Informality and Motherhood Penalties over the Life Cycle

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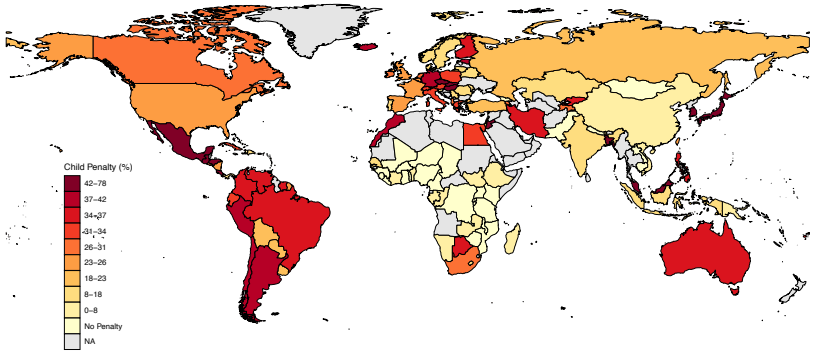
Breno Sampaio
(UFPE)

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(UCL, IFS)

NBER SI2026 - Gender in the Economy

Motivation

- Large share of gender inequality in the labor market is explained by the **motherhood penalty**; high incidence in **developing countries**:



Source: Kleven, Landais and Leite-Mariante (2025)

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- Potential intertemporal trade-off!

This Paper

- **Questions**

  1. What are the career costs of children for women in the presence of a **rigid formal labor market** and **high informality**? Is there an intertemporal trade-off associated with informality?
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- **What we do**

  A. High-quality admin data linking 40 million births to parental outcomes to estimate motherhood penalties in the formal sector for mothers and fathers in Brazil.

  B. Develop and estimate a partial equilibrium, life-cycle model of women's fertility and labor supply decisions (participation, formal/informal employment, self-employment).

  C. Counterfactuals to quantify the main mechanisms behind motherhood penalties + policies to reduce them.

Contributions

We bridge two literatures:

- **Career costs of children**
  E.g. Bertrand et al. (2010), Goldin (2014), Kleven et al. (2019), Berniell et al. (2021), Kleven et al. (2021), Kleven (2023), Kleven et al. (2025), Adda et al. (2017), Costa Dias et al. (2020), Ilieva (2022), Xiao (2023)

  ⇒ Estimates using rich admin data in high informality setting: observe couples, pre-birth history, high granularity

  ⇒ Life-cycle model with informality, fertility and labor supply decisions

- **Labor Supply and Informality**
  E.g. Meghir et al. (2015), Lopez Garcia (2015), Narita (2020), Bobba et al. (2021, 2022), Herreño and Ocampo (2021), Conti et al. (2022), Moreno (2022), Finamor (2025)

  ⇒ Fertility and labor supply decisions over the life cycle, accounting for sector-specific returns to experience, HK accumulation, and childbearing costs

Data

Data: family links

1. **Tax Authority's Registry:** universe of adult population (name, gender, DoB, mother's full name, addresses)
    - ChildID—Mother's name

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4. **School Census:** Administrative records of all students (2008–2017). Children's name, DoB, parents' full name
   - Child Name—Parents' names

Data: employment and (additional) fertility information

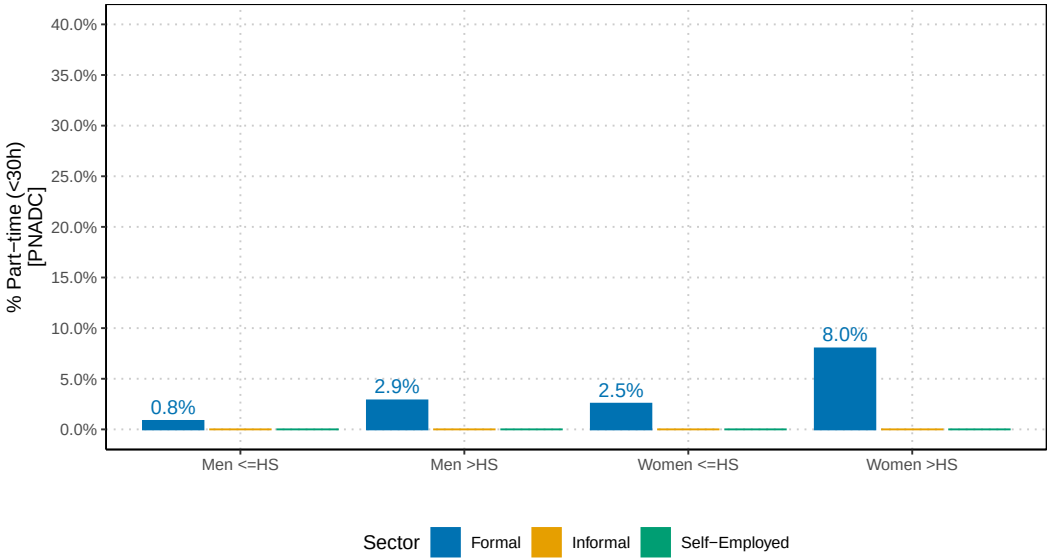
5. **RAIS** — Matched employer-employee with the universe of formal labor contracts (monthly level) [2002–2019]

6. **PNADC** — Quarterly household survey [2012–2019], employment information (with informality status)

Motivating Facts

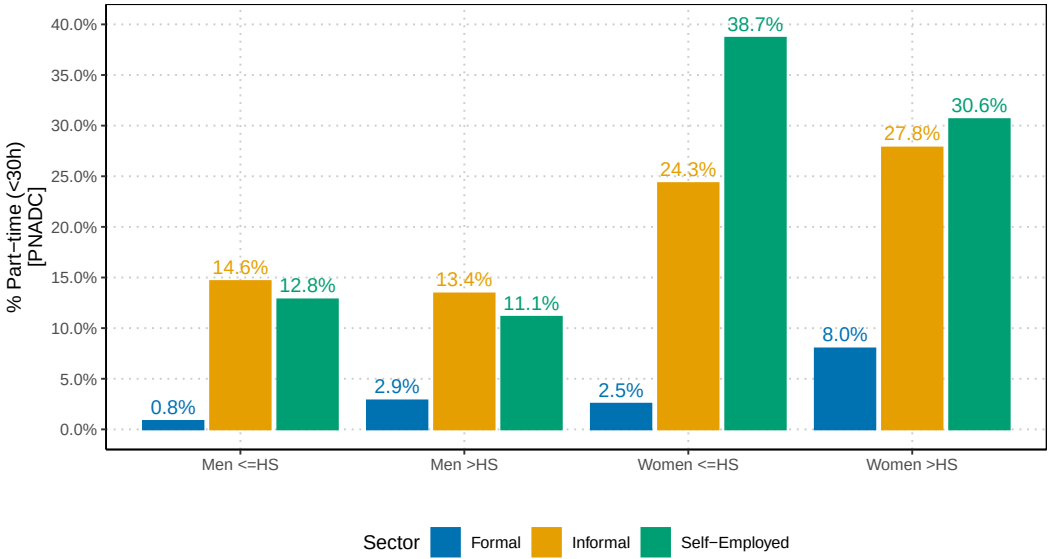
Lack of part-time contracts

Educ Trends Occupations

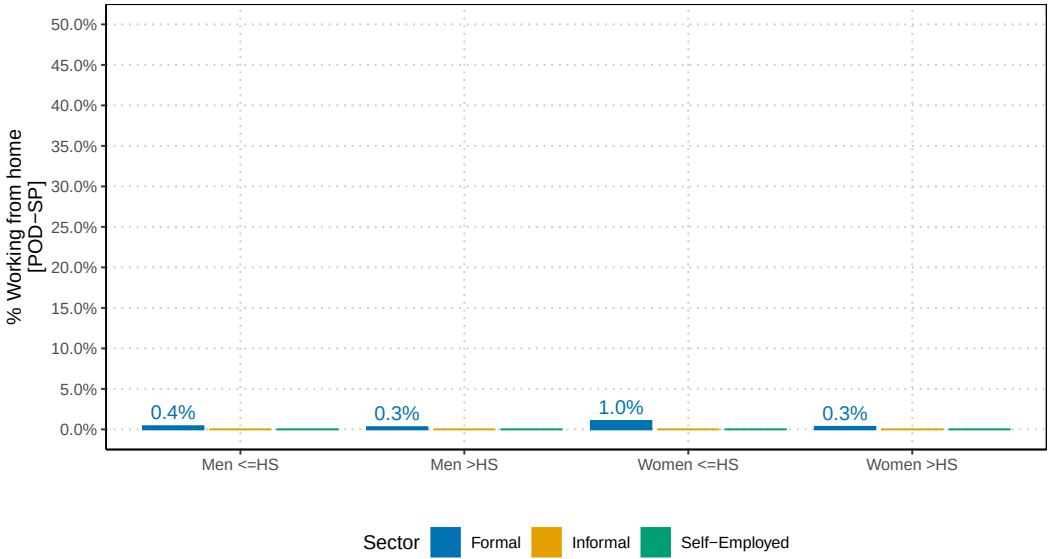


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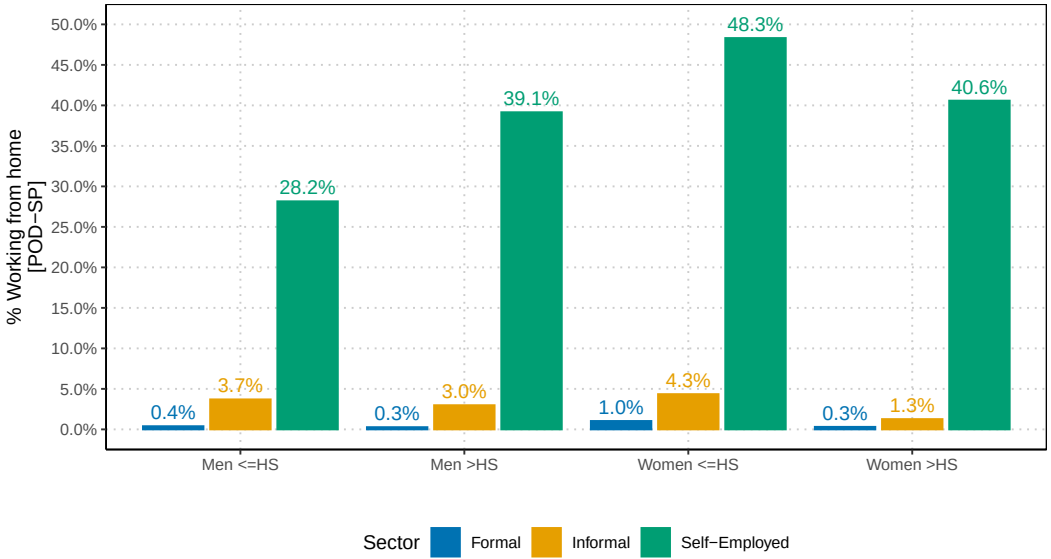
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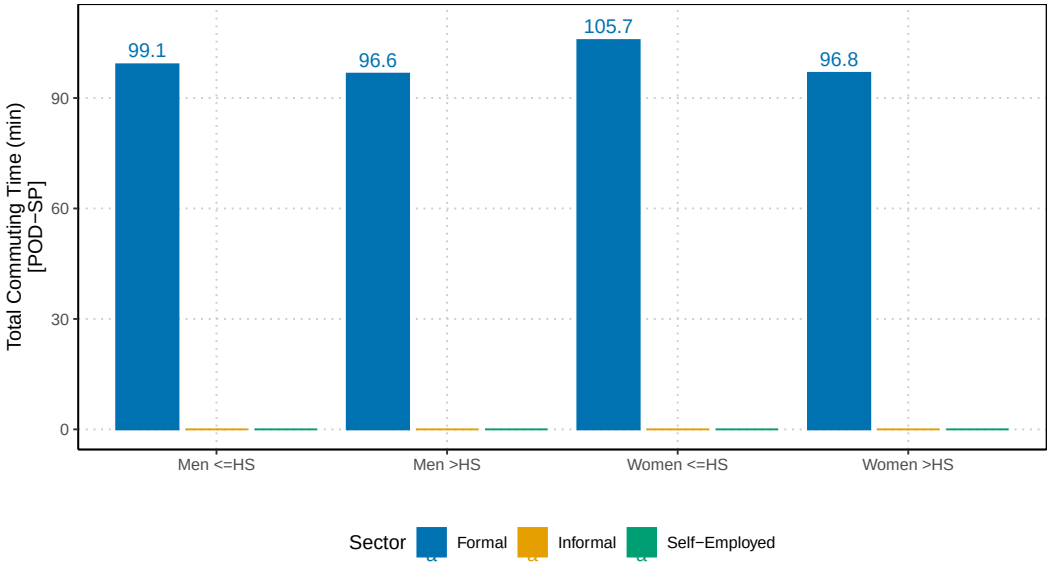
Working from home



