Child Penalties in Labour Market Skills

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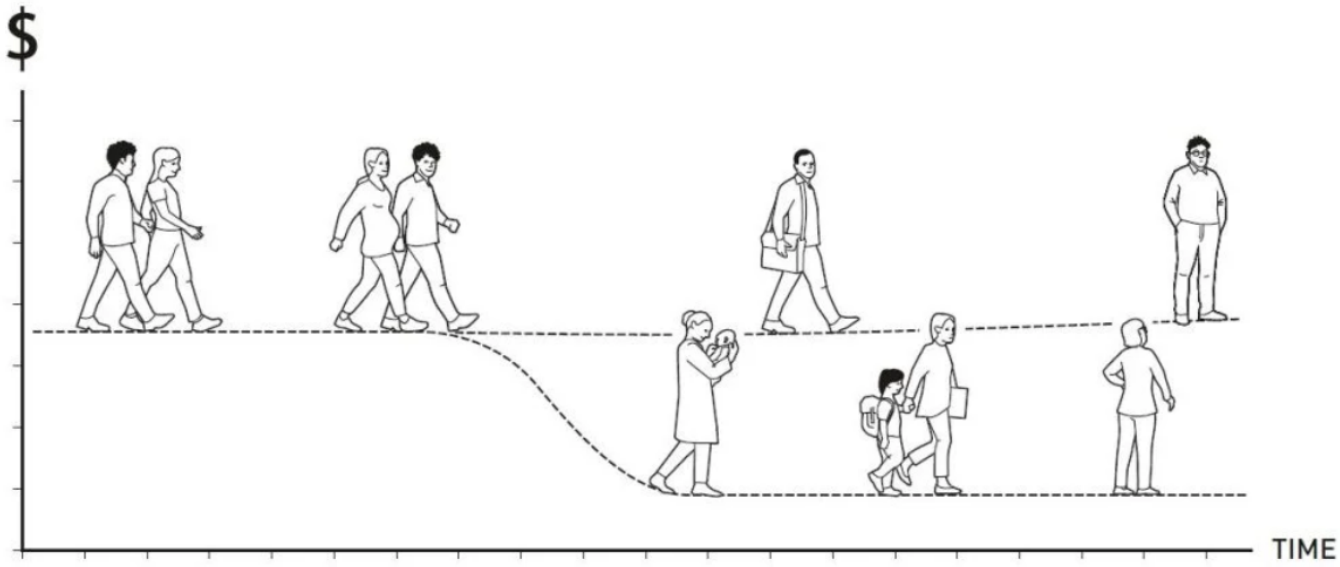
March 4, 2025

Motivation



The parenthood effect. © Johan Jarnestad/The Royal Swedish Academy of Sciences

- Sizeable gender gaps in labour market outcomes despite decades of convergence → Parenthood is a key driver of gender gaps (Cortés and Pan, 2023; Kleven et al., 2024a)

Motivation: Child Penalties

Child penalty: Quasi-experimental approach based on event studies around birth of first child to see (causal) effect of parenthood on (labour market) outcomes

- Definition we use: Long-run difference between outcomes of mothers and fathers after the birth of their first child

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Large body of evidence on child penalties...

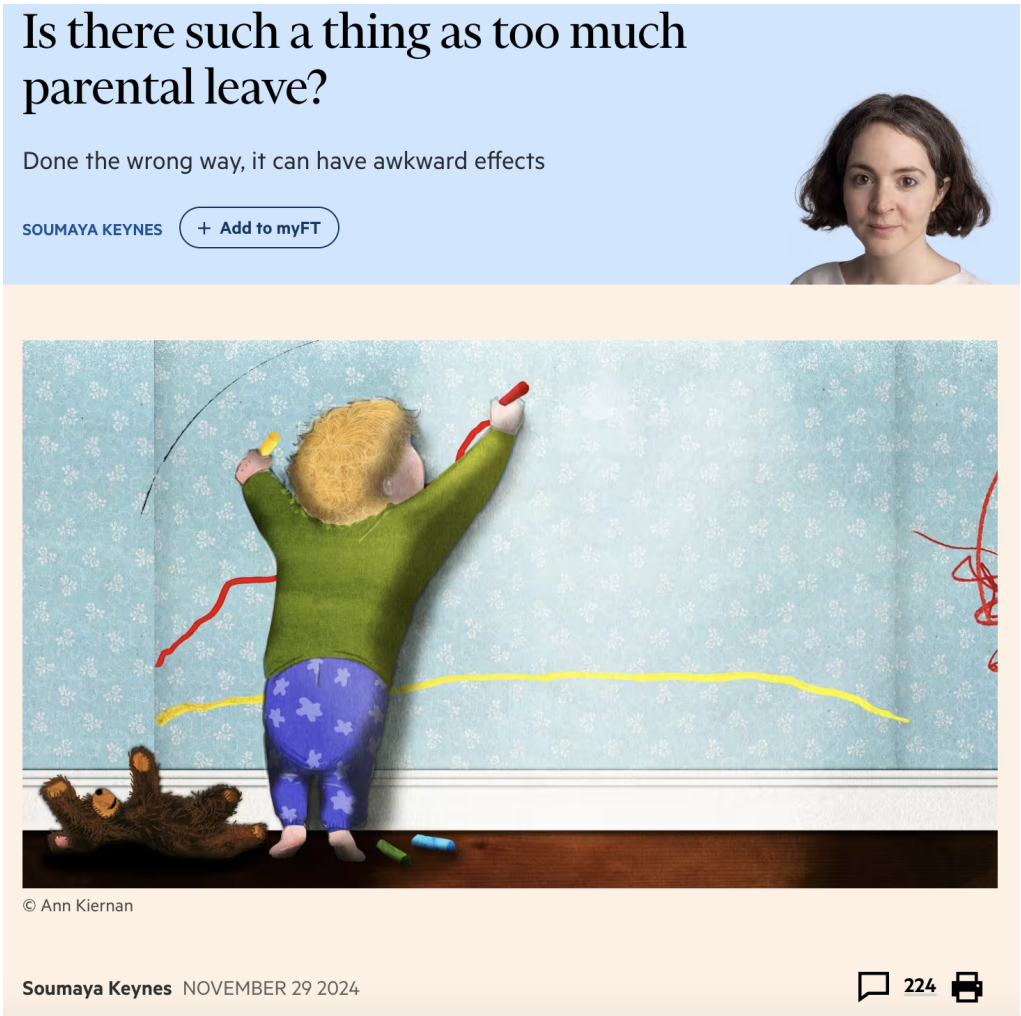
- ...in various countries (Kleven et al., 2024a)
- ...and the role of gender norms (Andresen and Nix, 2022; Jessen, 2022; Kleven et al., 2021)
- ...and mediating effects of policies (Ciasullo and Uccioli, 2024; Heckl and Wurm, 2023; Kleven et al., 2024b)

