Gendered Effects of the Minimum Wage

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Introduction

- Women are more likely to work in low-hours jobs.
  - In Germany, only half of employed women work full-time.
  - For women, marriage and children are strongly associated with reduced hours.

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- Germany introduced a national minimum wage in 2015: 8.50 €/hour.
  - Caliendo et al (2018): Negative effect on marginal employment (minijobs) but little effect on regular employment.
- The minimum wage likely has a larger impact on women than on men.

Research Questions

- What are the equilibrium effects of the minimum wage on wages, employment, and working hours for men and women?
- How do firms respond, and how do their responses shape equilibrium outcomes?
- How does the minimum wage affect the gender income gap?

What We Do

- **Build an equilibrium search model** with:
  - heterogeneous workers and firms,
  - jobs differing in wages and **hours requirements**.
- Calibrate the model using pre-reform data from Germany.
- Implement the minimum wage, allowing for **non-compliance**.
- Quantify the equilibrium effects of the initial minimum wage and assess the impact of higher minimum wage levels.

Main Takeaways

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- Firms raise wages, with the largest increases concentrated in low-hours jobs. This response dampens the extent of reallocation toward longer hours.

- Gendered effects:
  - The minimum wage reduces gender inequality mainly through the wage gap.
  - Its impact on the gender hours-worked gap is non-monotonic, peaking at 11 €, where, 30.4% of the impact on the gender income gap is due to hours worked.

Literature Review

- **Minimum wage and gender gaps:**

  DiNardo, Fortin, and Lemieux (1996); Autor, Manning, and Smith (2016); Bargain, Doorley, and Van Kerm (2019); Caliendo and Wittbrodt (2022)

  We examine not only the effect on the gender wage gap but **also the hours-worked gap**.

- **Minimum wage policies in equilibrium job search models:**

  Engbom and Moser (2022), Bloemer et al. (2024), Drechsel-Grau (2024)

  We allow firms to **adjust hours** as well as wages and to choose not to comply with the minimum wage. Focus on gendered effects.

- **Gender inequality using dynamic equilibrium models:**

  Morchio and Moser (2024), Amano-Patino, Baron and Xiao (2021)

  We emphasize the gender **hours gap** and analyze how **minimum wages** affect gender inequality.

Outline

Equilibrium Job-Posting Model

Model: Jobs and Workers

Job-posting model with random search *a la* Burdett and Mortensen.

- Job offers are characterized by
  - an hourly wage w
  - and an hours requirement $h \in \{h_{ME}, h_{PT}, h_{FT}\}$.

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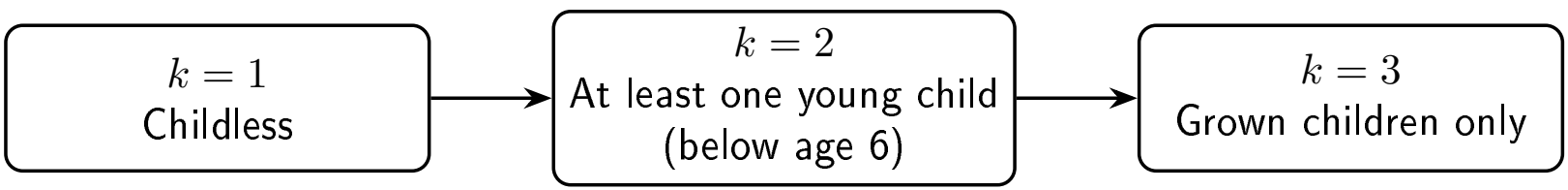

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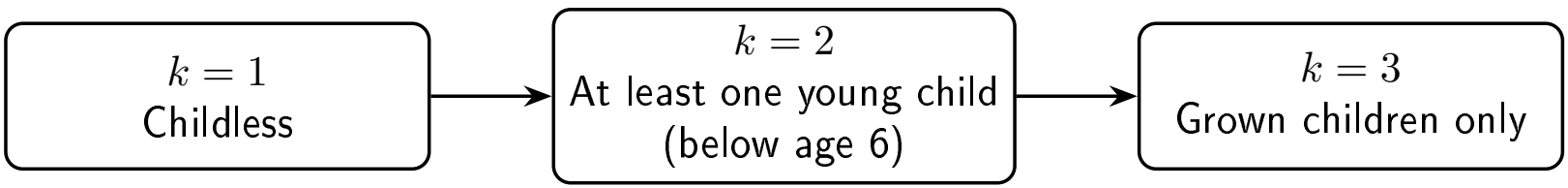

- Decisions: Job acceptance/rejection and quitting.

Model: Preference, Labor Efficiency, and Budget Constraint

- Flow utility

$$u^j(c, h, k) = \ln c + \psi_k^j \frac{\left(\bar{h} - h\right)^{1-\gamma_k^j}}{1-\gamma_k^j},$$

Preference for non-working hours $(\bar{h} - h)$ depends on gender j and children k

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- Budget constraint: ▸ Net-of-tax functions
  - Consumption c equals net-of-tax income.
  - Progressive income taxation.
  - Married workers pool incomes with their spouses and are subject to joint taxation.

Model: Job Finding and Separations

- Employed and non-employed workers receive job offers at rate λ.
- Offer distribution:
  - Δ^h: share of offers with hours requirement h.
  - $F_h(w)$: conditional wage distribution.
- Exogenous job separation rate $\delta(h)$.
- Workers may quit into non-employment upon child state transition.

▸ Value functions

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  - Complementarity between p and h.
- Optimal wage policy: $w_h(p)$ maximizes $\pi_h(w;p)$.

Model: Firm Decision (II)

- Optimal hours requirement given job-posting cost ε

$$h\left(p,\boldsymbol{\varepsilon}\right)=\arg\max_{h\in\mathcal{H}}\left\{\underbrace{\pi_h\left(w_h(p),p\right)}_{\text{expected flow profit}}-\underbrace{\left(\bar{\epsilon}_h-\varepsilon_h\right)}_{\text{Job posting costs}}\right\}.$$

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- Optimal hours policy $\Delta\left(h;p\right)$: the share of productivity-p firms that post a job with hours requirement h.
- Offer distribution (equilibrium object):

$$\begin{aligned}\Delta^h &= \int_{\underline{p}}^{\bar{p}}\Delta\left(h;p\right)d\Gamma\left(p\right)\\ F_h\left(w\right) &= \frac{\int_{\underline{p}}^{\left(w_h\right)^{-1}(w)}\Delta\left(h;p\right)d\Gamma\left(p\right)}{\Delta^h}\end{aligned}$$

▸ Equilibrium

Model Estimation

Overview of Estimation Strategy

- Data: German Socio-Economic Panel (SOEP) 2013-2014.
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  2. Demand side: estimate production function and job-posting cost distribution to match the offer distribution from supply-side estimation. ▸ More...