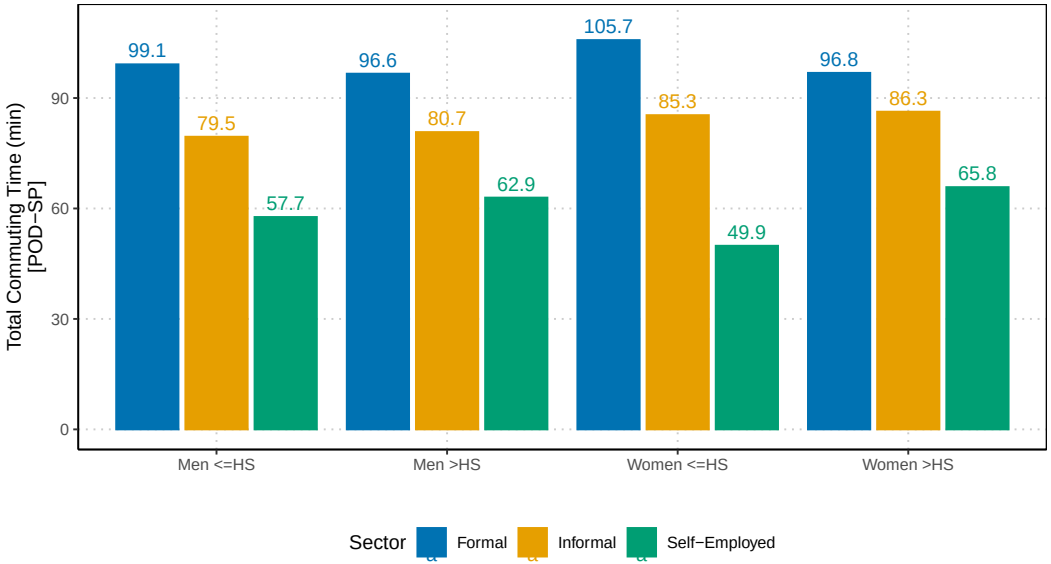
Working from home



Commuting time (conditional on any)



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Motherhood Penalties in the Formal Sector

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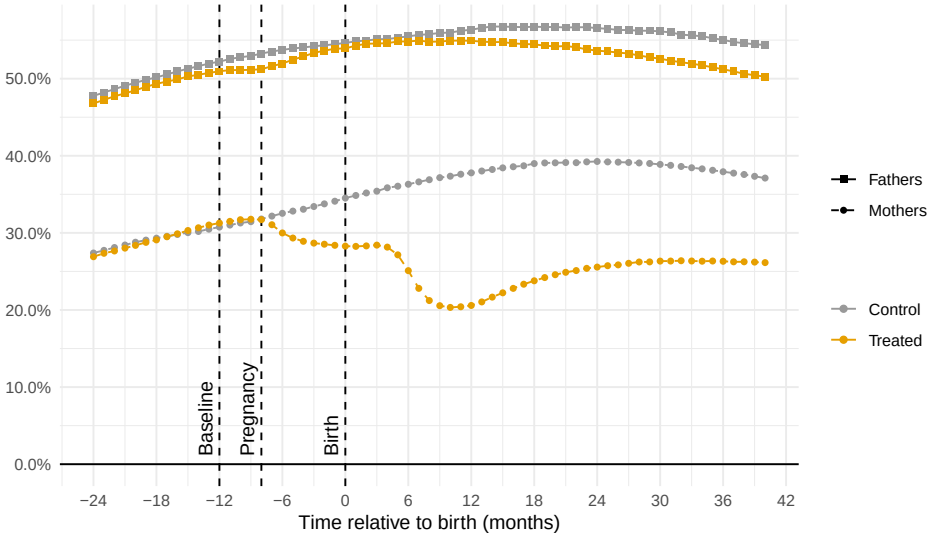
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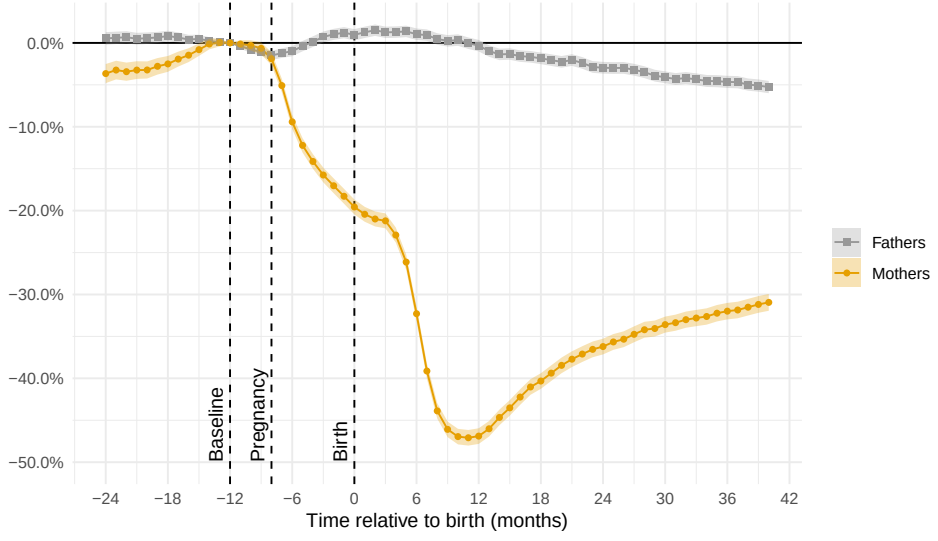
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  - Matching variables: gender, birth cohort, municipality, education, RAIS/CadUnico status

$$Y_{it} = \alpha + \gamma Treat_i + \sum_{\tau=-P}^{T} \gamma_\tau (Treat_i \times Time_\tau) + \eta_t + \varepsilon_{it}$$

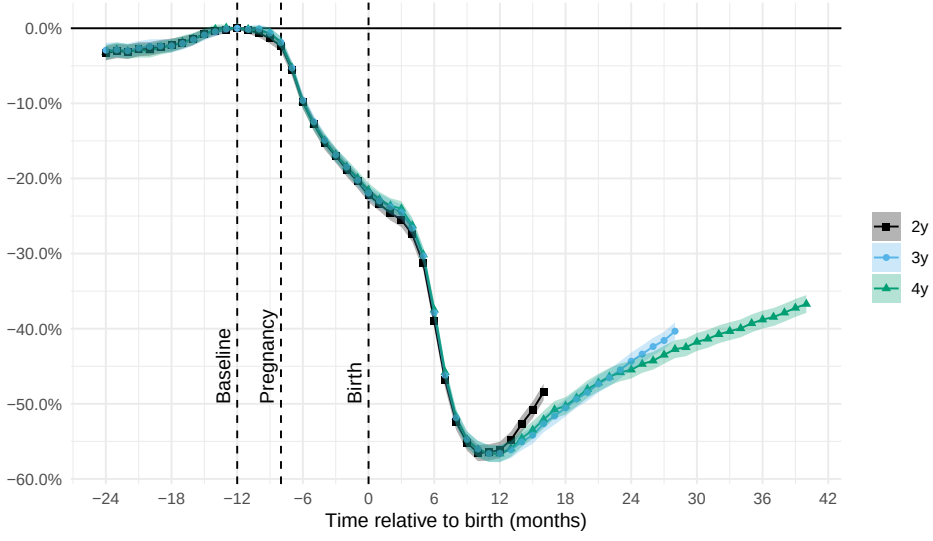
Career costs of children - Prob Formal Emp (Raw data)



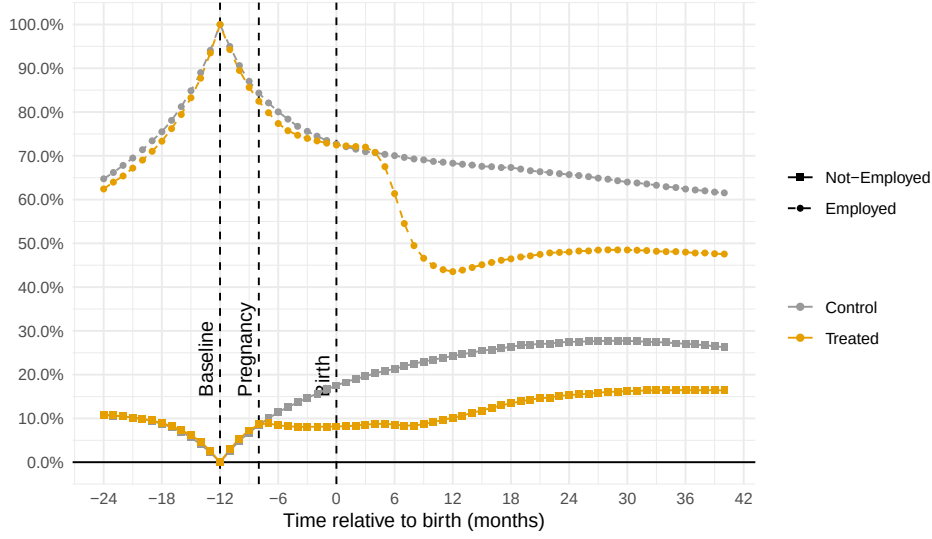
Career costs of children - Prob Formal Emp (ES Estimates)



Career costs of children - Prob Formal Emp (Comparison group)



Career costs of children - Prob Formal Emp (Baseline status)



Model

Main ingredients

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- Labor market characterized by search frictions

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- Brazilian legislation: women formally employed are entitled to maternity leave (4 months) and job protection (6 months).

