-2017)??

⏩ Child Penalty in the Model

# Firms' Job-Posting Decision (I)

- Firms take **labor supply** (in efficiency units, in steady state) $\ell(j, h, w)$ as given. labor supply
- **Job-posting decision**: Firms choose jobs offered with hours $h$ and skill-adjusted hourly wages $w^{m,h}$, $w^{f,h}$, to maximize the steady-state flow profit net of job-posting costs.
- **Flow profit** of productivity-$p$ firm when offering $(h, w^{m,h}, w^{f,h})$:

$$(p - w^{m,h})\,\ell(m, h, w^{m,h}) + (p\eta^{f,h} - w^{f,h})\,\ell(f, h, w^{f,h})$$

- **Optimal wages** $w^{j,h}(p)$, $j = m, f$, maximize flow profit given the hours choice $h$.

back

# Firms' Job-Posting Decision (II)

- Firms choose hours $h$ to maximize profit net of job-posting costs:

$$\max_h \{\pi^h(p) - \underbrace{(\bar{\varepsilon}^h + \varepsilon^h)}_{\text{job-posting costs}}\}$$

  where

  - $\pi^h(p)$: expected profit given optimal wage,
  - $\bar{\varepsilon}^h$: common component of job-posting costs
  - $\varepsilon^h$: idiosyncratic component of job-posting costs

- Decisions of productivity-$p$ firms:
  - $\Delta^h(p)$ proportion of jobs with hours $h$,
  - $w^{j,h}(p)$ wage offers in these jobs.

back

# Model: Labor Supply

Expected labor supply (in efficiency units) to job $(j, h, w)$ is

$$\ell(j, h, w) = \frac{\bar{g}(j, h, w)}{\Delta^h f^{j,h}(w)}$$

where

- $\bar{g}(j, h, w)$ is the efficiency units of labor employed in job $(j, h, w)$ in steady state:

$$\bar{g}(j, h, w) = \sum_{k,s,p} sH_p(h) \left[ g^j(w_j, h, s, p, k) + \sum_{h_{-j}, s_{-j}, p_{-j}} \int g((w_j, h, s, p), (w_{-j}, h_{-j}, s_{-j}, p_{-j}), k) dw_{-j} \right].$$

- $f^{h,j}(w_j)$ is the probability density of the wage-offer distribution,

Back: Overview Back: Firm Decision

# Stationary Equilibrium

1. Given the offer distribution, households optimally choose
   - job acceptance and job quitting,
   - parental leave take-up and hours reduction after childbirth.
2. Given households' labor supply, firms make optimal job-posting decisions.
3. The household/worker distribution is stationary.

back

# Model Estimation: Strategy

- **External calibration**: demographic transitions, search intensity, and policy parameters.

# Model Estimation: Strategy

- **External calibration**: demographic transitions, search intensity, and policy parameters.

- **Two-step estimation strategy** Bontemps, Robin, Van den Berg (1999, 2000), Fang & Shepard (2019)

  1. Supply side: estimate job separation rate, utility function, offer distrib., & human capital dist. and transition using *Simulated Method of Moments*.

  2. Demand side: estimate job-posting costs, productivity distribution & taste disc. to match the offer distribution from supply-side estimation.

Back

# Externally Estimated Parameters: Demographic Transition Rates

| Transition | Couple | Single male | Single female | Target |
|---|---|---|---|---|
| $k = 1$ to $k = 2$ | 0.085 | 0.040 | 0.084 | Age at first child |
| $k = 1$ to $k = 4$ | 0.010 | 0.046 | 0.044 | Share never had children |
| $k = 2$ to $k = 3$ | 0.090 | 0.106 | 0.098 | Age when youngest child turns 8 |
| $k = 3$ to $k = 4$ | 0.123 | 0.095 | 0.086 | Age when youngest child turns 20 |
| Retirement rate | 0.044 | 0.054 | 0.053 | Retirement age 65 |

*Source:* GSOEP 2007-2019.