Supply-Side Parameters

Parameter		Value	Target
Preference parameters, ψ_k^j	male, no children	1	Normalization.
$u^j(c,h,k) = \ln c + \psi_k^j \frac{(\bar{h}-h)^{1-\gamma_k^j}}{1-\gamma_k^j}$	male, young children	0.057	Employment rate
	male, grown children	0.363	by gender and
	female, no children	0.847	child state.
	female, young children	1.814	
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Preference parameters, γ_k^j	male, no children	2	Standard value.
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Labor efficiency, $a_j(h)$	male, all h	1	Normalization.
	female, ME	1.261	Gender wage gap by
	female, PT	1.310	hours.
	female, FT	0.856	

▸ Demand-side parameters

Model Fit

Moment	**Men**		**Women**	
	Data	Model	Data	Model
Employment distribution:				
No children				
ME	0.031	0.024	0.061	0.040
PT	0.072	0.096	0.213	0.152
FT	**0.756**	**0.718**	**0.608**	**0.588**
Young children				
ME	0.028	0.024	0.153	0.128
PT	0.055	0.103	0.318	0.322
FT	**0.809**	**0.842**	**0.111**	**0.106**
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PT	0.027	0.105	0.417	0.330
FT	**0.857**	**0.849**	**0.288**	**0.271**
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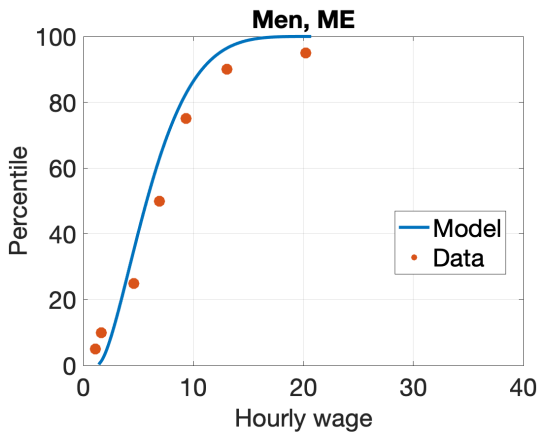
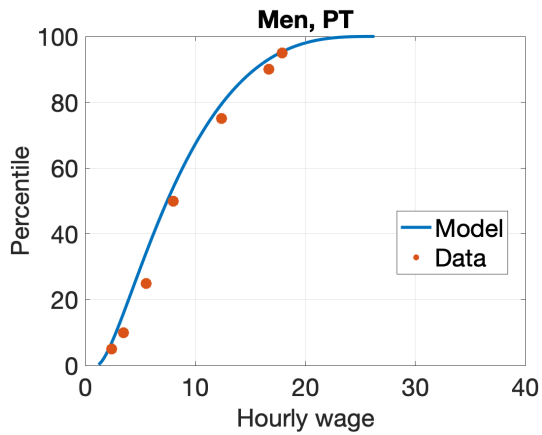
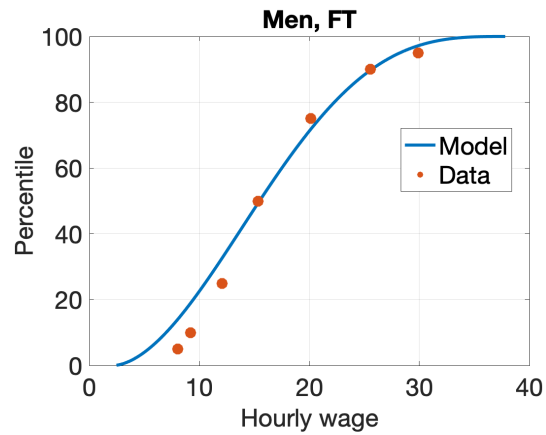
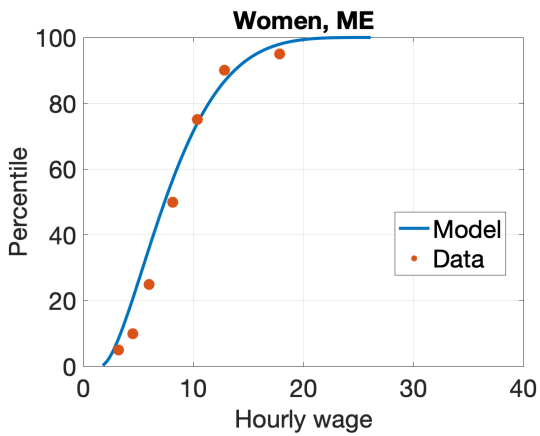
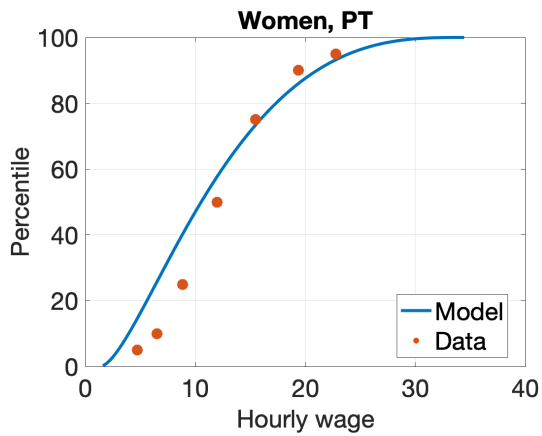
Model Fit: Hourly Wage Distribution

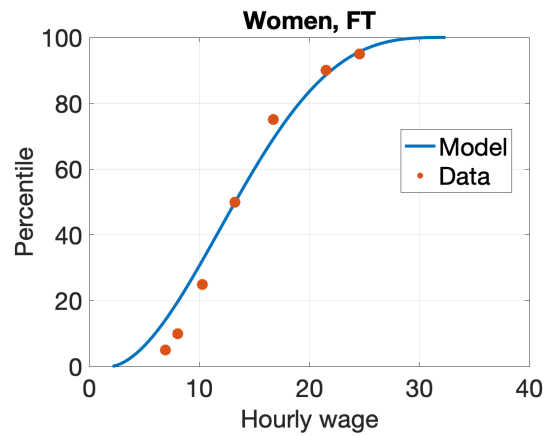












- Gender wage gap conditional on hours
- Positive correlation between hours and hourly wages ("part-time penalty")

Minimum Wage Policy

Minimum Wage in Germany and Non-Compliance

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- The minimum wage has been regularly adjusted. On October 1, 2022, it was raised to 12 € (10 in 2015 €). Further increase has been announced.
- Widespread non-compliance has been documented in the literature (Burauel et al., 2017; Bossler et al., 2022; Duetsch and Bruttel, 2021)
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  - In 2016, about 10% of eligible employees were receiving hourly wages below the 8.5 € threshold.
  - There is a lack of resources to enforce the minimum wage.
  - Lack of awareness: Less than one-fifth of workers are aware of the exact minimum wage level in 2020.

Implementing the Minimum Wage in the Model

- **Non-compliance penalty:**

$$\kappa(\omega; w_{min}) = \begin{cases} \kappa_0 \left(w_{min} - \omega\right)^2 & \text{if } \omega < w_{min} \\ 0 & \text{else.} \end{cases}$$

  - Job contact rate becomes $\lambda \max\{0, 1 - \kappa(\omega; w_{min})\} \leq \lambda$.
  - Parameter κ_0 is calibrated to match the observed share of non-compliance.