Model elements

Sectors (Formal, Informal, Self-emp.) differ in:

- Earnings and returns; HK accumulation (formal x non-formal)
- Arrival rates and destruction
- Part-time opportunities
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  - Set or estimate some parameters outside the model more
  - SMM for the 34 remaining parameters (preference and technology parameters)

- Moments used (232): (more)
  - Event study estimates
  - Short-panel transitions
  - Employment patterns by age, marital status, and age of youngest child
  - Earnings
  - Number of children
  - Spacing of children

Estimates

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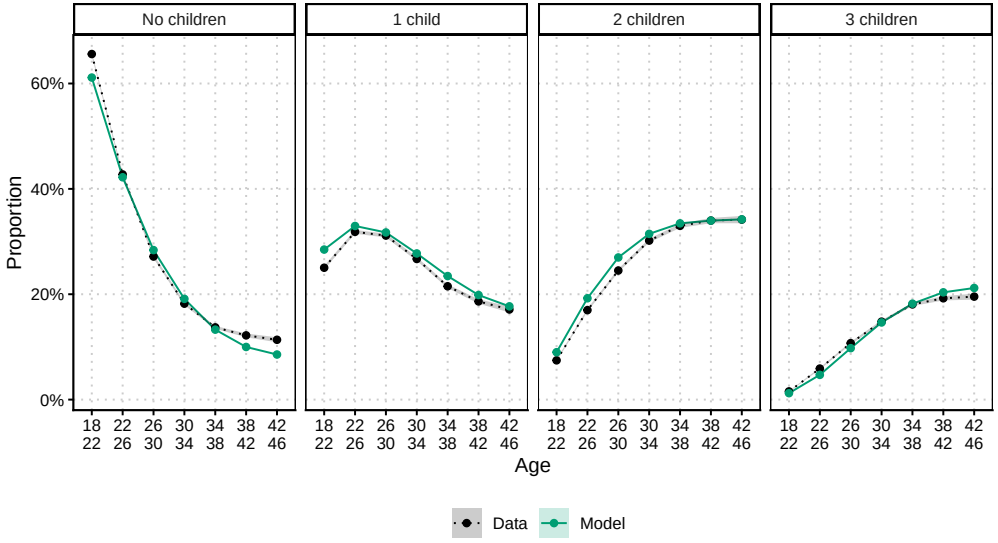
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  - With a baby 0–12 months: 25.6% lower arrival rates

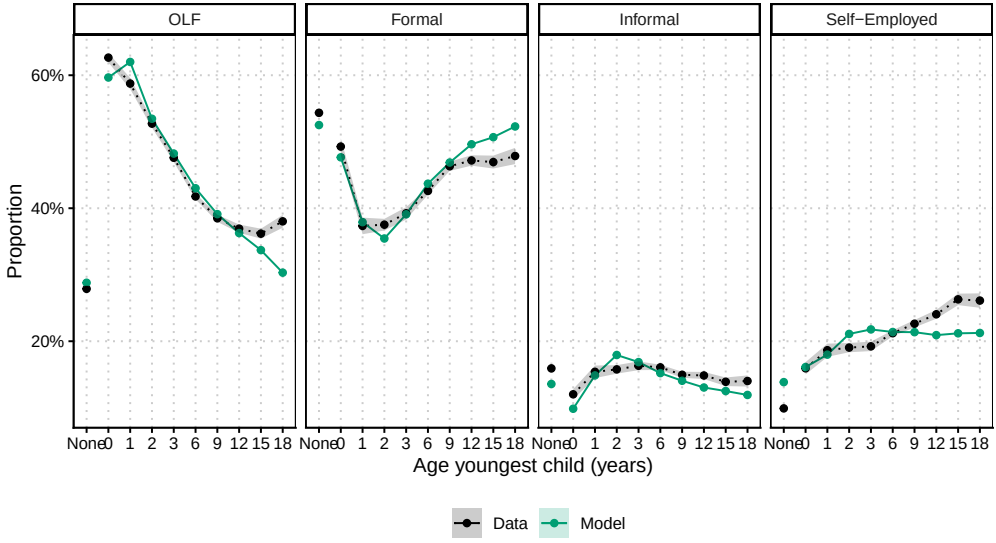
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- Part-time work
  - 100% self-employment, 30% for informal, 0.8% for formal

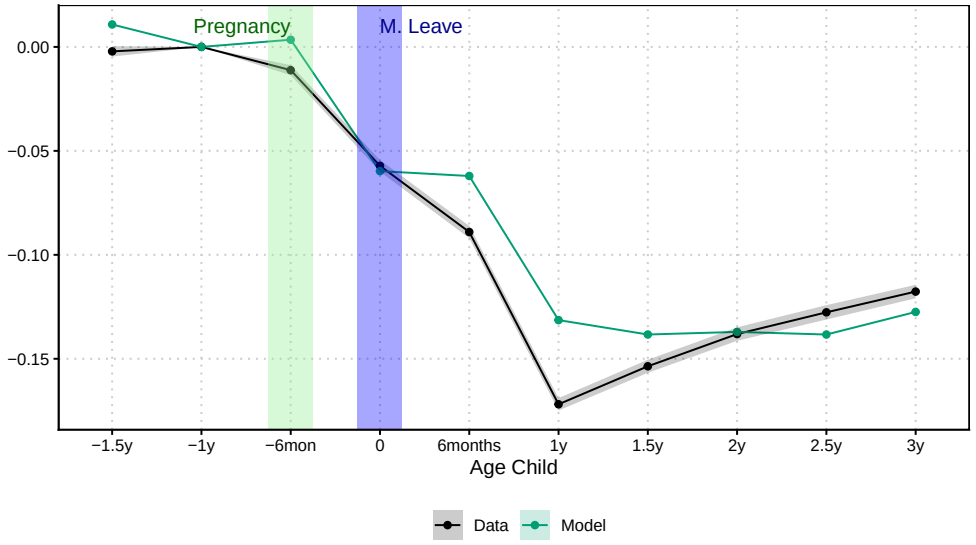
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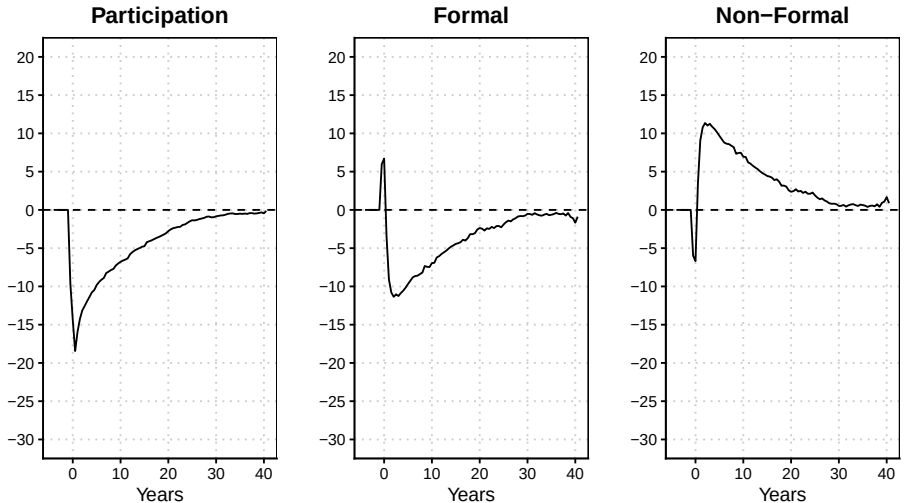


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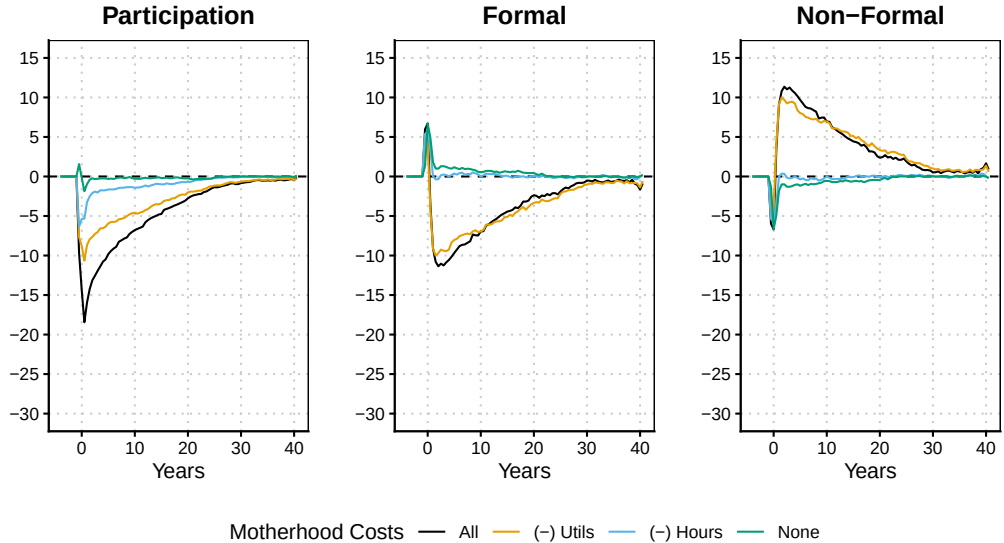


Counterfactuals

Motherhood penalty: shut down fertility in an unanticipated way



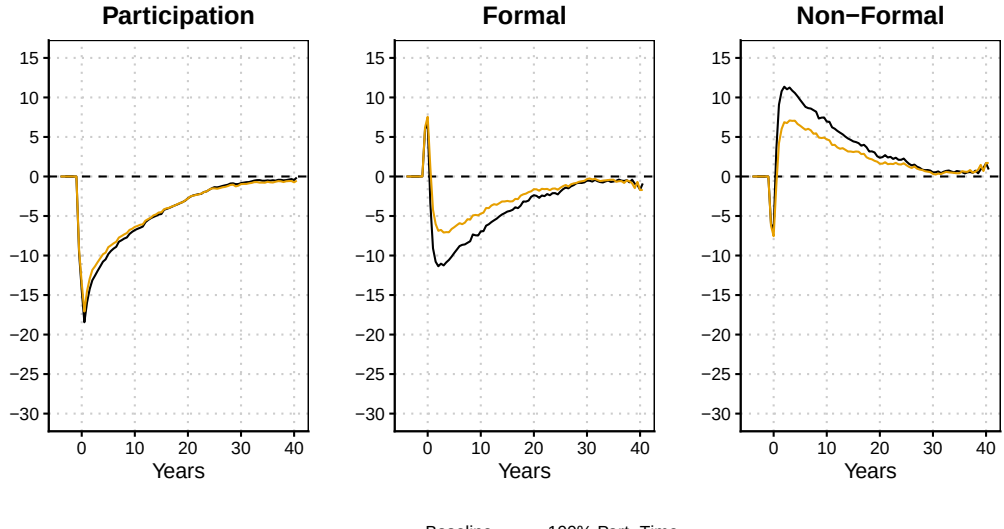
Motherhood penalty: Channels



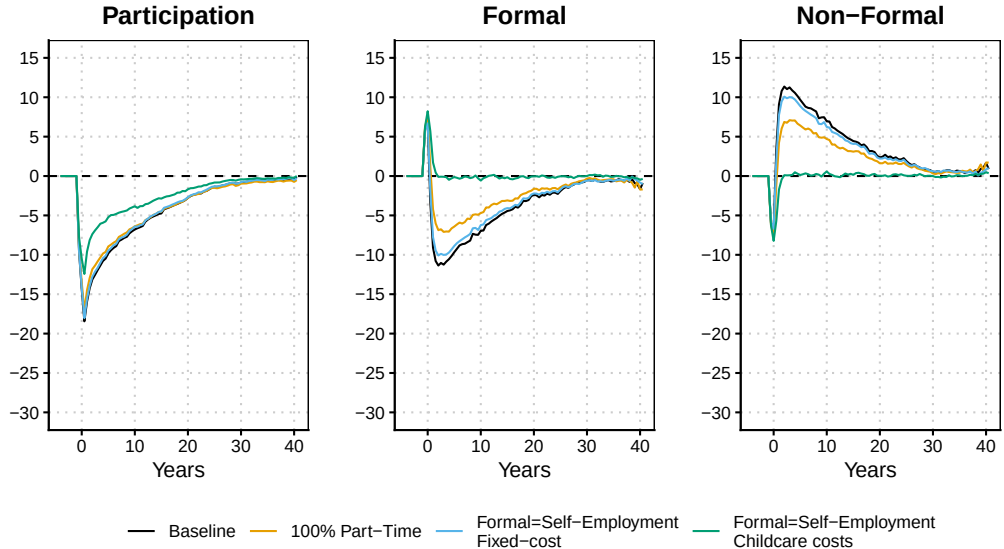
Motherhood penalty: Channels — decomposition