This Paper

- Could loss in labour market skills be a driver of child penalties?
- **New Evidence on Child Penalties in Labour Market Skills**
  - Prior research largely focuses on employment and earnings penalties
  - We ask: *Does parenthood also reduce general cognitive skills?*

- **Cross-Country Study on Parenthood & Cognitive Skills**
  - Uses PIAAC data (29 countries) to estimate penalties in numeracy, literacy, and problem-solving
  - Adapts Kleven's (2023) pseudo-panel approach to a single cross-section

This Paper



Is there such a thing as too much parental leave?

Done the wrong way, it can have awkward effects

SOUMAYA KEYNES + Add to myFT

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Soumaya Keynes NOVEMBER 29 2024 224

- Skills as a direct *outcome* of parenthood
- Skills as a *mechanism* affecting wages and employment penalties
- Policy relevance: parental leave, training, EPL

Empirical Strategy

Main challenge: No panel data available for rich measures of adult skills $\rightarrow$
$\rightarrow$ build upon method proposed by Kleven (2023) to estimate child penalties in single cross section

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Approach:

1. Validate single cross section version with German household panel (SOEP)
2. Apply new method to PIAAC data for adult skills

Key Findings

- **No evidence for larger skill depreciation among mothers**
  - Both mothers and fathers experience a (relatively small) decline in numeracy skills
  - Skill depreciation does not explain the child penalty in wages or employment
- Occupational skill mismatch plays a limited role
- Implication: Policies targeting skill development (e.g., retraining) may not be able reduce child penalties substantially

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  - 2nd PIAAC wave released in December 2024 (not part of our analysis yet)
- **Skills:** *"Competencies necessary to successfully navigate demands in everyday life and in the workplace"*
  - Not innate ability / intelligence
- Skill measures: numeracy, literacy, and problem-solving in technology-rich environments ▸ correlation of scores
- Additionally: rich set of labour market information and personal characteristics
- PIAAC dataset returns around 25,000 results on Google Scholar

Adult Skills and Parenthood

Some evidence on skill depreciation during unemployment (Cohen et al., 2023; Dinerstein et al., 2022), but unemployment $\neq$ parenthood (without employment)

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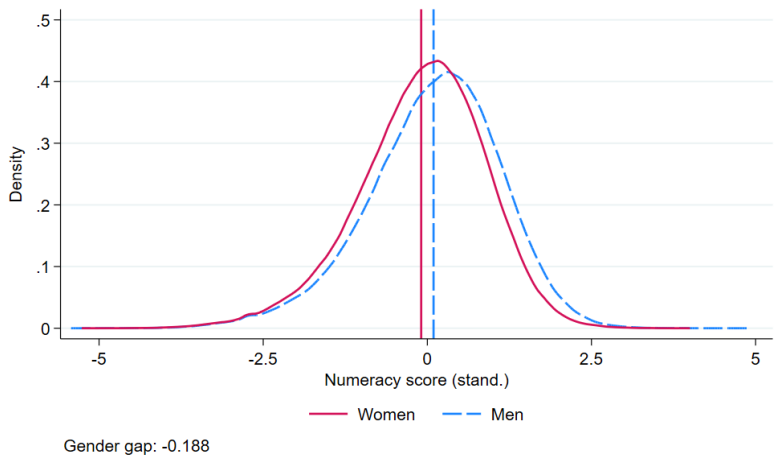
Numeracy Scores

A: All

B: by age and gender



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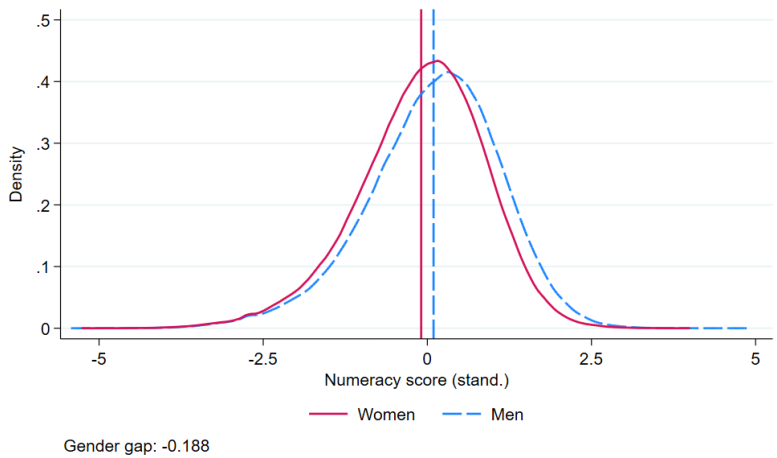

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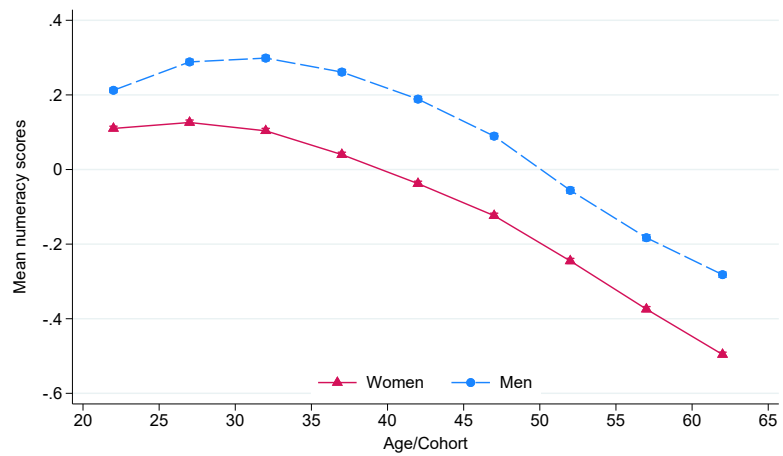