▸ Calibration of κ_0 ▸ Validation

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- Firms can **choose to be inactive** (by not posting any jobs).
  - Inactivity is associated with zero profit.
  - The fraction of active firms:

$$\Delta^{act}(w_{min}) = \sum_{h \in \mathcal{H}} \Delta^h(w_{min}) \leq 1.$$

Results

- Equilibrium effects of imposing the minimum wage of 8.5 €.
- Varying the minimum wage from 8.5 € to 14 €.

Firm Response to Minimum Wages

Margins of adjustment

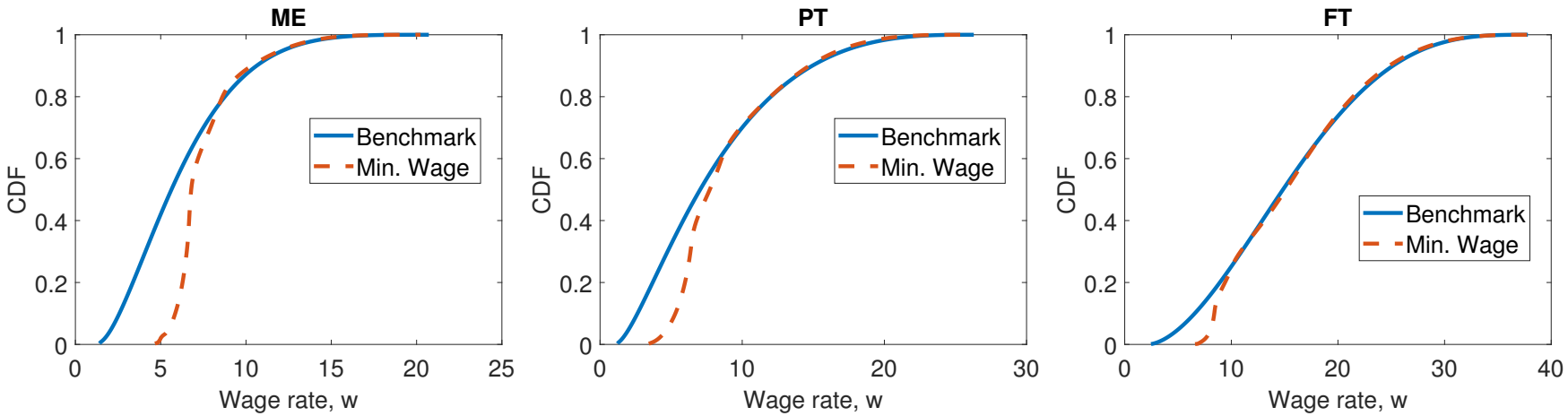
Firms have three margins of adjustment:

1. Increasing the posted wage
2. Changing the hours requirement
3. Choosing to become inactive

Firm Response to the Min. Wage

Wage adjustment

Effects on the wage offer distribution, $F_h(w)$



Summary:

- Largest wage increases among marginal-employment job offers.

Firm Response to the Min. Wage

Activity and hours requirement

	Min. wage effect (% change)
Active firms	-0.9
Firms posting ME jobs	-5.5
Firms posting PT jobs	-2.9
Firms posting FT jobs	-0.4

Summary:

- Imposing the minimum wage only modestly reduces the share of recruiting firms,
- ...and it leads to a shift of the offer distribution toward full-time jobs.

Min. Wage Effects on Labor Market Dynamics

	CF Effects *Without* firm response (% change)	**Equilibrium Effects** *With* firm response (% change)
Offer contact rate	-2.0	
MEN		
Job-finding rate	-1.9	
Job-separation rate	-0.8	
WOMEN		
Job-finding rate	-0.2	
Job-separation rate	-4.5	

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	CF Effects *Without* firm response (% change)	**Equilibrium Effects** *With* firm response (% change)
Offer contact rate	-2.0	-1.2
MEN		
Job-finding rate	-1.9	-0.1
Job-separation rate	-0.8	-0.6
WOMEN		
Job-finding rate	-0.2	-0.5
Job-separation rate	-4.5	-2.3

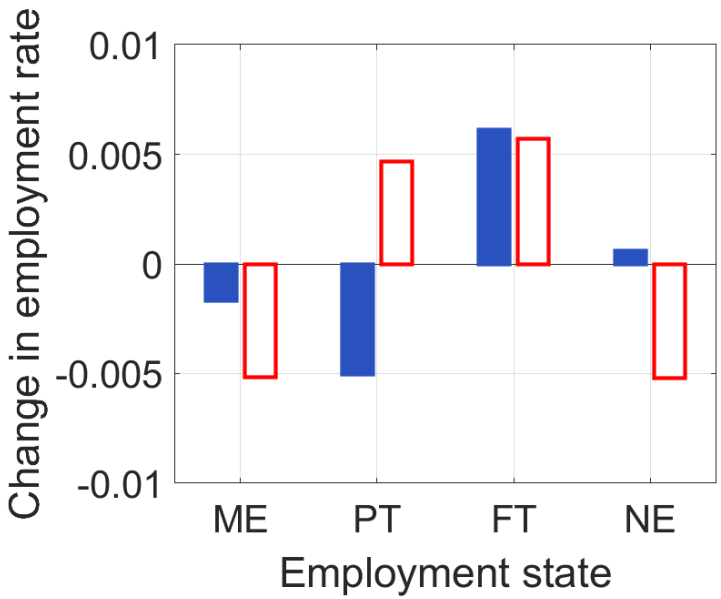
Summary:

- Non-compliance penalty reduces offer contact rate.
- Higher posted wages lead to higher job-acceptance rates.
- Job separation rates become lower as worker reallocate to jobs with longer hours.

Min. Wage Effects on Employment and Hours

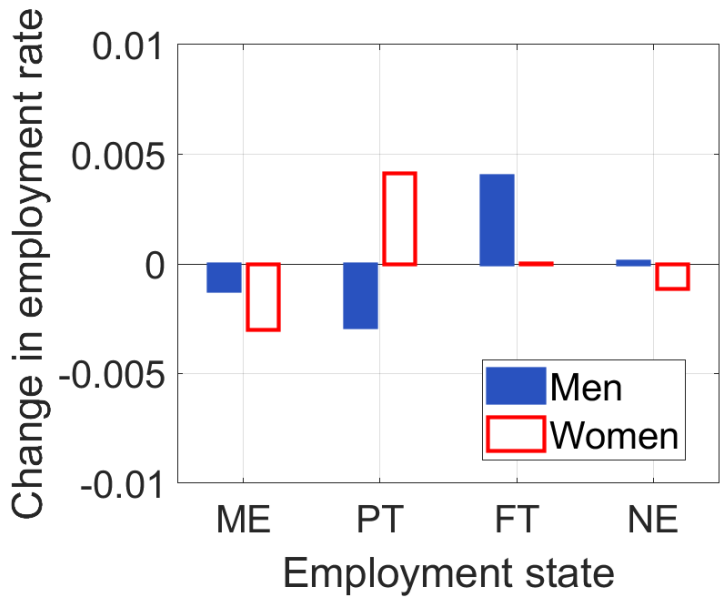
Counterfactual Effects

(*Without* firm response)



Equilibrium Effects

(*With* firm response)



Summary:

- The minimum wage leads to upward reallocation in hours for both men and women.
- Firms' response **dampens** the reallocation and the positive employment effects of the minimum wage, particularly for women.