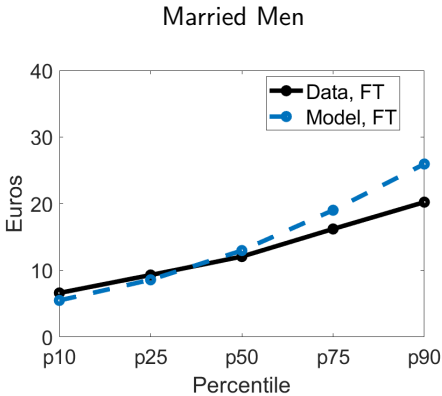
back

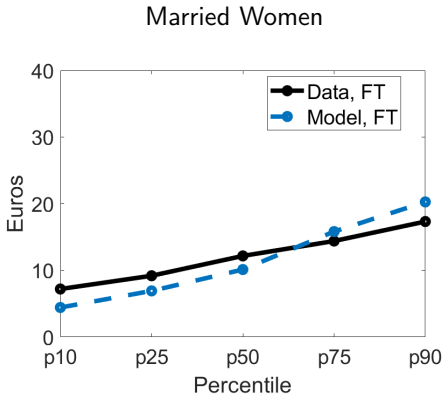
# Externally Estimated Parameters: Other

| Parameter | Description | Value | Target/Source |
|---|---|---|---|
| *Preference parameters:* | | | |
| $\gamma$ | Labor supply elasticity | 2 | Standard value |
| $\bar{h}$ | Time constraint (hours/week) | 80 | Standard value |
| $\rho$ | Discount rate | 0.05 | Standard value |
| *Skills* | | | : |
| $s_H$ | High skill | 1 | Normalization |
| $s_L$ | Low skill | 0.64 | Glitz and Wissmann (2021) |
| *Weekly hours:* | | | |
| $h_F$ | Weekly hours in FT | 43.259 | Mean weekly hours full time (GSOEP) |
| $h_P$ | Weekly hours in PT | 20.397 | Mean weekly hours part time (GSOEP) |
| *Policy parameters:* | | | |
| $b_m$ | NE benefit, Men | 919.02 | Median monthly unemployment benefit, Men (GSOEP) |
| $b_f$ | NE benefit, Women | 699.06 | Median monthly unemployment benefit, Women (GSOEP) |
| $\tau_{0,k}$ | Tax function, Level | 55.72 | Tax regression (GSOEP) |
| $\tau_{1,k}$ | Tax function, Curvature | 0.37 | Tax regression (GSOEP) |
| | Parental leave expiration rate | 0.5 | 1/median duration of parental leave |
| | Parental leave benefits | 0.67 | Replacement rate (GSOEP) |
| | Minimum PL allowance (per month) | 100 | Statutory policy |
| | Maximum parental leave (per month) | 6000 | Statutory policy |

back

# Wage Distribution at Entry



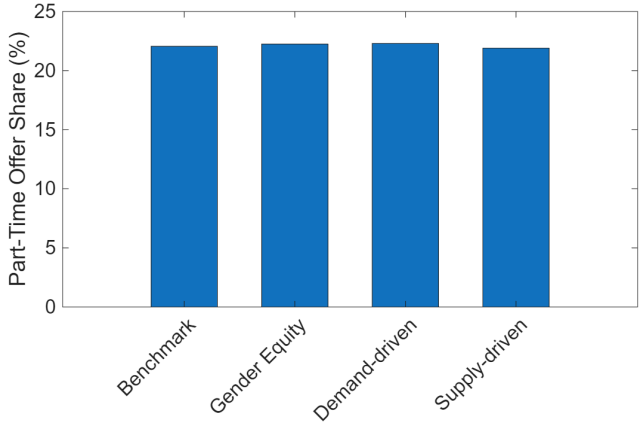

Wage distribution

# Model Fit: Other

| | Data | Model |
|---|---|---|
| Job sep. prob, male PT | 0.009 | 0.008 |
| Job sep. prob, male FT | 0.005 | 0.006 |
| Wage growth, PT | 0.0011 | 0.0009 |
| Wage growth, FT | 0.0017 | 0.0011 |

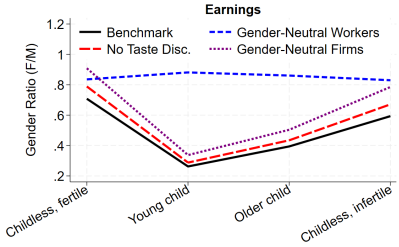
back

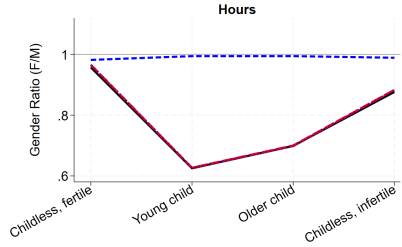
# Part Time Offer Share Driven by Labor Supply