Outcome	Baseline Cost	Share (%) attributable to		
		Utility cost	Hours cost	Search cost
Participation, pp.	-3.502	35.7	49.8	14.5
Formal Employment (all), pp.	-3.628	15.7	70.8	13.5
Formal Employment (intensive margin), pp.	-2.601	-3.8	101.7	2.0
Formal Experience, years	-0.417	13.4	71.4	15.2
Total Experience, years	-0.474	24.8	54.5	20.6
Consumption, %	-7.544	22.7	59.6	17.7
Consumption-Leisure index, %	-1.908	9.6	78.6	11.9

Motherhood penalty: Counterfactuals



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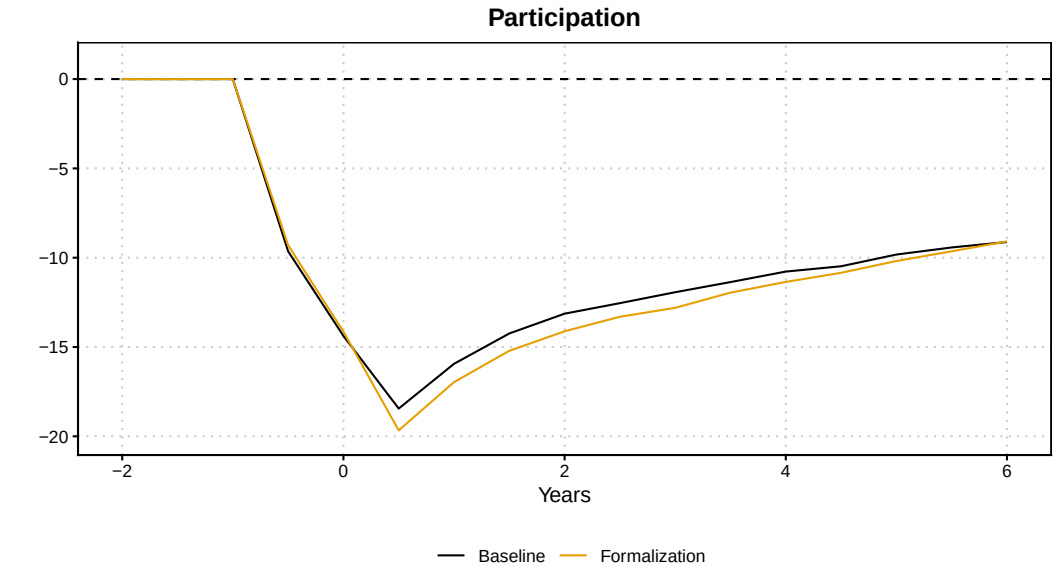


Motherhood penalty: Formalization program

Formalization program:

- Increases formal employment by 5pp
- Decreases non-formal employment by 5pp
- Leaving participation (for non-mothers) the same

Motherhood penalty: Formalization program (Short-run)



Motherhood penalty: Formalization program (Long-run)

Formalization program:

- Increases formal employment by 5pp
- Decreases non-formal employment by 5pp
- Leaving participation (for non-mothers) the same

$\Rightarrow$ increases welfare by 1%

$\Rightarrow$ decreases participation of mothers of young babies

Final Remarks

- In the presence of high rigidities in the formal sector, informality helps women stay attached to the labor force after childbirth
- However, this comes at the cost of lower: attachment to the formal sector, HK accumulation, and earnings over their life cycle
  - Intertemporal trade-off of informality!
- Reducing childcare costs in terms of time, or making it closer to the one observed in self-employment, produces the largest formalization effects after childbearing

Thank you!

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Appendix

Presentation

- Introduction
- Institutional setting and data
- Motivating Facts
- Child penalties
- Model
- Estimation
- Results
- Counterfactuals
- Conclusions

- Appendix

State space

	Variable	Notation
Demographics	Age	t
	Married	m
	Number of children	n
	Age of youngest child	a
Previous LM status	Sector	j^-
Experience levels	Formal	e
	General	g

$$\Omega = (t, m, n, a, j^-, e, g)$$

Shocks

Area	Shock	Notation
Preference Shocks	For Participation	ζ_o
	For Conception	ζ_b
Labor Market Shocks	Arrival from sector j to j'	$\zeta_\lambda^{j,j'}$
	Productivity for sector j	ζ_w^j
Demographic shocks	Marriage	$\zeta_{d,m}$
	Conception success	$\zeta_{d,b}$

Timing 1

1. The woman starts her period at $\Omega = (t, m, n, a, j^-, e, g)$ and she observes the conception shock ζ_b.
   - If $\zeta_b \geq \bar{\zeta}_{b\Omega}$, she tries to get pregnant $b = 1$.
2. The woman then observes the participation shock ζ_o.
   - If $\zeta_o \geq \bar{\zeta}_{o\Omega,b}$, she decides to be out of the labor market $o = 1$ (and $j = O$)
3. If the woman enters the labor market. We first check whether she receives a separation shock (only if $j^- \in \{F, I, S\}$).

$$j_{aux} = \begin{cases} U & \text{if } j^- \in \{F, I, S\} \text{ and fired} \\ j^- & \text{otherwise} \end{cases}$$

Timing 2

4. Given j_{aux}, she may or may not receive offers from F, I, S, observes the wage for F and I, and decides in which sector she wants to be and how much to work.

5. If she decided to be in S, she then learns the earnings.

   - Note that for transitions we compare j^- (and not j_{aux}) with j

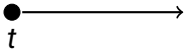
6. Towards the end of the period the demographic shocks are realized, whether she will start next period married or single (given current m) and whether she will have a baby born (if $b = 1$).

Timing (1 period $=$ 1 semester)

- t

▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

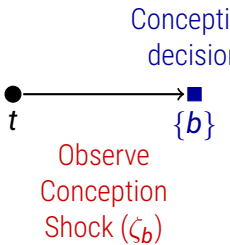
Timing (1 period $=$ 1 semester)



Observe
Conception
Shock (ζ_b)

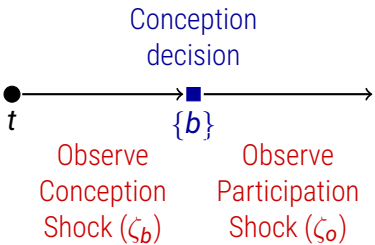
▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period $=$ 1 semester)



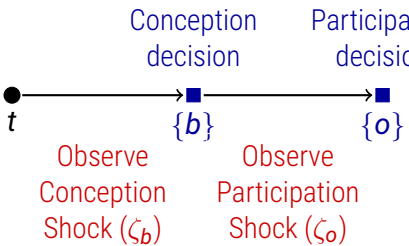
▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period $=$ 1 semester)



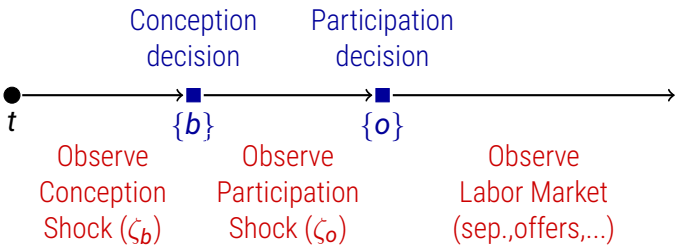
▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period $=$ 1 semester)



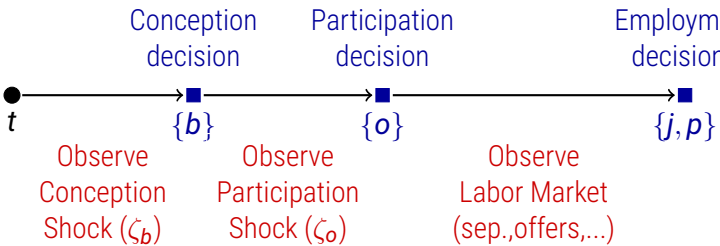
▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period = 1 semester)



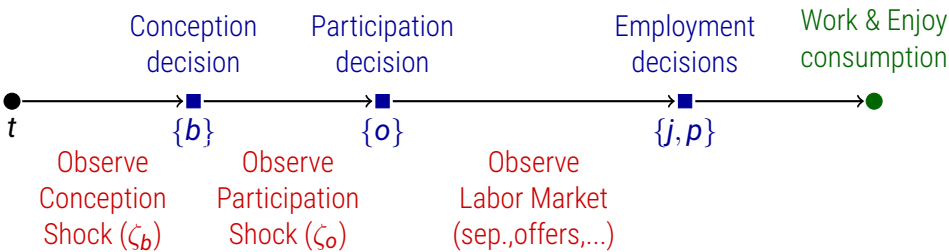
▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period = 1 semester)



▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period = 1 semester)



▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Timing (1 period = 1 semester)



▸ Earnings ▸ Flows ▸ Leisure ▸ Utility fcn

Instantaneous utility more

$$u(\Omega; b, j, p; \zeta) = \frac{(c^{\nu} \ell^{(1-\nu)})^{1-\sigma}}{1-\sigma} + \zeta_b b + \zeta_o \mathbb{1}\{j = 0\} - \chi \mathbb{1}\{j \neq 0, j^{-} = 0\}$$

$$- h(a)\mathbb{1}\{j \neq 0\} - \gamma \left(1 - \frac{a}{1.5}\right) \mathbb{1}\{b = 1, a \leq 1.5\}$$

Back

Labor Market: Experience

- When working in the formal sector, women accumulate formal experience, e.
- When working as informal employees or self-employed, women accumulate general experience, g.
- When working part-time, in either sector, women accumulate a fraction $(1 - \rho_e)$ of the full-time equivalent experience accumulation.

$$
\begin{aligned}
e_{t+1} &= e_t + \mathbb{1}\{j_t = F\}\,(1 - \rho_e p_t) \\
g_{t+1} &= g_t + \mathbb{1}\{j_t \in \{I, S\}\}\,(1 - \rho_e p_t)\,.
\end{aligned}
$$

Back

Labor Market: Earnings

- The formal sector only rewards formal experience, while the other sectors reward total experience $(e + g)$.
- When working part-time, women lose a fraction ρ_w of their labor earnings.
- At each point in time, there is a sector-specific productivity shock given by ζ_t^j.

$$w_t(j, e, g, p; \zeta_t) = \begin{cases} exp\left(r_0^F + r_1^F(e) + r_2^F(e)^2 + \zeta_t^F\right)(1 - \rho_w p), & \text{if } j = F \\ exp\left(r_0^I + r_1^I(e+g) + r_2^I(e+g)^2 + \zeta_t^I\right)(1 - \rho_w p), & \text{if } j = I \\ exp\left(r_0^S + r_1^S(e+g) + r_2^S(e+g)^2 + \zeta_t^S\right)(1 - \rho_w p), & \text{if } j = S \\ 0, & \text{if } j = O, U. \end{cases}$$

Back

Labor Market: Flows

- Individuals receive job offers stochastically, and, when employed, face exogenous separation shocks δ_j + endogenous separation.
- Base arrival rates are adjusted for an experience channel:

$$\lambda_{j,j'} = \lambda^0_{j,j'} \left(\frac{1}{1 + \frac{1-\omega_{j'}}{\omega_{j'}} \exp(-e - g)} \right)$$

$\Rightarrow$ Arrivals to formal and self-employment are increasing in experience. Only formal experience (e) is rewarded in the formal sector.