Min. Wage Effects: Summary

- The minimum wage compels low-productivity firms to post higher wages. **Wage increases are the largest among ME jobs**.
- Non-compliance penalty leads to a reduction in the job contact rate.
- Since higher wages increase the job acceptance probability, the minimum wage only modestly reduces the job-finding rate.
- Workers **upward reallocate in hours** as low-hours jobs are more impacted by the policy. Firms' wage response dampens this reallocation effect.
- As women move from ME to PT jobs, their **job separation and non-employment rates decrease**.

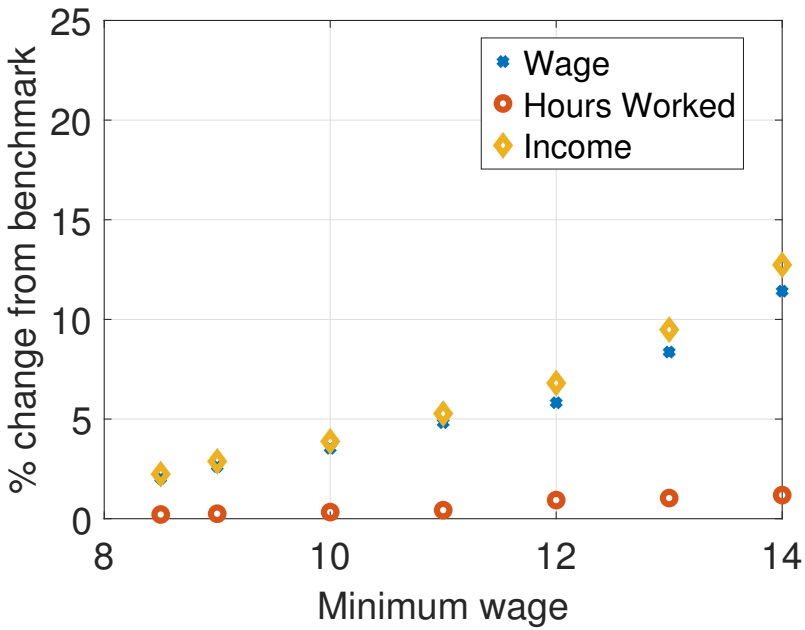
▸ Role of enforcement ▸ Heterogeneous Effects

Equilibrium Effects of Minimum Wages on Gender Gaps

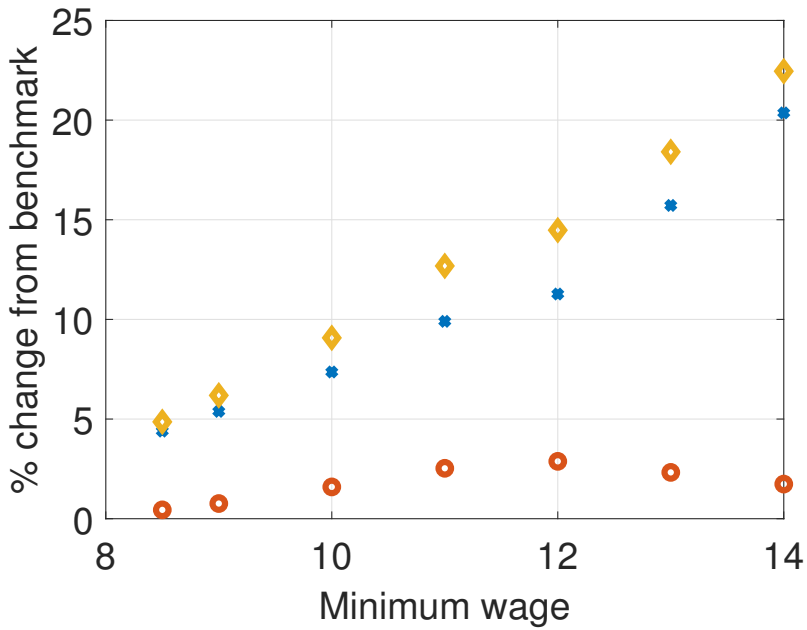
- We vary the minimum wage from 8.5 € to 14 € to study how the policy affects gender inequality.
- Gender gap in a variable x is defined as x^f / x^m.
  (A gender gap of 100% indicates gender equity.)
- We consider the gender **income** gap, which is decomposed into gender gaps in **wage** and **hours worked**.