'Standard' Child Penalty Approach

Requirement: Panel data on individual outcome for men and women before and after childbirth

Estimation as in Kleven et al. (2019), separately by gender:

$$Y_{ist}^{g} = \sum_{j \neq -1} \alpha_j^g \, \mathbb{I}[j = t] + \sum_k \beta_k^g \, \mathbb{I}[k = age_{is}] + \sum_y \gamma_y^g \, \mathbb{I}[y = s] + \nu_{ist}^g$$

... controlling for time and life-cycle trends, variation from age at which individuals have first child

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But: panel data not always available $\rightarrow$ exploit rich information from repeated cross sections

Adaptation to Repeated Cross Sections (Kleven, 2023; Kleven et al., 2024a)

	event time															
	t-5	t-4	t-3	t-2	t-1	**t=0**	t+1	t+2	t+3	t+4	t+5	t+6	t+7	t+8	t+9	t+10
	survey year															
	s-5	s-4	s-3	s-2	s-1	**s**	s+1	s+2	s+3	s+4	s+5	s+6	s+7	s+8	s+9	s+10
observation	age															
	a-5	a-4	a-3	a-2	a-1	**a**	a+1	a+2	a+3	a+4	a+5	a+6	a+7	a+8	a+9	a+10
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Adaptation to Single Cross Section

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	survey year															
	s	s	s	s	s	**s**	s	s	s	s	s	s	s	s	s	s
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Child Penalties in PIAAC (Single Cross Section)

Estimation from Kleven et al. (2019) adapted to international setting with single cross section:

$$Y_{it}^{g} = \sum_{j \neq -2} \alpha_j^g \, \mathbb{I}[j = t] + \sum_{k} \beta_k^g \, \mathbb{I}[k = age_i] + \mu_c + \gamma X_i^g + \nu_{it}^g$$

Challenge: Single cross-section does not allow to account for time trends in outcomes and cohort differences

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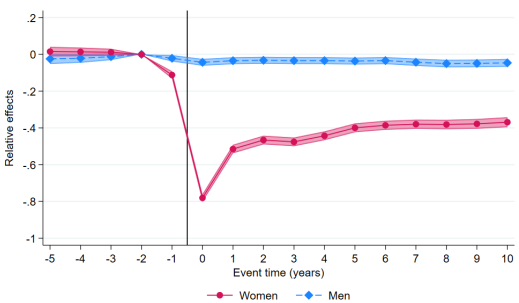
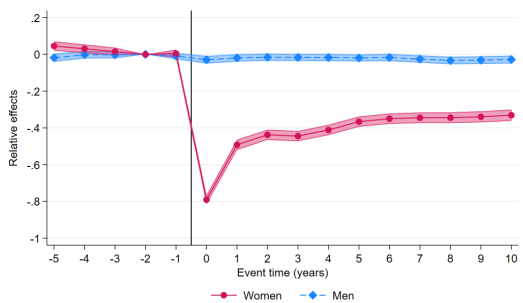
SOEP validation