Back

Leisure

- One unit of leisure at every period ($\ell = 1$).
- If OLF, $\ell = 1$. If participating:
  - Loses h^U if unemployed due to job search;
  - Loses h^j, a sector-specific fixed cost of working + working hours, h^{FT} or h^{PT}
- If she has a young child and works, additional childcare costs that depend on the age of the youngest child and the sector:

$$g(a,j) = \begin{cases} 0, & \text{if } j \in \{O,U\} \\ \left(\frac{\bar{A}-a}{\bar{A}+\frac{1}{\pi_1}a}\right)\theta(1-\theta_I\mathbb{1}\{j=I\}-\theta_S\mathbb{1}\{j=S\}), & \text{if } j \in \{F,I,S\} \end{cases}$$

- Leisure: $\ell = 1 - h^U\mathbb{1}\{j=U\} - \left(h^j + h^{FT}(1-p) + h^{PT}p + g(a,j)\right)\mathbb{1}\{j \in \{F,I,S\}\}$.

back

Parametrization (back)

- Preference Shock ζ_o (for being out of the labor force)

$$\zeta_o \sim N(0, \sigma_o)$$

- Preference Shock ζ_b (for conception; variance normalized)

$$\zeta_b \sim N\Big(\mu(m,n), 1\Big)$$

- Probability of conceiving by age t: $Pr(\nu_{it} > \bar{\nu}_t)$

$$\nu_{it} \sim U[0,1] \quad \text{and} \quad \bar{\nu}_t = \sqrt{\frac{\nu_0}{\nu_1 - t}}$$

Parametrization (2) (back)

- Probability of marrying by age t: $Pr(\gamma_{it} > \bar{\gamma}_t^0)$

$$\gamma_{it} \sim U[0,1] \quad \text{and} \quad \bar{\gamma}_t^0 = [1 + \exp(\varphi_0 + \varphi_1 t + \varphi_2 t^2)]^{-1}$$

- Probability of divorcing by age t: $Pr(\gamma_{it} > \bar{\gamma}_t^1)$

$$\gamma_{it} \sim U[0,1] \quad \text{and} \quad \bar{\gamma}_t^1 = \varphi_3$$

- Child penalty (time)

$$g(a,j) = \left(\frac{\bar{A} - a}{\bar{A} + \frac{1}{\pi_1} a} \right) \theta \left(1 - \theta_I \mathbb{1}\{j = I\} - \theta_S \mathbb{1}\{j = S\} \right)$$

- Child penalty (utility)

$$h(a) = \left(\frac{\bar{A} - a}{\bar{A} + \frac{1}{\pi_2} a} \right) \phi$$

Parametrization (3) (back)

- Returns to experience

$$h^k(e) = \alpha_1^k e + \alpha_2^k e^2$$

- Earnings shocks

$$\varepsilon^j \sim N(0, \sigma_{\varepsilon_j})$$

Parameters — 1st stage (back)

Discount rate	β	1	Set from the literature
Coefficient of risk aversion	σ	1	Set from the literature
Earnings intercept	μ_F, μ_I, μ_S	3	PNAD
Variance of income shocks	$\sigma_F, \sigma_I, \sigma_S$	3	PNAD
Prob Conceiving	$\nu_0 = 5, \nu_1 = 55$	2	Set from literature
Prob Marrying/Divorcing	$\varphi_0, \varphi_1, \varphi_2, \varphi_3$	4	Estimated separately
Part-time earnings	ρ_w	1	Set to prop of hours part-time
Part-time penalty (experience)	ρ_e	1	Set to 0.50
Formal wage	$\tau_0 = 1.306, \tau_1 = 0$	2	Haanwinckel and Soares (2021)
Fixed cost of working	χ_F, χ_I, χ_S	3	Commuting time (Census)

Parameters and Identification (2nd stage) (back)

Consumption-weight	ν	1	Prop PT
Participation shock	$\mu_o(m), \sigma_o$	3	Proportion out the labor force
Conception shock	$\mu_b(m,n)$	3	Fertility patterns by marital status, LC
Childcare time	$\pi_1, \theta, \theta_I, \theta_S$	4	LM by age of kid and event studies
Childcare utility	π_2, ϕ	2	Reduced form
Fixed cost of working	χ_0	1	% working part-time by sector
Switching cost	$\chi_{j,j}$	1	Prop staying OLF
Arrival rates	$\lambda_{j,j'}$	9	Transitions
Arrival PT options	$\lambda_{F,PT}, \lambda_{I,PT}$	2	Transitions & %PT

Parameters and Identification (2nd stage) (back)

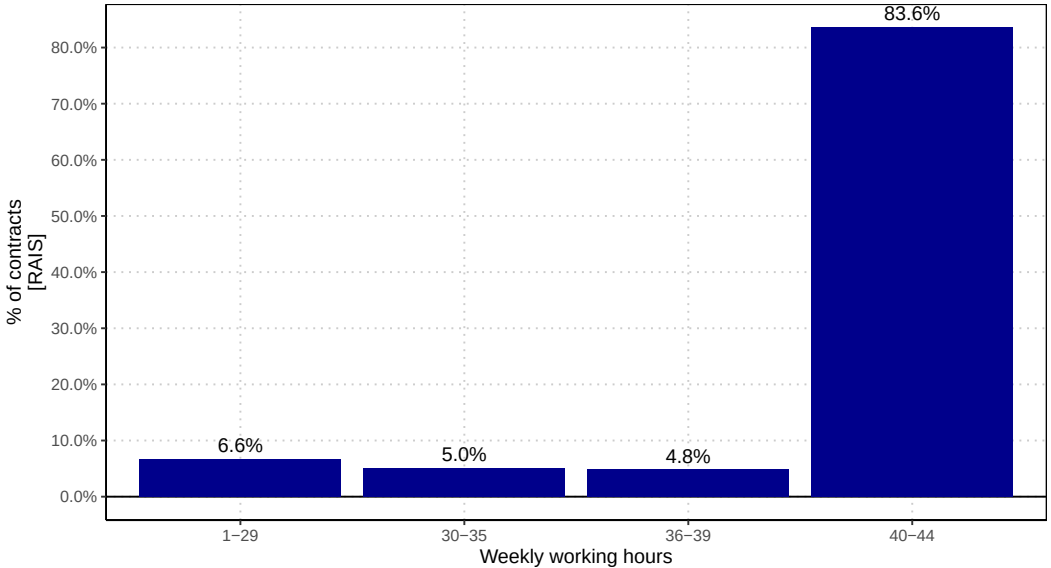
Destruction rates	$\delta_F, \delta_I, \delta_S$	3	Transitions
Returns to experience	r_F, r_I, r_S	3	Income
Adj to search	ω_S	1	Life-cycle LM
Adj Search pregnancy	κ_1, κ_2	2	Reduced form

Formal earnings in Haanwinckel and Soares (2021)

- $W = a \times w + b$
- In a they include:
  - 13 wage, Vacation, Severance Payment INSS, IRPF, FGTS (50%), FGTS firing penalty, Insurance,...
- b includes abono salarial & UI
- Their estimates for unskilled workers
  - $a = 1.306$
  - $b = (0.05 + \delta 4)\bar{w}$