Equilibrium Effects of Minimum Wages on Gender Gaps

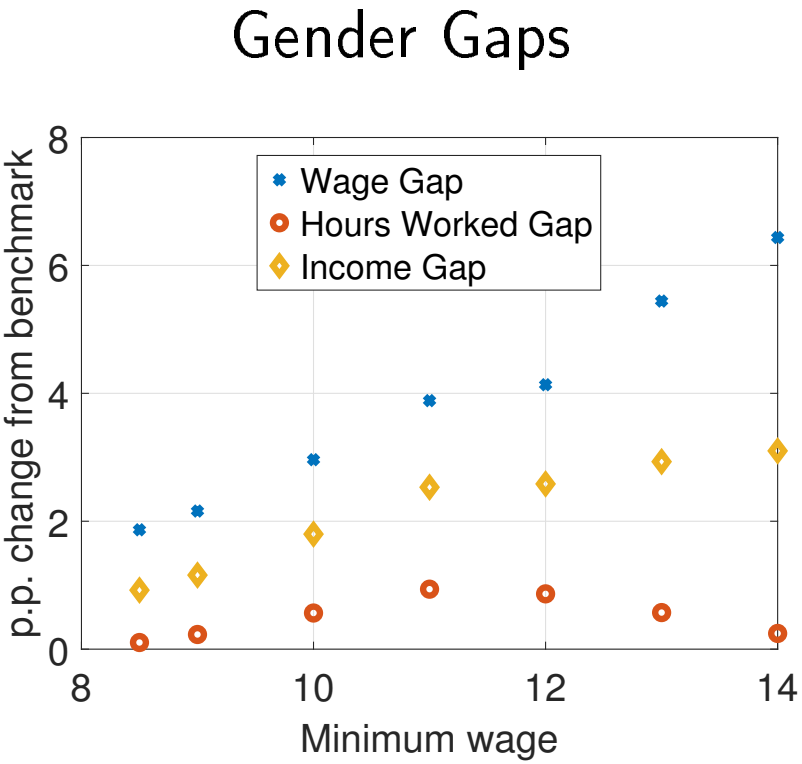
Men

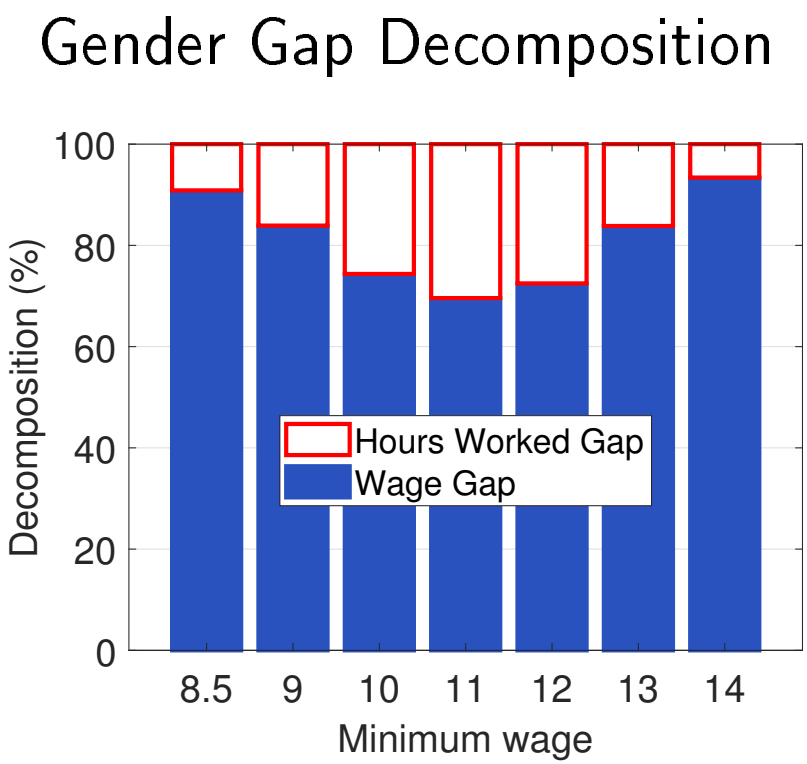


Women



Equilibrium Effects of Minimum Wages on Gender Gaps





Conclusion

- We build and estimate an equilibrium search model with
  - heterogeneous workers and firms and
  - jobs characterized by an hourly wage and an hours requirement.

Findings

- Equilibrium effects of the 8.5 € minimum wage:
  - Firms increase posted wages most for marginal employment (ME) jobs.
  - Workers reallocate upward in hours; the firm wage response dampens this effect.
  - As women transition away from marginal-employment jobs, they benefit from lower job separation rates.
- The minimum wage reduces both the gender wage gap and the gender hours-worked gap. At 11 €, 30% of the reduction in the gender income gap is attributable to the hours-worked margin.

Appendix

Gender Differences in Employment and Hours in Germany

Employment distribution by gender:

	Men	Women	**Women/Men**
Full-time	0.811	0.393	**0.48**
Part-time	0.052	0.302	**5.8**
Marginal employment*	0.026	0.085	**3.3**
Non-emp.	0.112	0.220	**2.0**

Source: SOEP. 25-55 year olds, 2006-2017.

* Marginal employment ("minijobs") are jobs with monthly pay below 450 € and average weekly hours around 11.

▸ Back

What Drives Gender Differences in Employment and Hours?

- **Marriage** is associated with a higher marginal-employment rate for women, but a higher full-time rate for men.
- Having **young children** is associated with lower employment and lower hours for women only.
- Employment rate and hours decrease in **spousal income**. Back

Marginal effects on...	Full-time	Part-time	Marginal emp.	Non-emp.
Men:				
Marital status and spousal income (base = unmarried):				
Married, high-income spouse	0.14***	0.039***	0.0013	-0.18***
Married, low-income spouse	0.24***	0.0059	0.00013	-0.25***
N. kids under 6	0.021	-0.00310	-0.027***	0.0093
N. kids	-0.0028	-0.00038	0.00042	0.0028
Women:				
Marital status and spousal income (base = unmarried):				
Married, high-income spouse	-0.049***	0.065***	0.051***	-0.0662***
Married, low-income spouse	-0.0034	0.053***	0.058***	-0.11***
N. kids under 6	-0.13***	-0.092***	-0.057***	0.28***
N. kids	-0.042***	0.0047	0.010***	0.027***

***$p < 0.001$. Other controls: age, education, and year and federal state fixed effects.

Net-of-Tax Income

- Net-of-tax income of **employed** workers:
  - Single workers

$$\mathbf{1}_{\{PT,FT\}}\tau_{0,k,x}y^{1-\tau_{1,k,x}} + \mathbf{1}_{\{ME\}} \underbrace{y}_{=a_j(h)wh}$$

  - Married workers

$$\frac{1}{2}\left\{\tau_{0,k,x}[\mathbf{1}_{\{PT,FT\}}y + \underbrace{\mathcal{X}(x)}_{\text{Spousal inc.}}]^{1-\tau_{1,k,x}} + \mathbf{1}_{\{ME\}}y\right\}$$

- Net-of-tax income of **non-employed** workers:
  - Single workers

$$\underbrace{b_{j,x}}_{\text{Non-emp. benefit}} + \underbrace{b_j^k}_{\text{Parental benefit}}$$

  - Married workers

$$\frac{1}{2}\left\{b_{j,x} + b_j^k + \tau_{0,k,x}[\mathcal{X}(x)]^{\tau_{1,k,x}}\right\}$$

Back

Value of Non-employment, V_j^n

$$\mathcal{D}_j^n V_j^n(k,x) = u^j(c,0,k) + \overbrace{\phi_{j,x}(k) V_j^n(k',x)}^{\text{child state transition}}$$

$$+ \underbrace{\sum_{h' \in \mathcal{H}} \int \lambda \Delta^{h'} \max \left\{ \overbrace{V_j^e\left(\{w',h'\},k,x\right) - \mu(j,k,h')}^{\text{accept}}, \overbrace{V_j^n(k,x)}^{\text{reject}} \right\} dF_{h'}(w')}_{\text{job offer arrival}},$$

where

- $\mathcal{D}_j^n = \rho + \rho_d + \phi_j(k) + \lambda$.
- $c = \mathcal{N}^n(j,k,x)$ (net-of-tax income).
- $\phi_{j,x}(k)$ is child state transition rate
- $\lambda \Delta^h$ is contact rate for job offers with hours requirement h
- $\mu(j,k,h)$ is "adjustment" disutility