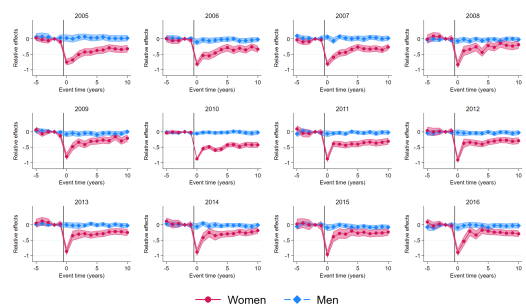
Panel



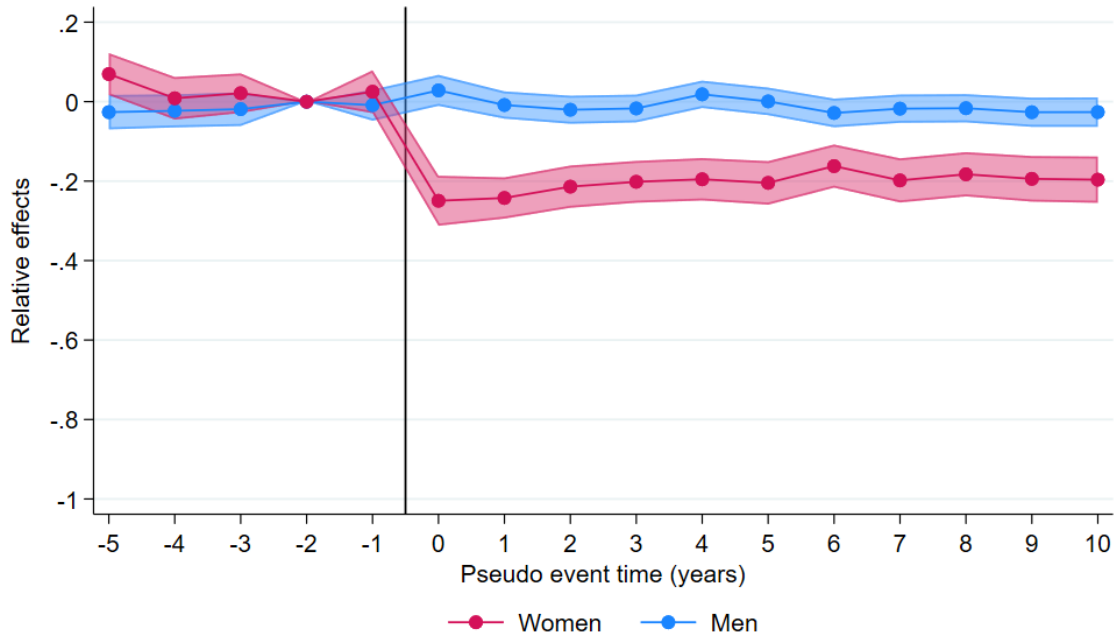
Repeated cross-section



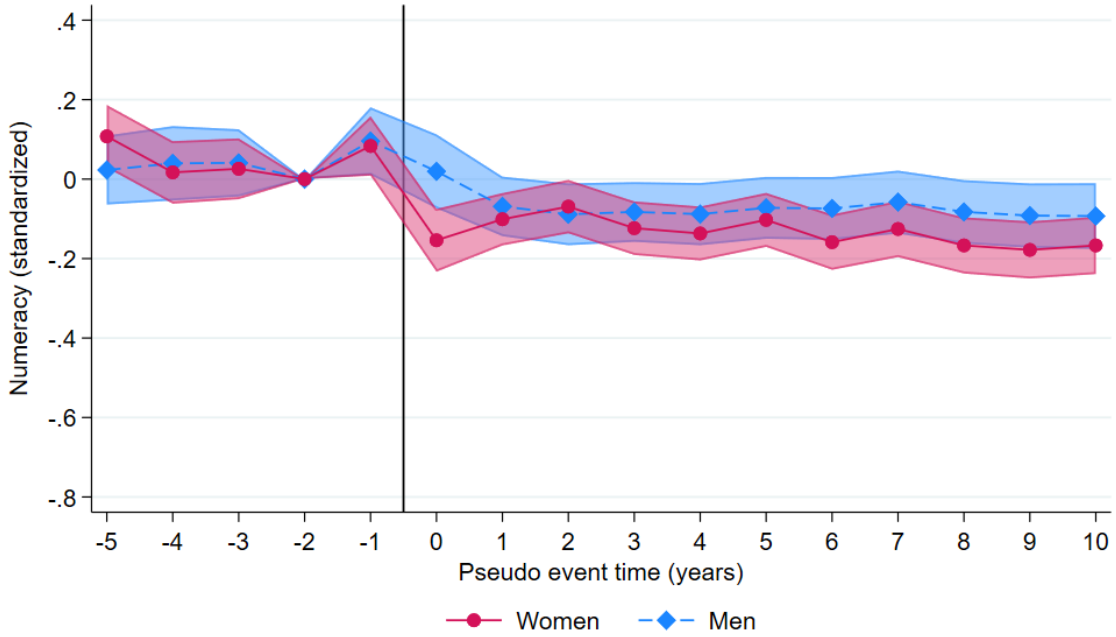
Single cross-sections



Employment Around Childbirth (PIAAC 2012)



Numeracy Skills around Childbirth



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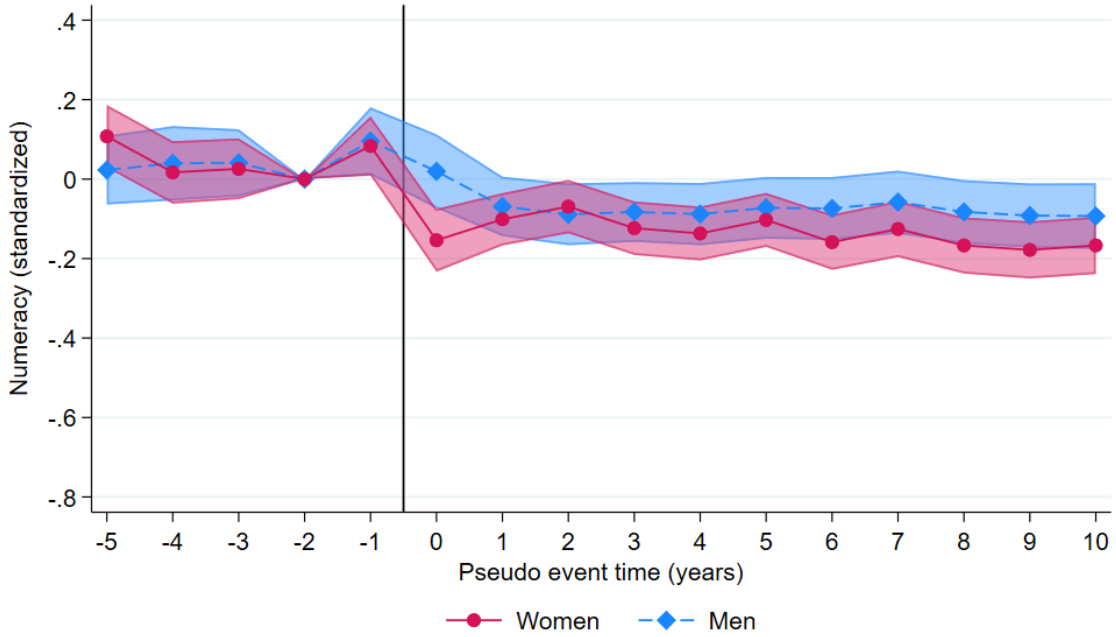


- No strong evidence for larger drop in numeracy skill for mothers
- Only weak evidence of small long-term differences