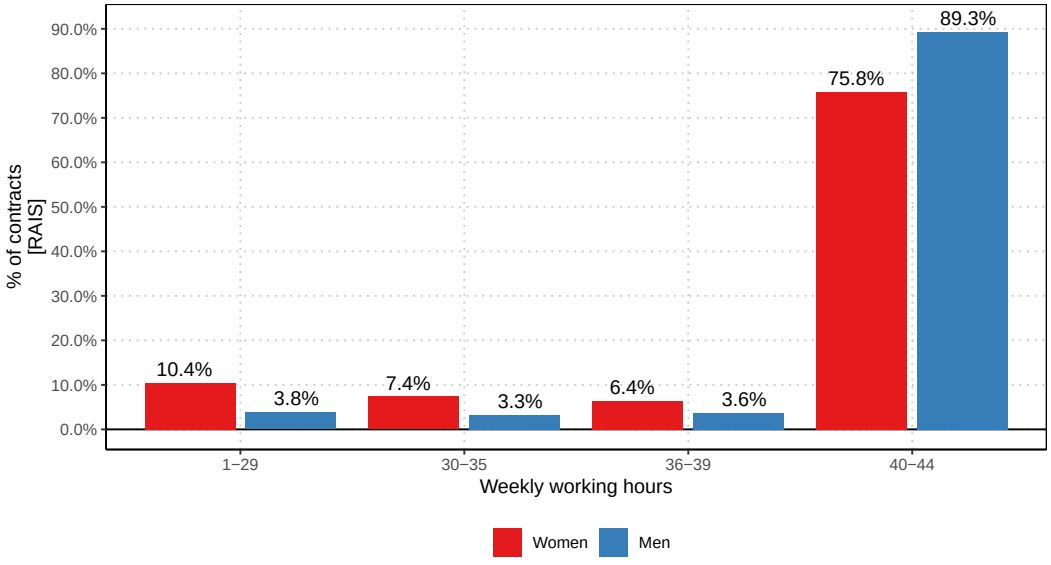
Lack of part-time contracts

Educ Trends Occupations

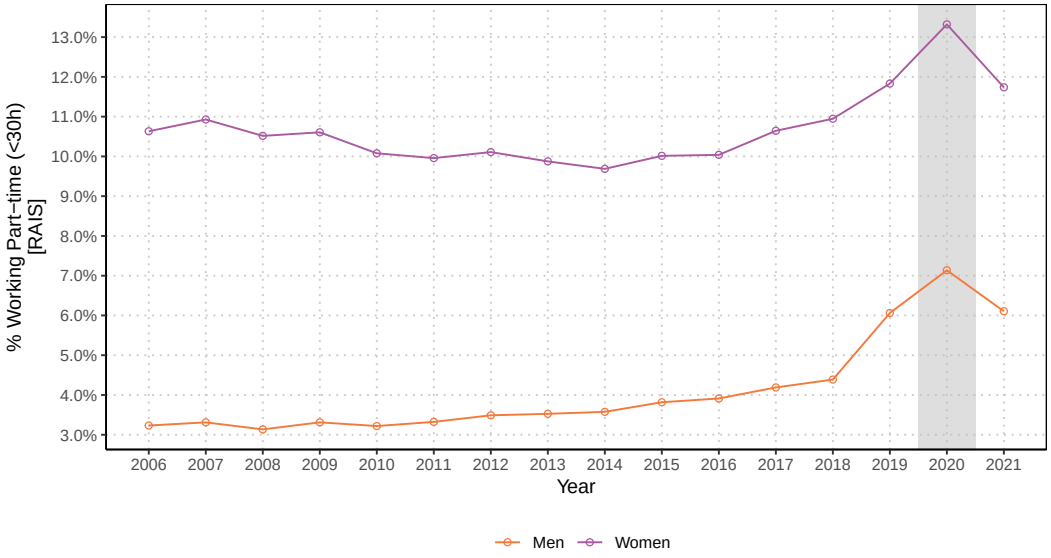


Lack of part-time contracts

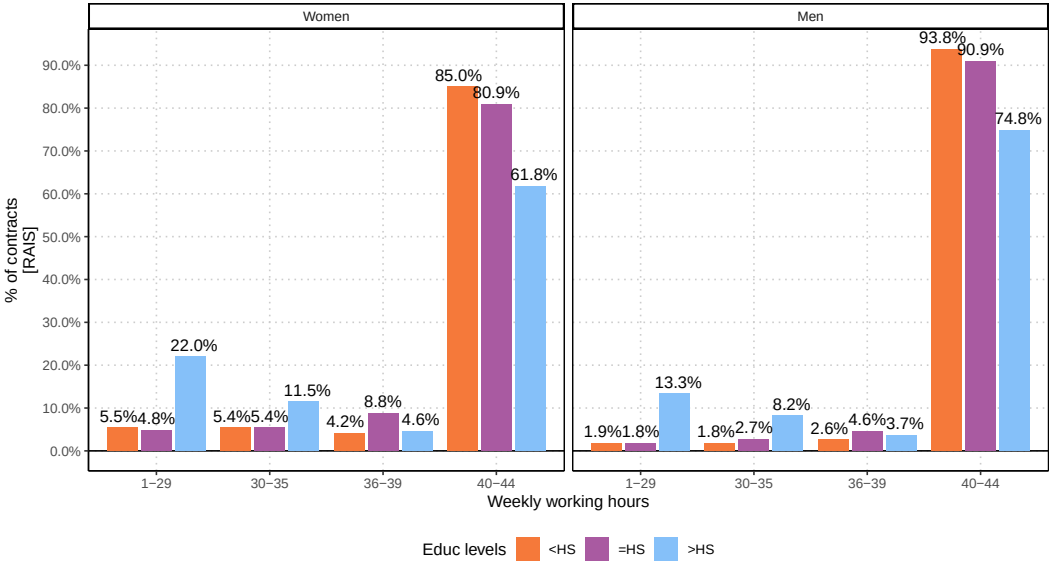
Educ Trends Occupations



Lack of part-time contracts (back)



Lack of part-time contracts (back)



Lack of part-time contracts (back)

Outcome: Part-time ($<$ **30** hours)

Model:	(1)	(2)	(3)	(4)
Constant	0.0696***	0.0414***	0.0183***	
	(0.0016)	(0.0012)	(0.0015)	
Women		0.0655***	0.0442***	0.0142***
		(0.0039)	(0.0031)	(0.0028)
Educ $=$ HS			-0.0038*	-0.0128***
			(0.0020)	(0.0020)
Educ $>$ HS			0.1419***	0.0078*
			(0.0053)	(0.0047)
OCC FE	-	-	-	Yes

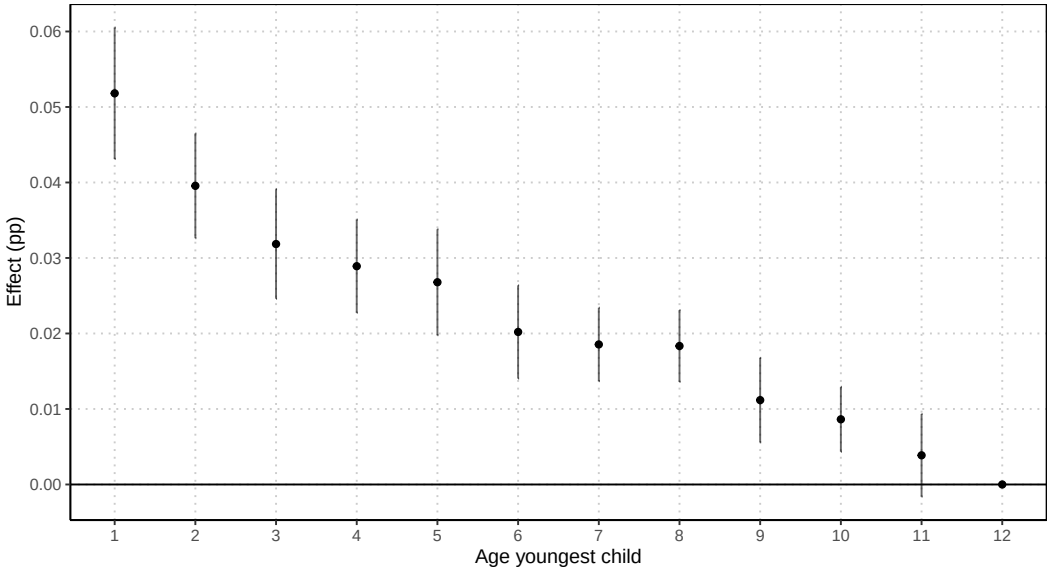
Institutional Setting

- Formal sector:
  - minimum wage, severance payment, forced savings
  - social security contributions (unemployment insurance, health and parental leaves, disability insurance, pension contributions)
- Safety net:
  - Conditional Cash Transfer, Minimum Pension Guarantees

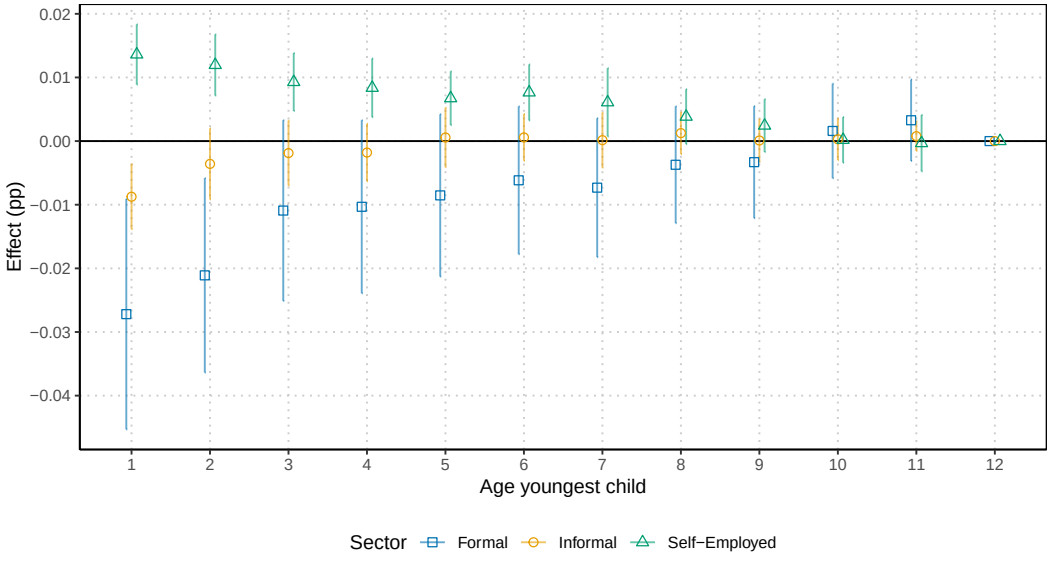
Institutional Setting

- Formal sector:
  - minimum wage, severance payment, forced savings
  - social security contributions (unemployment insurance, health and parental leaves, disability insurance, pension contributions)
- Safety net:
  - Conditional Cash Transfer, Minimum Pension Guarantees
- Pregnancy/Children:
  - Pregnant women cannot be fired from the formal sector
  - Leave: 120 days for mothers and 5 days for fathers in the formal sector
  - Around 23% of children aged 0–3 attended childcare [Census 2010]
    15% public and 8% private

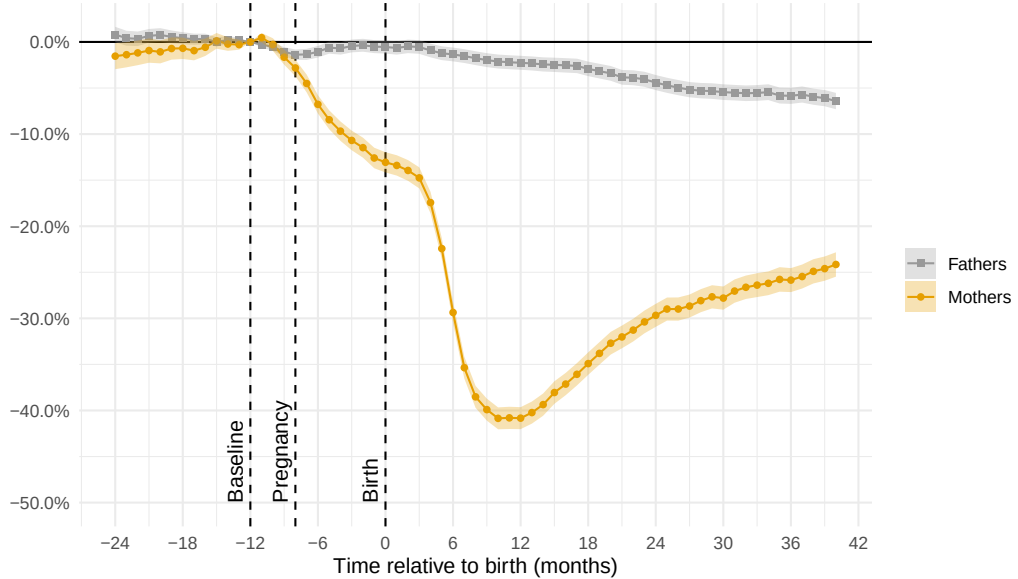
Working Part-time by age of youngest child



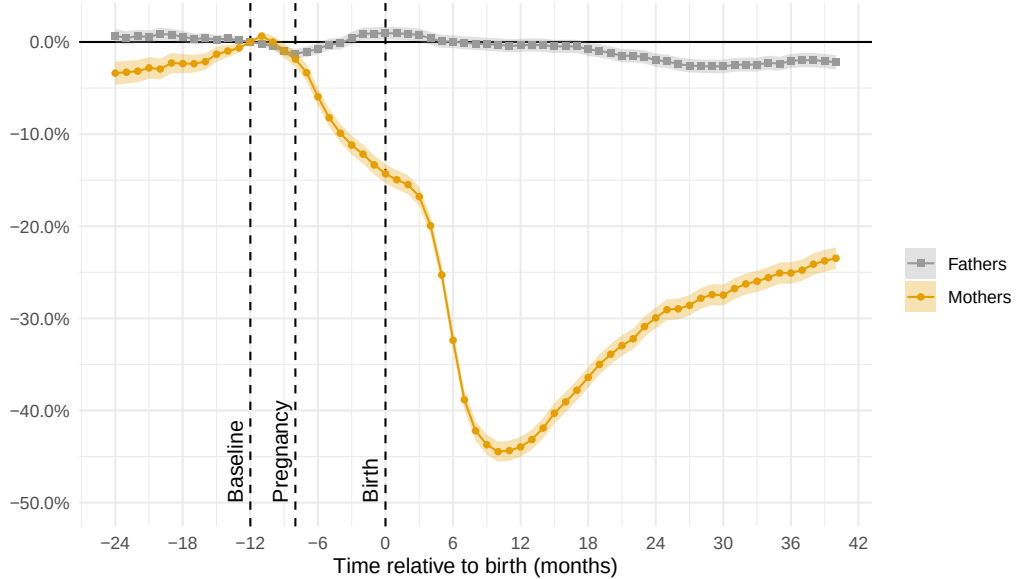
Sector of work by age of youngest child



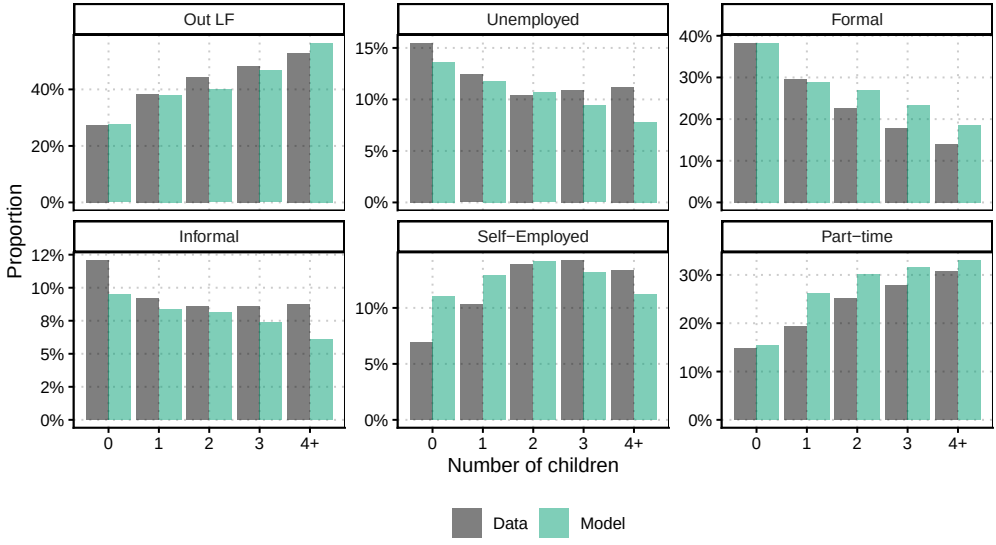
Career costs of children - Months employment