▸ Back

Value of Employment, V_j^e

$$\mathcal{D}_j^e V_j^e\left(\{w,h\},k,x\right) = u^j\left(c,h,k\right) + \overbrace{\delta(h)V_j^n(k,x)}^{\text{job separation}}$$

$$+ \underbrace{\phi_{j,x}(k)\max\left\{\overbrace{V_j^e\left(\{w,h\},k',x\right)-\mu(j,k',h)}^{\text{stay employed}},\overbrace{V_j^n(k',x)}^{\text{quit}}\right\}}_{\text{child state transition}}$$

$$+ \underbrace{\sum_{h'\in\mathcal{H}}\int \lambda\Delta^{h'}\max\left\{\overbrace{V_j^e\left(\{w',h'\},k,x\right)-\mu(j,k,h')}^{\text{accept}},\overbrace{V_j^e\left(\{w,h\},k,x\right)}^{\text{reject}}\right\}dF_{h'}(w')}_{\text{job offer arrival}},$$

where

- $\mathcal{D}_j^e = \rho + \rho_d + \delta(h) + \phi_j(k) + \lambda$.
- $c = \mathcal{N}^e(a_j(h)wh, j, k, x)$ (net-of-tax income)
- $\phi_{j,x}(k)$ is child state transition rate
- $\lambda\Delta^h$ is contact rate for job offers with hours requirement h
- $\mu(j,k,h)$ is "adjustment" disutility

Back

Labor Supply

- Steady state distributions
  - $g^{j,e}(w,h,k,x)$: measure of the employed.
  - $g^{j,n}(k,x)$: measure of the non-employed.
- Labor supply to job (w,h) is

$$l(w,h) = \frac{\overbrace{\sum_j \sum_k \sum_x a_j(h) g^{j,e}(w,h,k,x)}^{\text{efficiency units of labor}}}{\underbrace{\Delta^h f_h(w)}_{\text{measure of job offers}}}.$$

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Equilibrium

Definition

A stationary equilibrium is defined by the offer distribution Δ^h and $F_h(w)$ for each $h \in \mathcal{H}$ such that

i. Given the offer distribution, individuals make optimal job acceptance and quitting decisions.

ii. The distribution of individuals is stationary.

iii. Given labor supply, firms make the optimal sector choice and wage policy $w_h(p)$ and $\Delta(p; h)$.

iv. Offer distribution Δ^h and $F_h(w)$ are derived from $w_h(p)$, $\Delta(p; h)$, and $\Gamma_h(w)$.

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Supply-Side Estimation

- We parametrize the wage offer distribution $F_h(\cdot)$ with Beta-distributions with parameters $\{\alpha_{F_h}, \beta_{F_h}\}_{h \in \mathcal{H}}$
- Supply-side parameters to be determined
  - Offer distribution parameters: $\left\{\alpha_{F_h}, \beta_{F_h}, \Delta^h\right\}_{h \in \mathcal{H}}$
  - Preference parameters: $\left\{\psi_k^j, \gamma_k^j\right\}_{j=1,2;k=1,2,3}$
  - Labor efficiency: $\{a_j(h)\}_{j=1,2;h \in \mathcal{H}}$
  - Labor force transition rates: λ, $\{\delta(h)\}_{h \in \mathcal{H}}$
- Method of moments estimation. Targets:
  - Hourly wage distribution by hours and gender.
  - Employment rate and hour distribution by gender, and child state.
  - Job separation rate by hour type.

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Demand-Side Estimation

- Demand-side parameters to be determined
  - Production function: $\{\theta_h\}_{h\in\mathcal{H}}$
  - Job-posting cost: $\{\bar{\epsilon}_h\}_{h\in\mathcal{H}}$, scale parameter of the type-I extreme value distribution σ_ε
- Estimation strategy: look for demand-side parameters such that, when firms make optimal job-posting decisions, the resulting offer distribution is the one uncovered in the supply-side estimation.

▸ Back

Demand-Side Parameters

Parameter	Value	Target
Hourly productivity shifter:		
θ_{ME}	0.649	Wage offer distribution by hours.
θ_{PT}	0.386	
θ_{FT}	1	Normalization.
Common component of the job-posting cost (monthly):		
$\bar{\epsilon}_{ME}$	2477.5	Offer distribution over hours.
$\bar{\epsilon}_{PT}$	913.5	
$\bar{\epsilon}_{FT}$	0	Normalization
Scale parameter, idiosyncratic job-posting cost (monthly):		
σ_{ε}	1299.1	Dispersion of wage offer distributions.

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Model Validation

Effects of the Introduction of the German Minimum Wage

Empirical Estimates vs. Model Predictions

	Data	Model	Data Source
Overall employment effect (p.p.)	-0.42	0.07	Caliendo et al. (2018)
Marginal employment effect (p.p.)	-2.97	-3.09	Caliendo et al. (2018)
Regular employment effect (p.p.)	-0.19	0.38	Caliendo et al. (2018)
Effect on monthly wage at P5	11.9%	38.56%	Bossler and Schank (2023)
Effect on monthly wage at P20	21.1%	23.93%	Bossler and Schank (2023)
Effect on monthly wage at P50	2.0%	-0.86%	Bossler and Schank (2023)

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Non-Compliance Penalty Calibration

- Impose the 8.5 € minimum wage in the estimated model.
- We calibrate the penalty parameter κ_0 to match the **drop in the share of full-time jobs with an hourly wage below 8.5 €**.
  - Data (SOEP): 3.93 percentage point drop.
  - Model: 4.04 percentage point drop.

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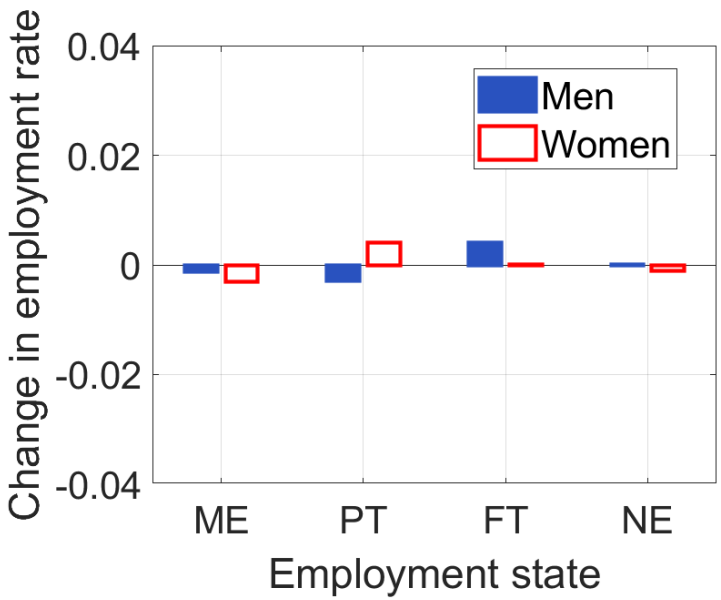
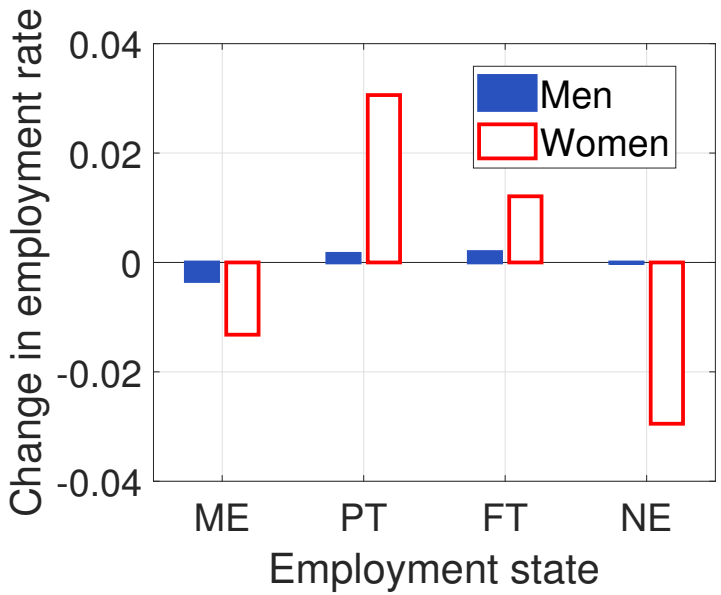
Role of Enforcement