▶ estimation table

Literacy and problem-solving skills around childbirth

Figure: Literacy

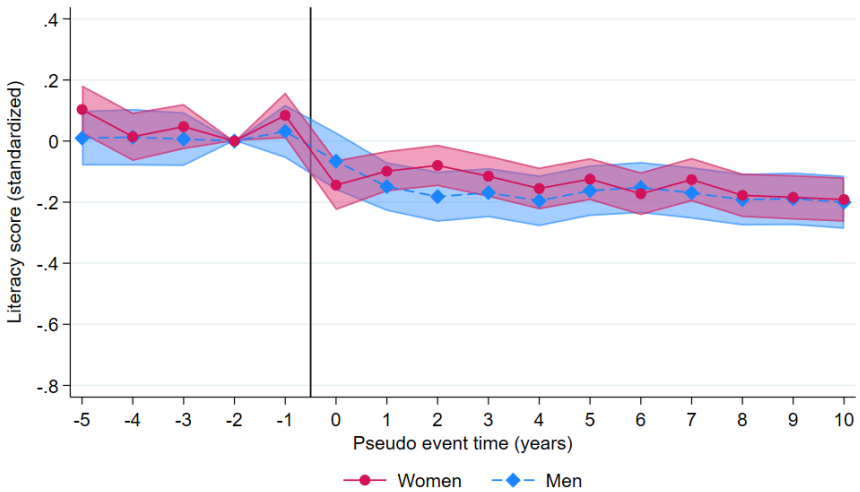
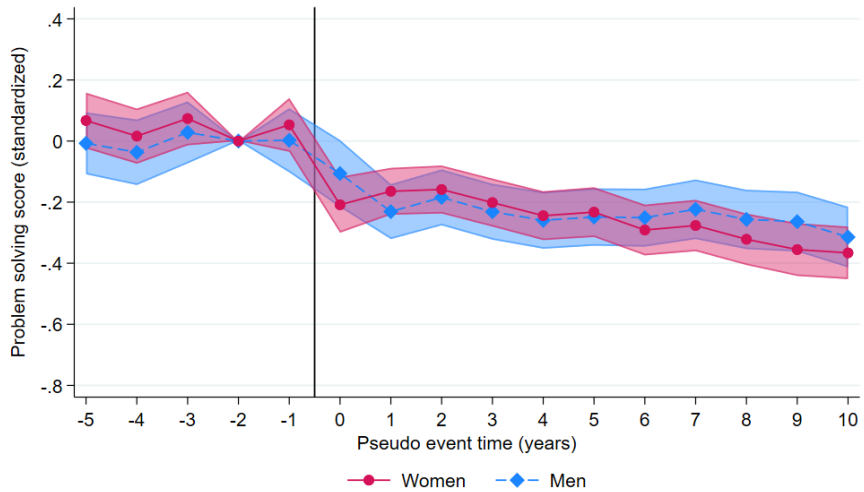


Figure: Problem-solving



Implications on skill-(mis)match I

- Despite no evidence for sizeable differential skill development, we may still be concerned about selection of parents into jobs misaligning with their skills
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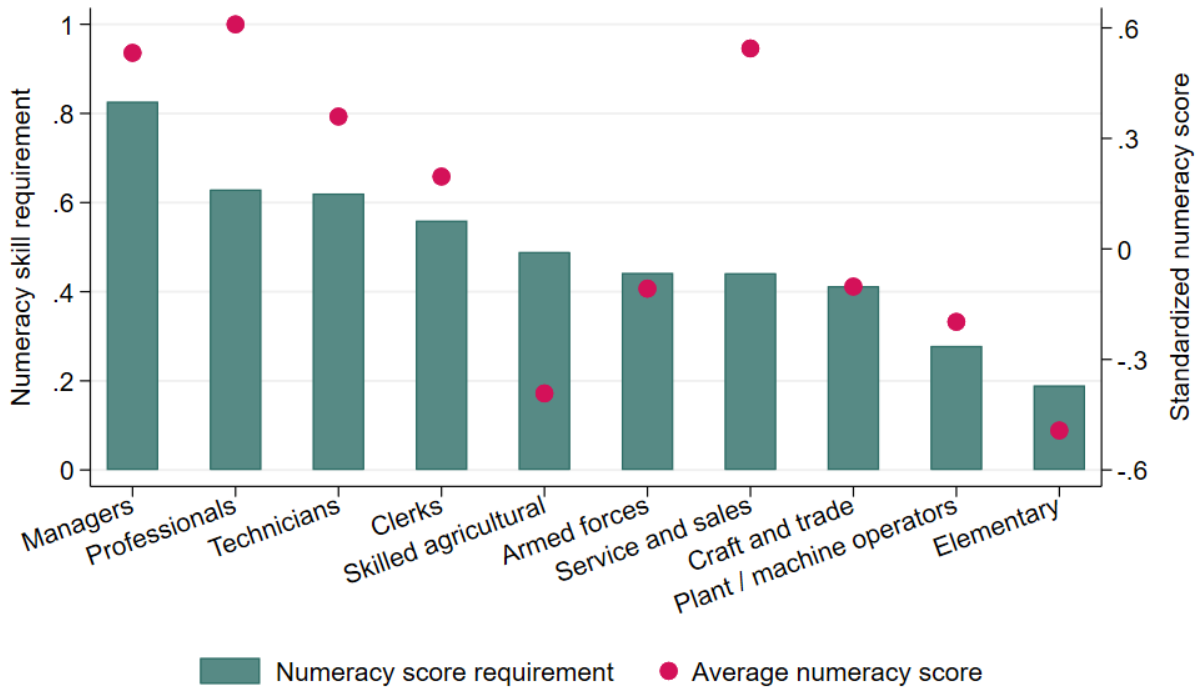
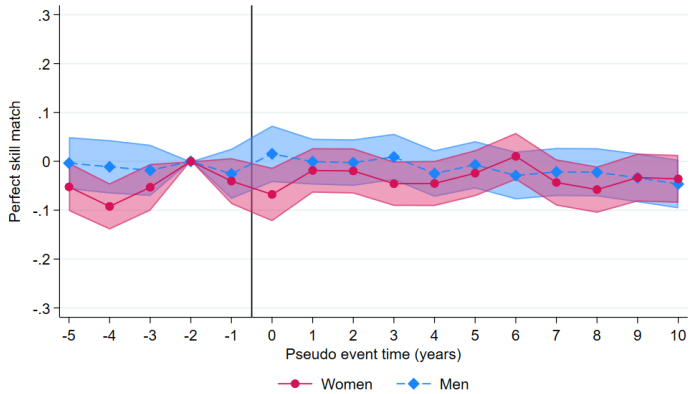
Implications on skill-(mis)match II

Figure: Numeracy score requirement in 1-digit ISCO occupations ($\rho = 0.9$)



Implications on skill-(mis)match III

Perfect match (same quintile)