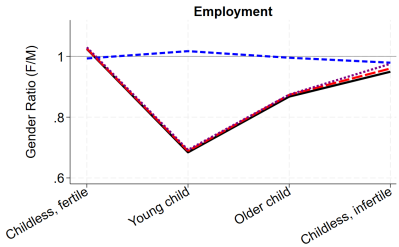



Back

# Drivers of Gender Gaps Across Life Stages



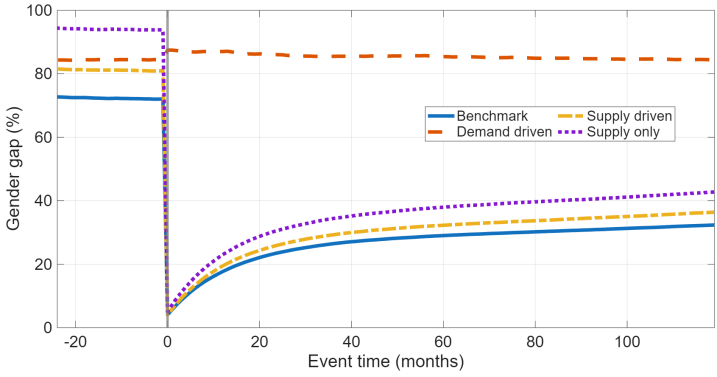





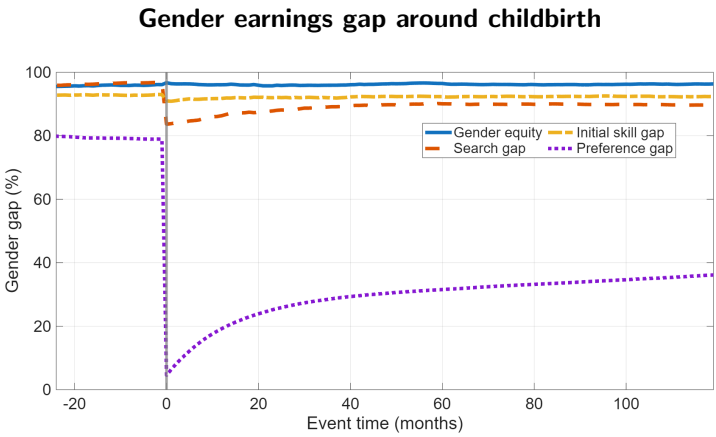
⏩ Back: Earnings Gap

# Gender Earnings Gap After Childbirth




⏩ Bach: Earnings Change after Childbirth

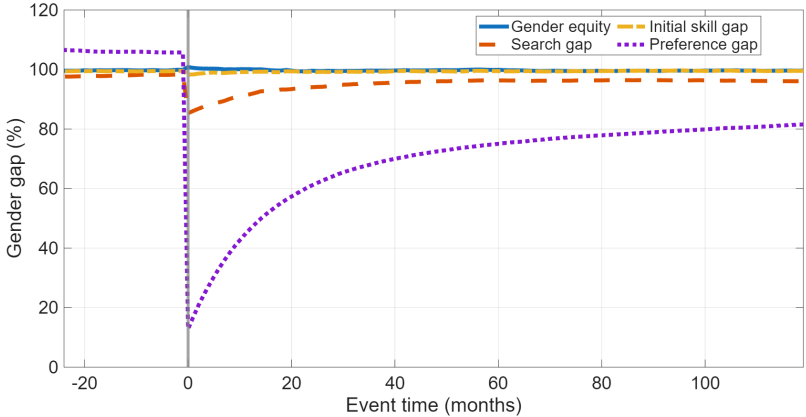
# “Preference” is the main driver of gender gap around childbirth




▸▸ Bach: Earnings Change after Childbirth

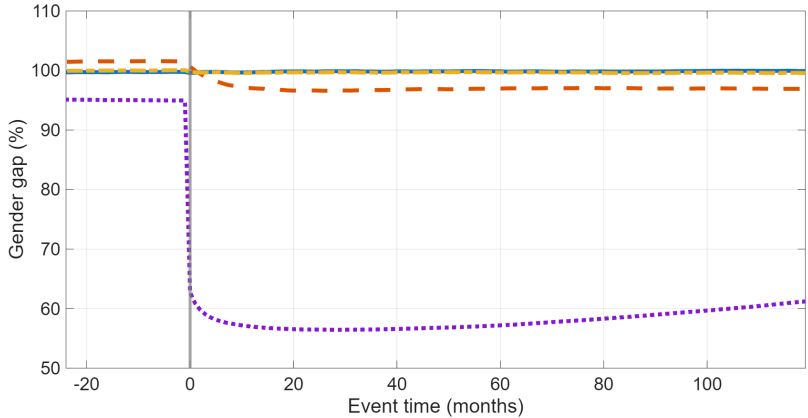
# “Preference” is the main driver of gender gap around childbirth