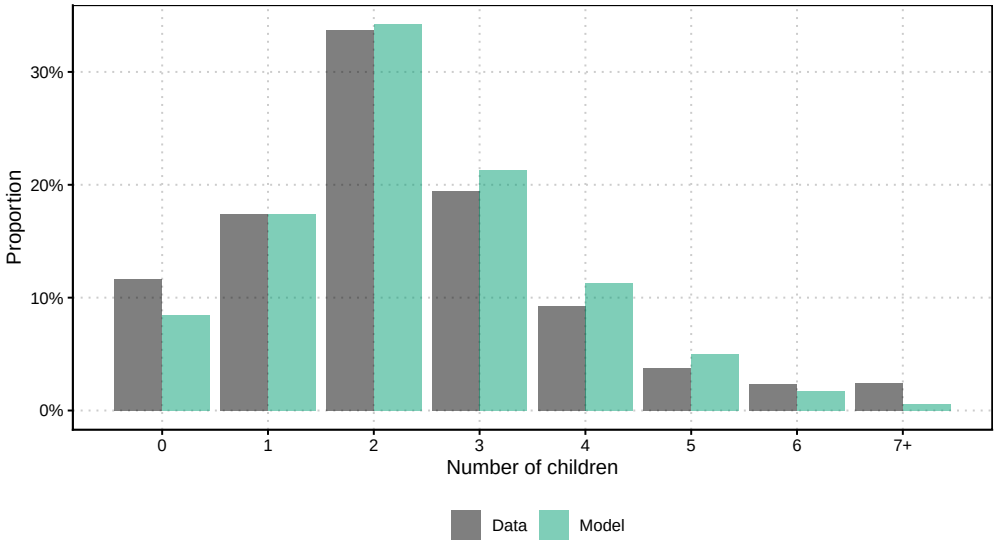
Career costs of children - Formal Earnings



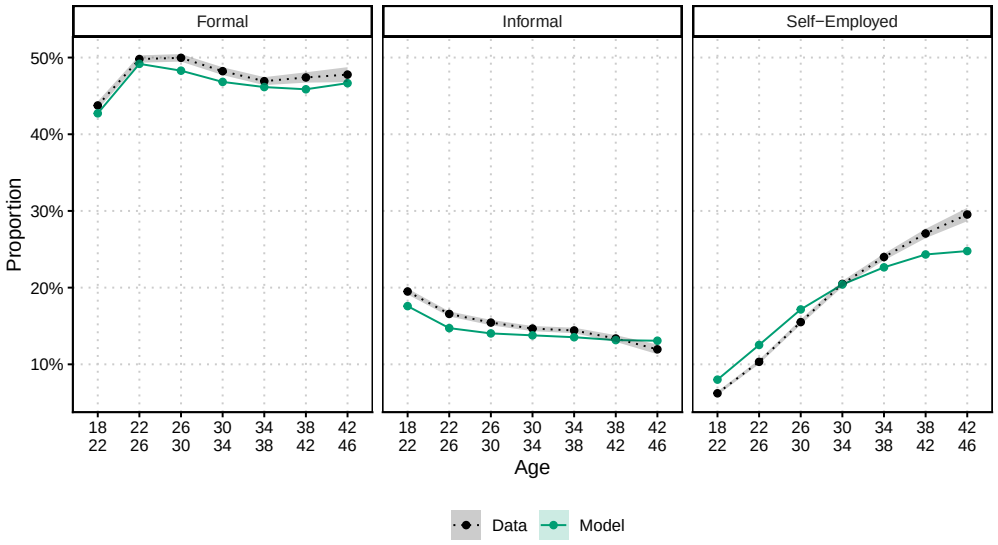
Model Fit: untargeted moments



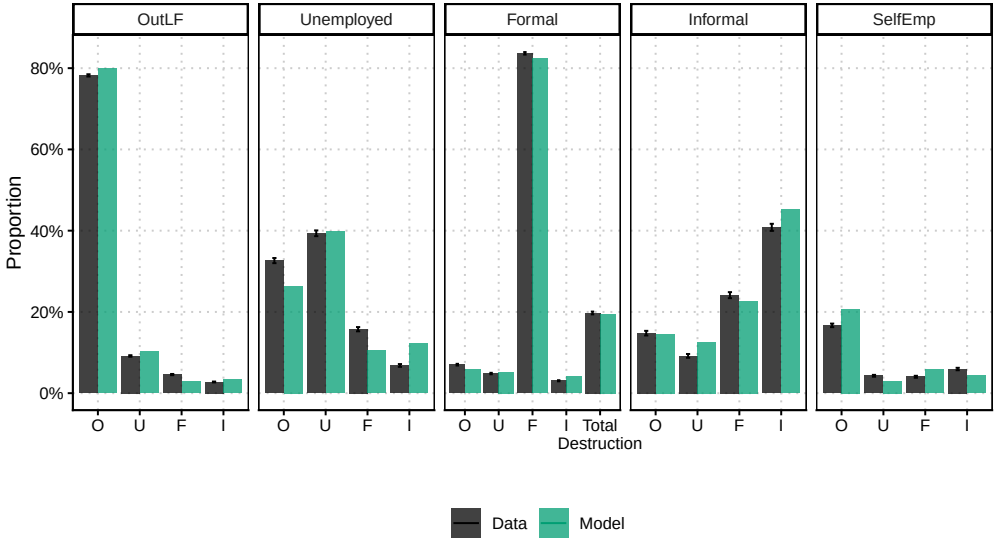
Model Fit: untargeted moments



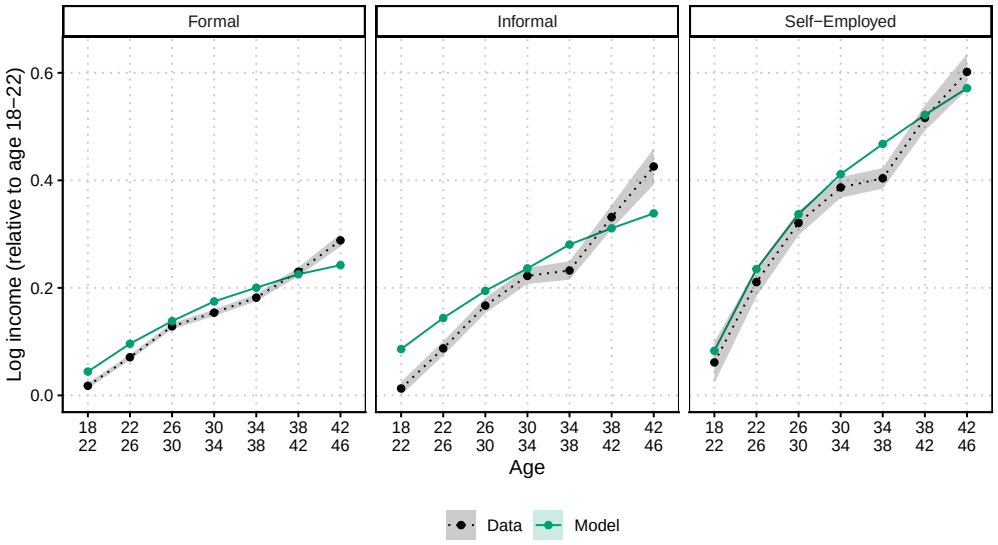
Model fit: Proportion of women across sectors



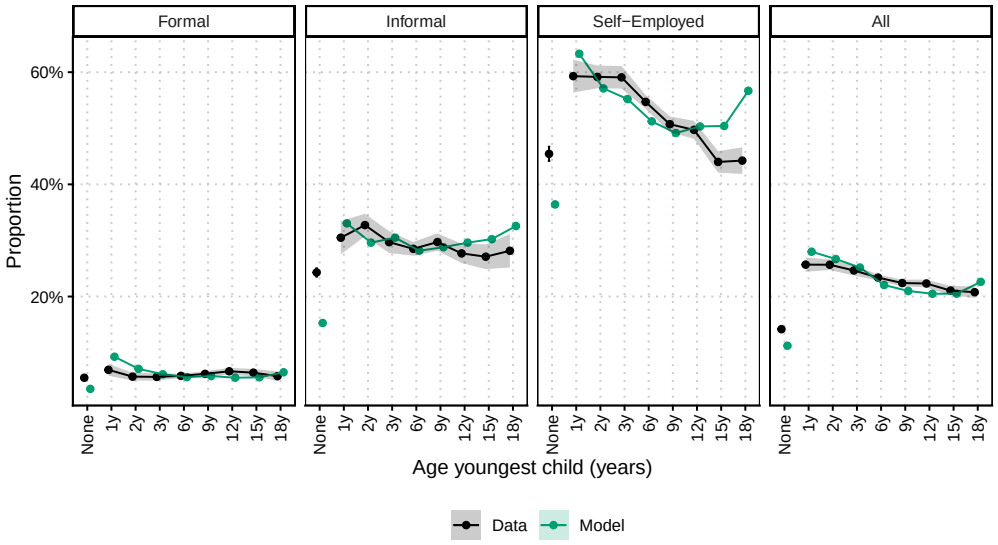
Model fit: Transitions across labor market states



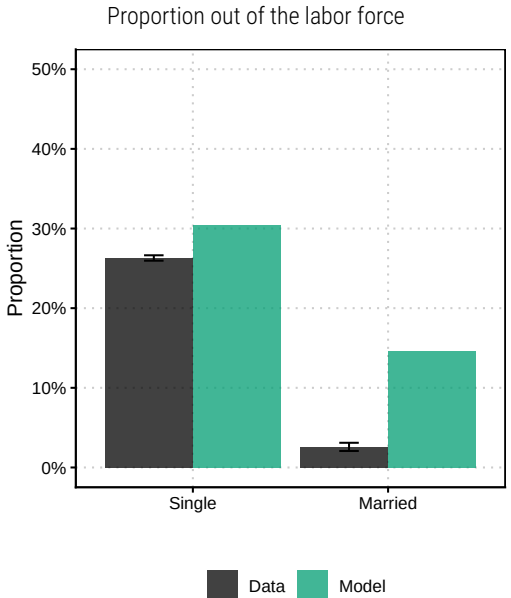
Model fit: Income profile (growth)