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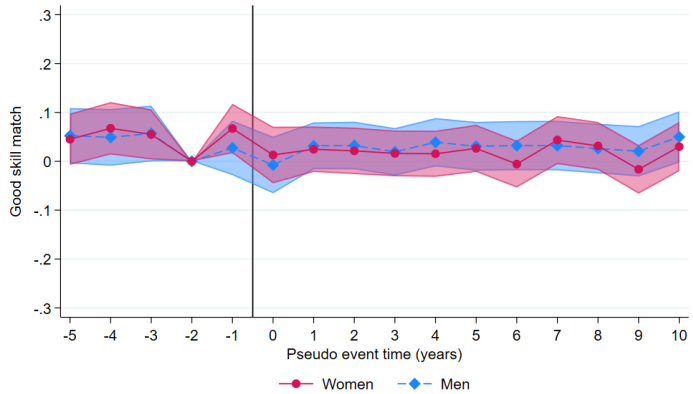

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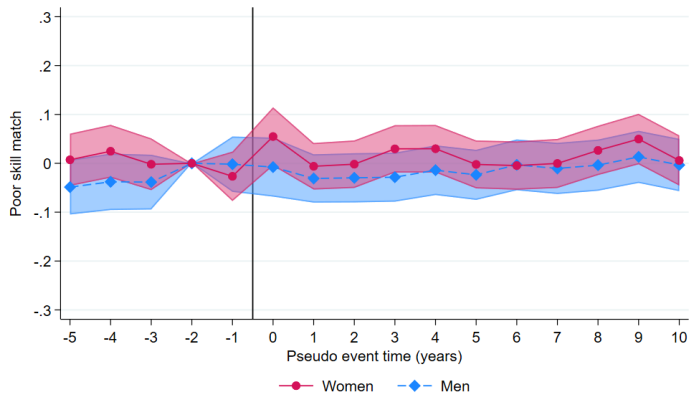

Implications on skill-(mis)match III

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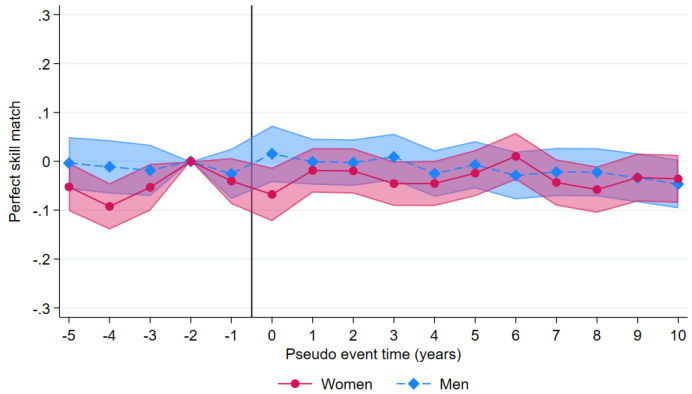

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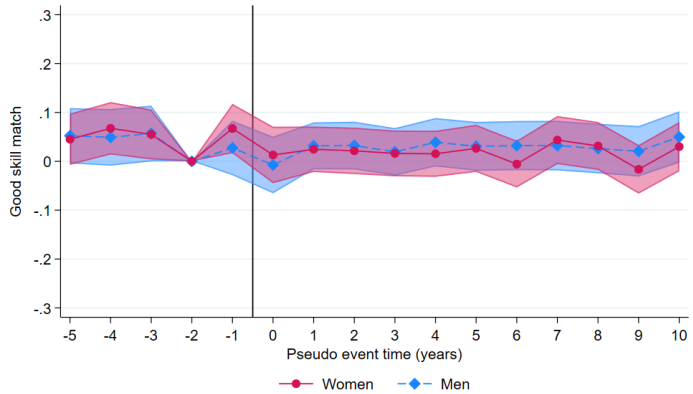

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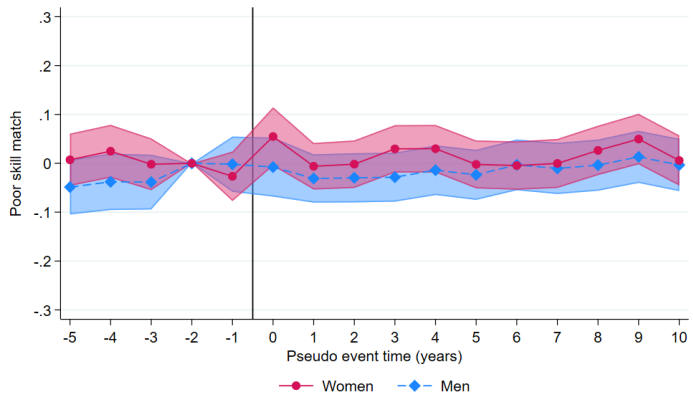

- Very weak evidence of a relative shift from *perfect* (same skill quintile) to *good* (one quintile apart) at the expense of mothers
  - Men have slightly better matches on average

How is skill use changing?

- PIAAC data captures to what degree skills are used in different domains
  - Work: Mechanical reduction if not employed
  - Home: Consequence of childbirth ambiguous

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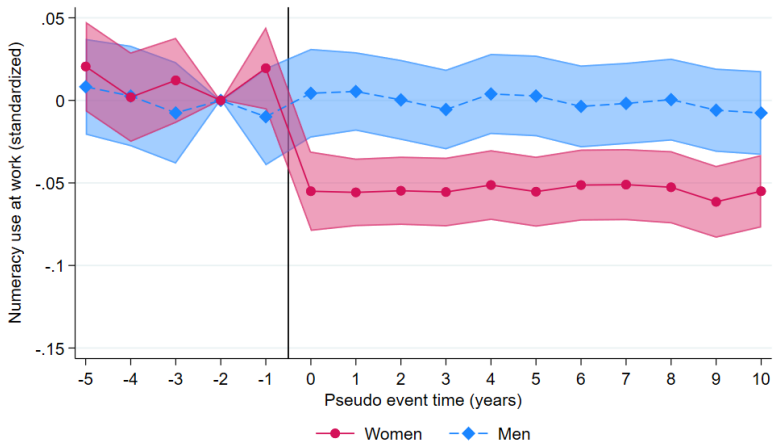
Numeracy use