**Gender employment gap around childbirth**

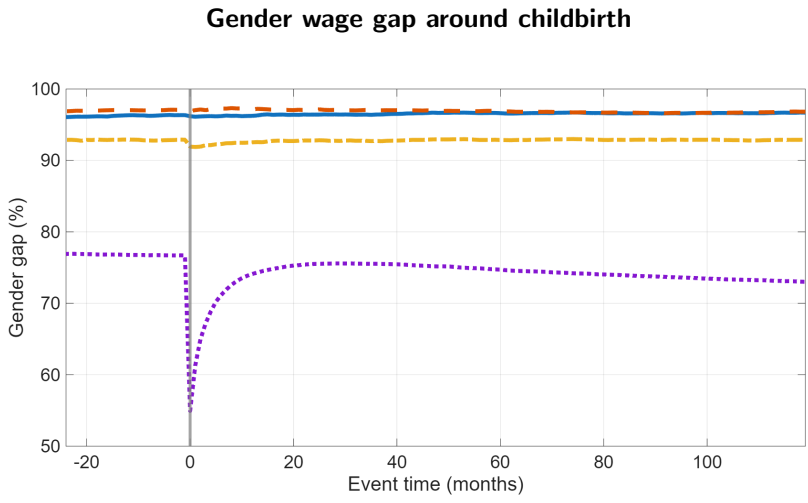


# “Preference” is the main driver of gender gap around childbirth

**Gender hours gap around childbirth**

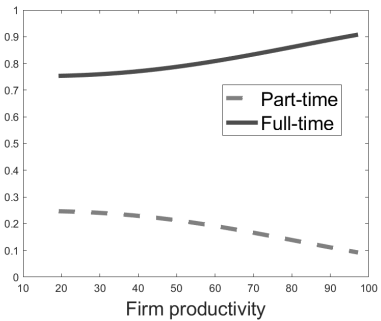


# “Preference” is the main driver of gender gap around childbirth



# Sorting: More productive firms are more likely to post FT jobs

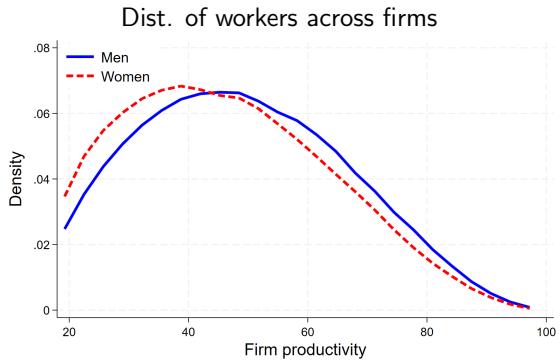
Probability of Posting PT vs. FT Jobs
by Firm Productivity




1. **More productive firms are more likely to post FT jobs.**

Back

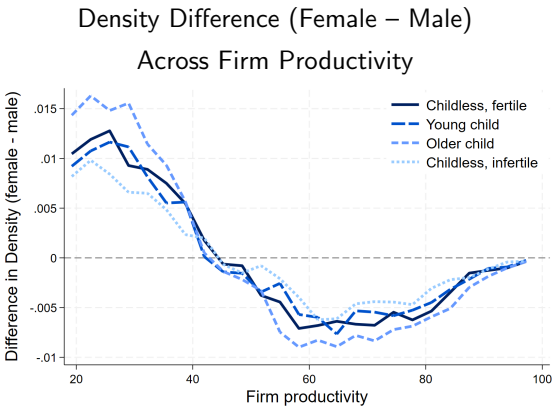
# Sorting: Men and Women Sort to Different Firms via Hours Choice




1. More productive firms are more likely to post FT jobs.
2. **Men are more likely to work FT. → Men are sorted into more productive firms.**

Back

# Sorting: Varies Across Life Stages




1. More productive firms are more likely to post FT jobs.
2. Men are more likely to work FT.
   $\rightarrow$ Men are sorted into more productive firms.
3. **Sorting is strongest for parents with older children.**

Back

# Counterfactual Parental Leave (PL) Policies

Goal: study the effects of the two components of PL policies, **parental allowance** and **job protection**.

We consider the following counterfactual policies:

- **Low replacement**: Half the PL allowance replacement rate, same duration as benchmark.
- **Short PL**: Same parental allowance replacement rate, but half the PL duration.

Back

# PL Take-Up Rate under Counterfactual Policies

| Gender | Benchmark | Low Allowance | Short PL |
|---|---|---|---|
| Married Mothers | 77% | 76% | 77% |
| Married Fathers | 16% | 14% | 41% |

Back

# Short PL Policy Reduces Gender Inequality After Childbirth