Baseline



Higher Non-Compliance Penalty

(κ_0 is doubled)



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Heterogeneous Effects of the 8.5 € Minimum Wage

- **Employment and hours**: marital status and spousal matter for the upward reallocation in hours.
- **Welfare**: Singles gain from higher wages while the married are hurt.
- **Employer productivity**: lower average employer productivity for those who are single or married to a low-income spouse. Higher average employer productivity for the rest.

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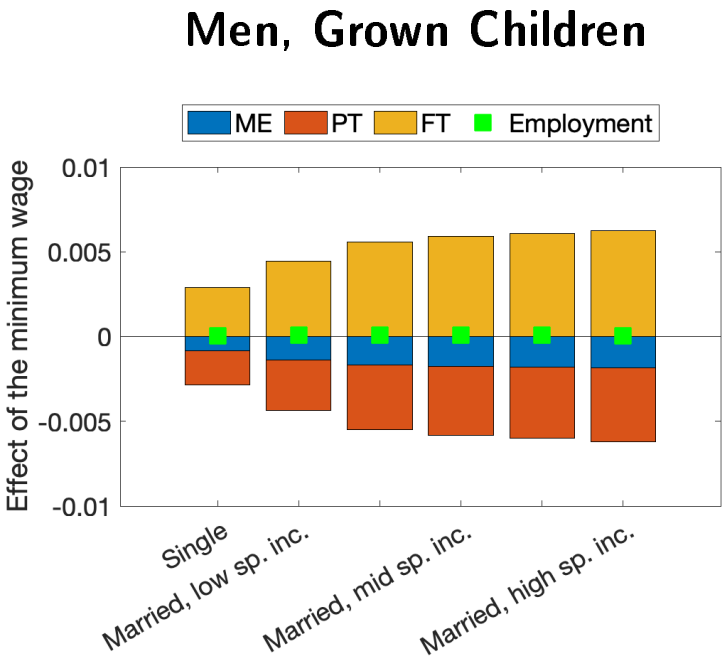
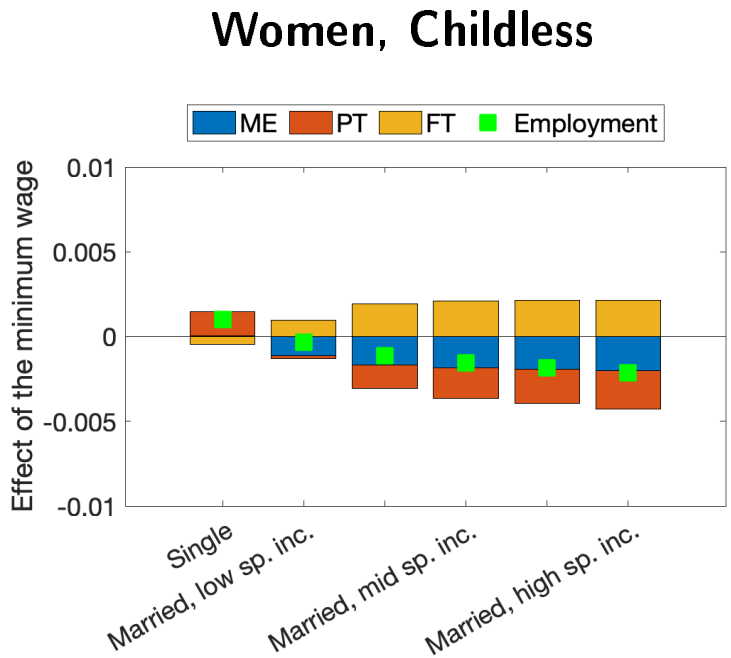
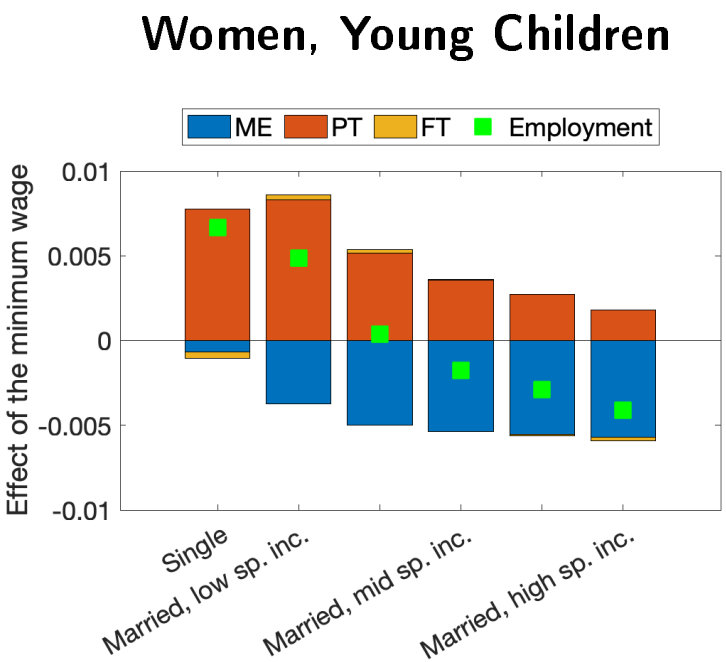
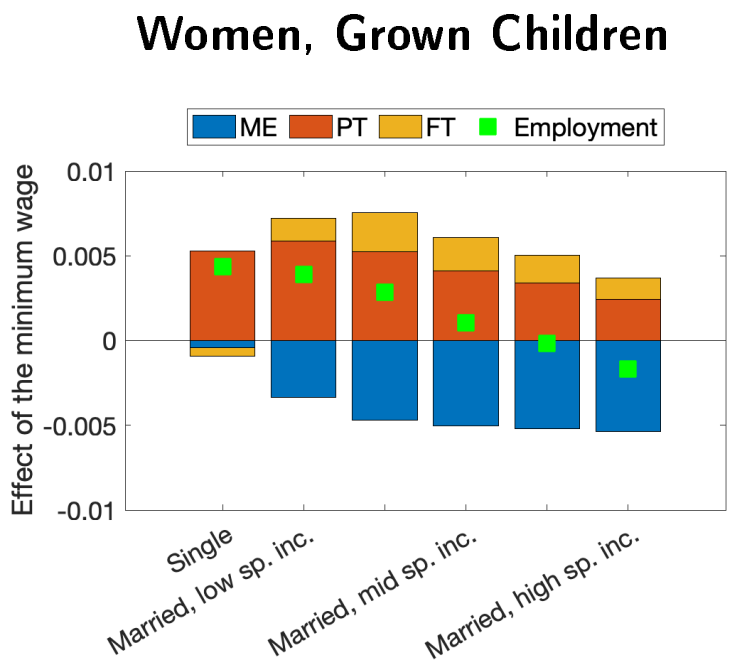
Heterogeneous Effects on Employment and Hours