At work



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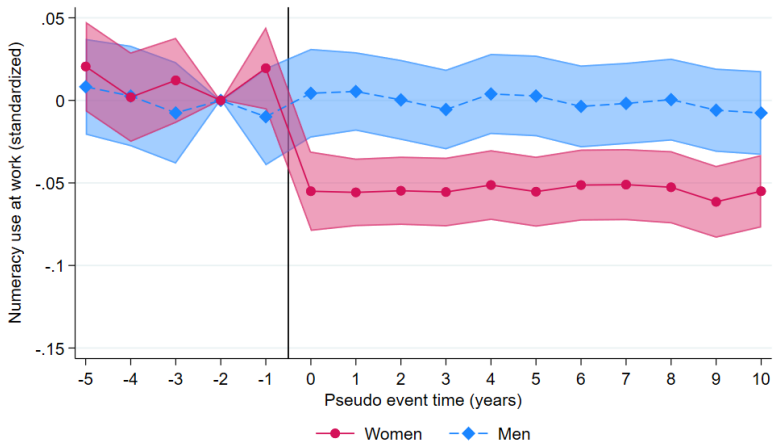
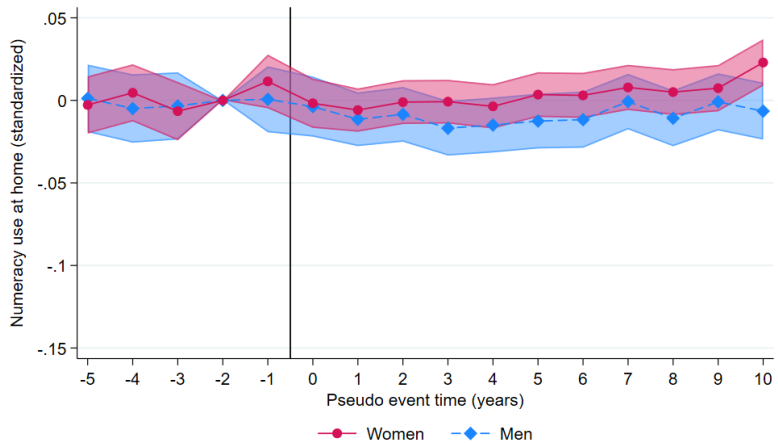


At home

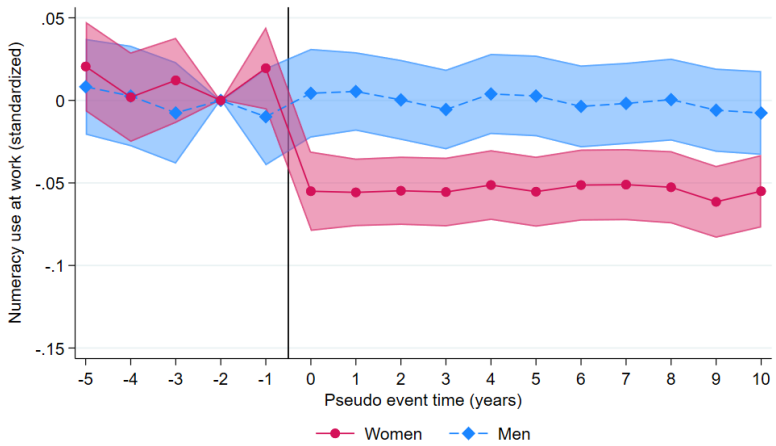


How is skill use changing?

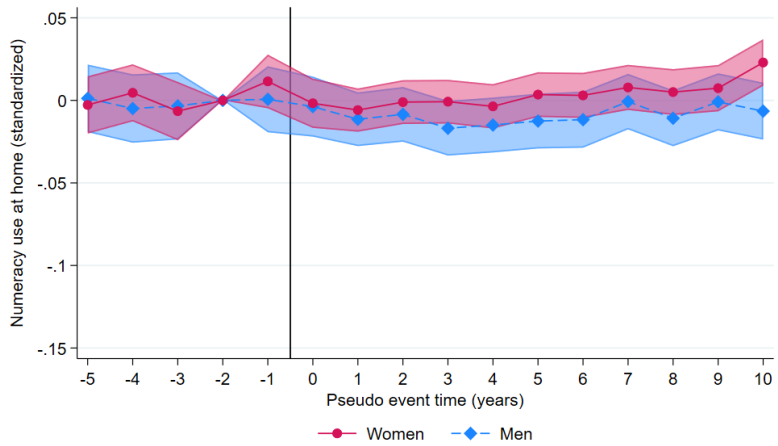
- PIAAC data captures to what degree skills are used in different domains
  - Work: Mechanical reduction if not employed
  - Home: Consequence of childbirth ambiguous