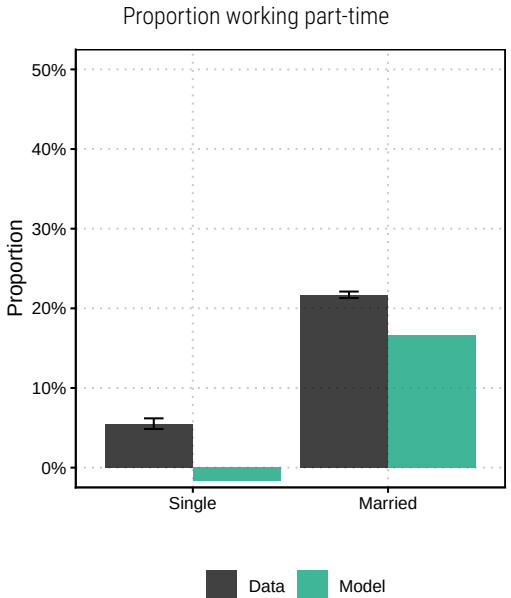


Model fit: Proportion working part-time by sector

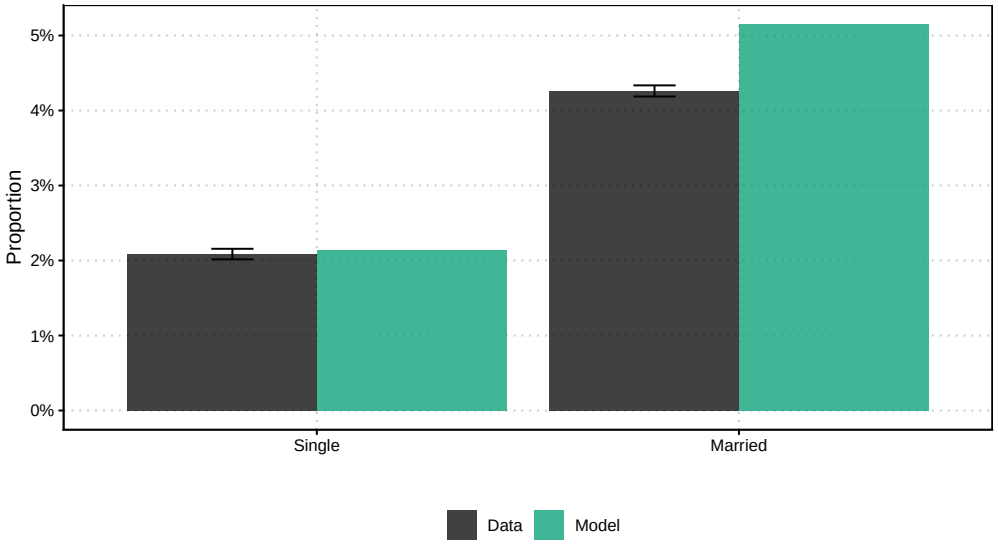


Model fit: Employment patterns by marital status

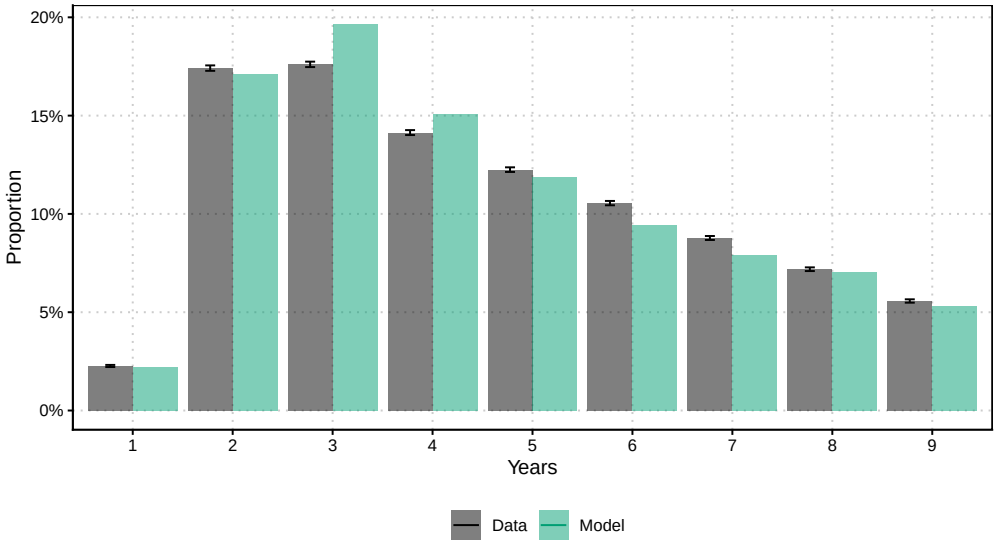




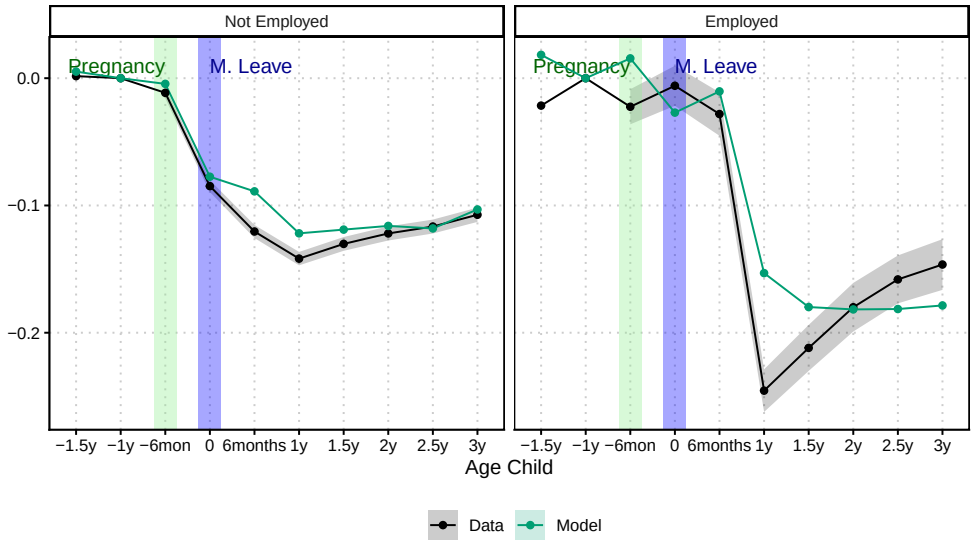
Model fit: Proportion of women with a newborn by marital status



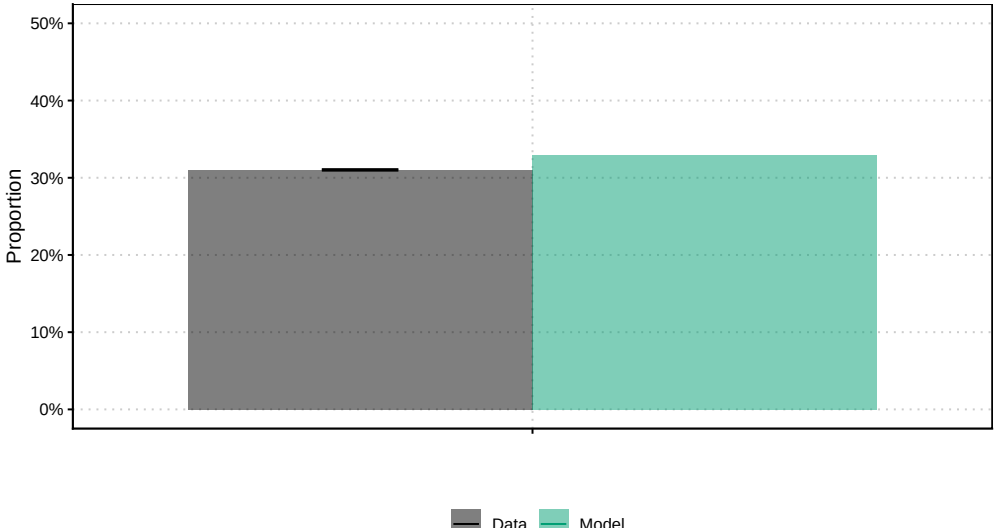
Model fit: Spacing between first and second child



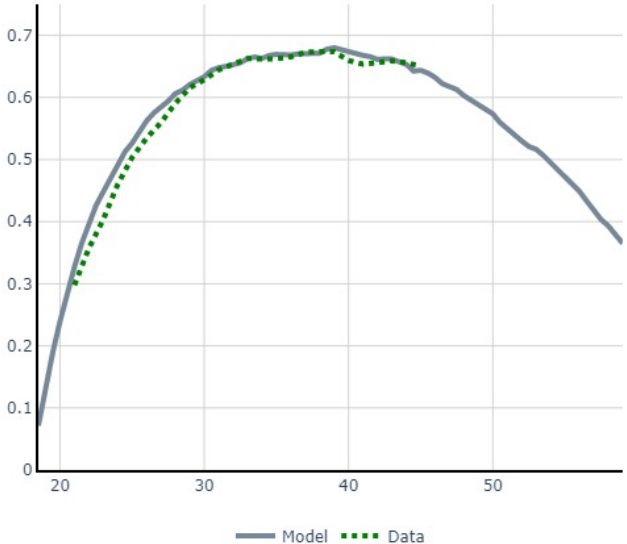
Model fit: Motherhood penalty by baseline employment status



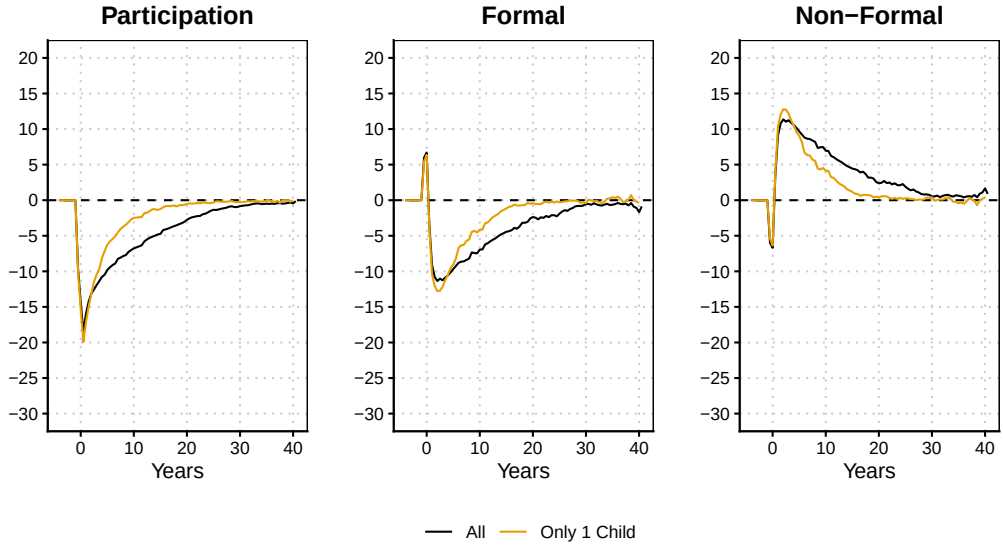
Model fit: Pregnant women — proportion formally employed at baseline



Model fit: Marriage process calibration



Motherhood penalties (event study)



Counterfactuals: formal costs compared to informal employment