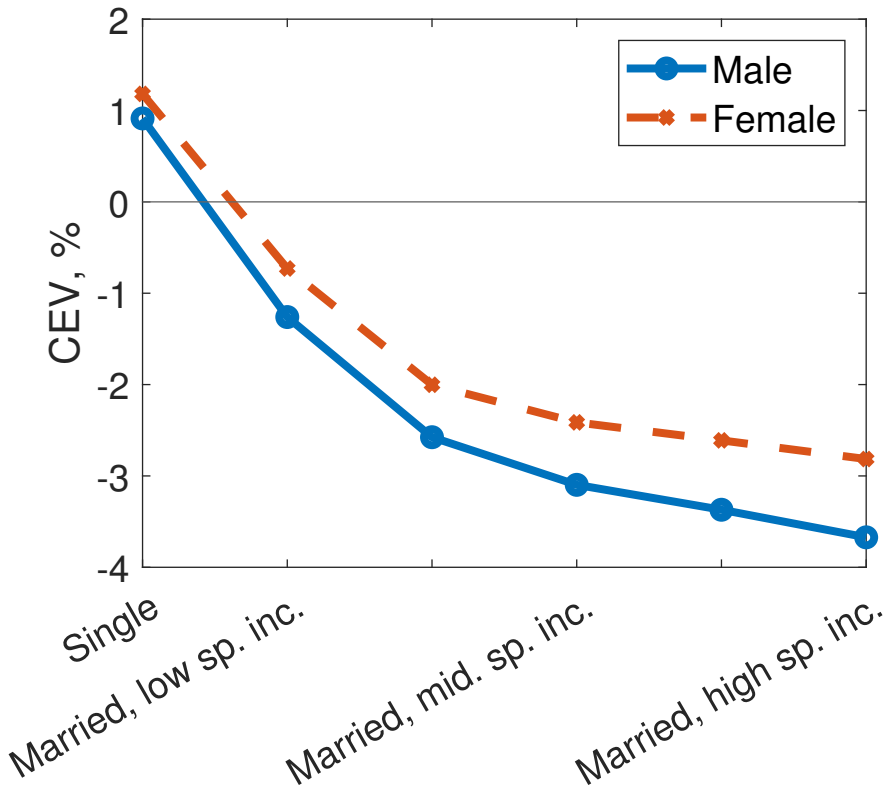








Heterogeneous Effects on Welfare



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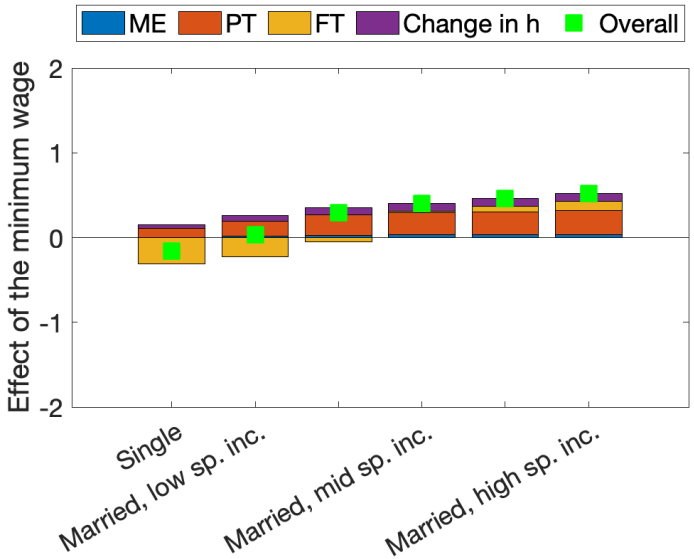
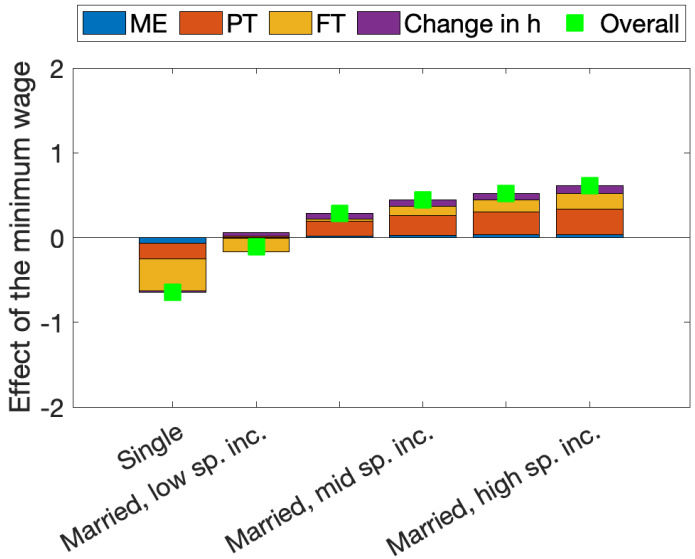
Heterogeneous Effects on Employer Productivity

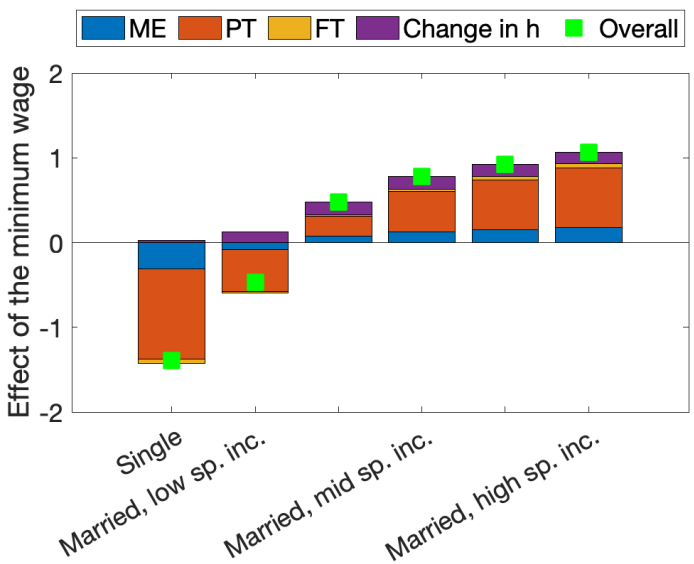
Men, Grown Children



Women, Childless



Women, Young Children



Women, Grown Children