Numeracy use

At work



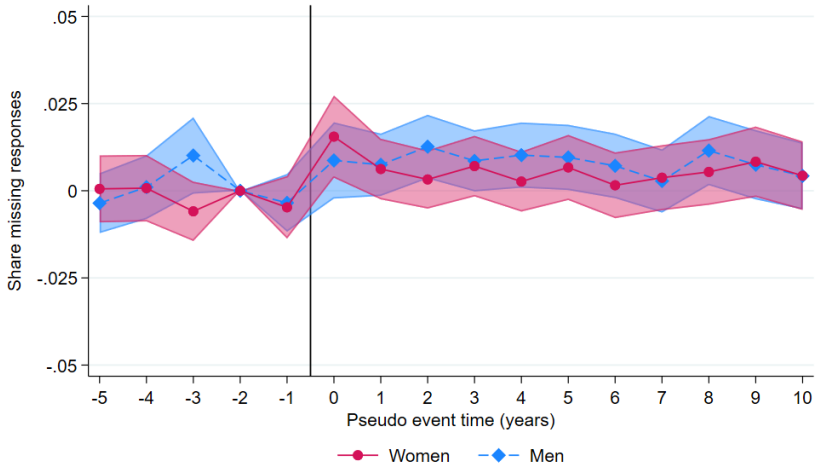
At home



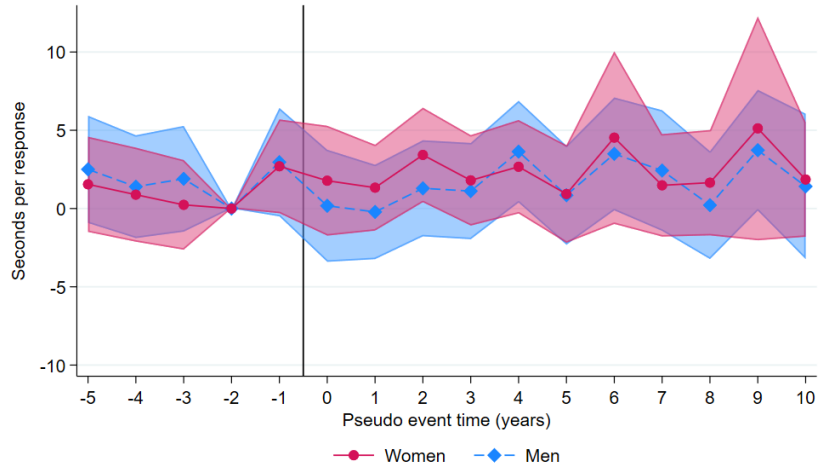
- Drop in skill use at work **entirely explained by lower labour market participation**

→ Despite reduced skill use at work for mothers, their skills do not deteriorate more

Child Penalty in Response Behaviour



Share of numeracy questions left unanswered (with controls)



Average time per numeracy question (in seconds, with controls)

- Some evidence of an increase in share of questions left unanswered, for both parents
- Also, no differences in average (or share of extreme) response times

What could explain the drop in skills for fathers (and mothers)?

- Parents (of young children) sleep less well and more interrupted (Richter et al., 2019) which has been linked to worse cognitive performance (Alhola and Polo-Kantola, 2007)

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  - Share of questions skipped: Slight increase immediately after childbirth
  - Time per question: No change

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Additional Results and Challenges

- Besides the provided standardized score (assembled with a very complicated OECD recipe), answers on individual question is also provided in the data
  - Respondents answer only a subset of answers
- As an additional check, we calculate the share of correct answers weighted by difficulty. Using this as the dependent variable, we identify a child penalty of 5 pp in the long-run (7.5%)
- We cannot rule out other skill-related mechanisms
- Look at groups of countries. Limited power but 2nd wave may help.

Key Takeaway

- No evidence of skill depreciation as a mechanism for child penalties
  - Despite employment drop and less skill use at work
- This challenges the idea that human capital loss explains gender gaps in labour market outcomes.
  - Child penalties in labour market outcomes cannot be explained by loss of general labour market-relevant human capital
  - Larger role for occupation- and firm-specific skills not captured here?
  - Parental leave policies can matter in many other ways (Huebener et al., 2021; Schmieder et al., 2024)

Discussion

- Our results suggest that policies aiming to reduce skill gaps (e.g. post-maternity training) are unlikely to close gender earnings gaps
- Policies that address direct labour market frictions and expectations (e.g., paid paternity leave, subsidized childcare) may be necessary as well
- Child penalty in employment and wages appears to be about labour market expectations and gender/parenthood norms rather than general skills, in line with Ayllón et al. (2025) who look at marriage dissolutions

Thank you!

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Addenda

Descriptive Table PIAAC (I)

back

Country	Numeracy score		Age at first childbirth	
	Men	Women	Men	Women
Belgium	289	271	28	26
Chile	217	197	25	23
Czech Republic	280	270	26	23
Denmark	283	273	28	26
Ecuador	190	182	25	22
Estonia	276	270	25	23
Finland	288	277	28	26
France	260	249	28	25
Greece	256	249	30	25
Hungary	273	272	27	24
Ireland	262	250	28	26
Israel	258	246	28	25
Italy	253	241	30	26
Japan	294	283	30	27
Kazakhstan	247	247	26	24

Descriptive Table PIAAC (II)

back

Country	Numeracy score		Age at first childbirth	
	Men	Women	Men	Women
Korea	268	258	29	26
Lithuania	269	266	26	24
Mexico	215	207	25	23
Netherlands	288	272	30	27
New Zealand	278	266	28	26
Norway	286	271	28	25
Peru	187	172	26	22
Poland	259	258	27	24
Singapore	265	252	30	27
Slovak Republic	277	274	26	23
Slovenia	260	256	27	24
Spain	252	240	29	26
Sweden	284	272	28	26
United Kingdom	270	255	28	25
Total: 29	262	251	27	25

First-time Parents in PIAAC (I)

notes back

Country	Survey year	First-time parents	First-time mothers	First-time fathers	Median education	Live with partner
Belgium	2011/12	29	14	15	4	0.95
Chile	2014/15	65	41	24	2	0.68
Czech Republic	2011/12	31	25	6	2	0.81
Denmark	2011/12	41	15	26	4	0.92
Ecuador	2017	25	17	8	2	0.73
Estonia	2011/12	35	21	14	2	0.93
Finland	2011/12	52	26	26	2	0.91
France	2011/12	62	36	26	4	0.93
Greece	2014/15	29	12	17	2	0.91
Hungary (A,W)	2017	100	66	34	2	0.71
Ireland	2011/12	15	8	7	2	0.92
Israel	2014/15	21	9	12	2	0.89
Italy	2011/12	37	24	13	3	0.78
Japan	2011/12	12	5	7	4	0.96
Kazakhstan	2017	28	15	13	2	0.92

First-time Parents in PIAAC (II)

notes back

Country	Survey year	First-time parents	First-time mothers	First-time fathers	Median education	Live with partner
Korea	2011/12	58	31	27	4	0.93
Lithuania	2014/15	26	16	10	3	0.79
Mexico	2017	43	22	21	4	0.90
Netherlands	2011/12	34	22	12	3	0.80
New Zealand (A)	2014/15	75	38	37	1	0.77
Norway	2011/12	44	17	27	2	0.95
Peru (W)	2017	28	12	16	4	0.89
Poland	2011/12	30	18	12	3	0.77
Singapore (A,W)	2014/15	8	3	5	2	0.72
Slovak Republic	2011/12	49	31	18	2	0.89
Slovenia	2014/15	14	7	7	4	0.95
Spain	2011/12	19	14	5	2	0.92
Sweden (W)	2011/12	26	12	14	2	0.95
United Kingdom	2011/12	43	26	17	3	0.93
Total	29	1,079	603	476	2	0.85

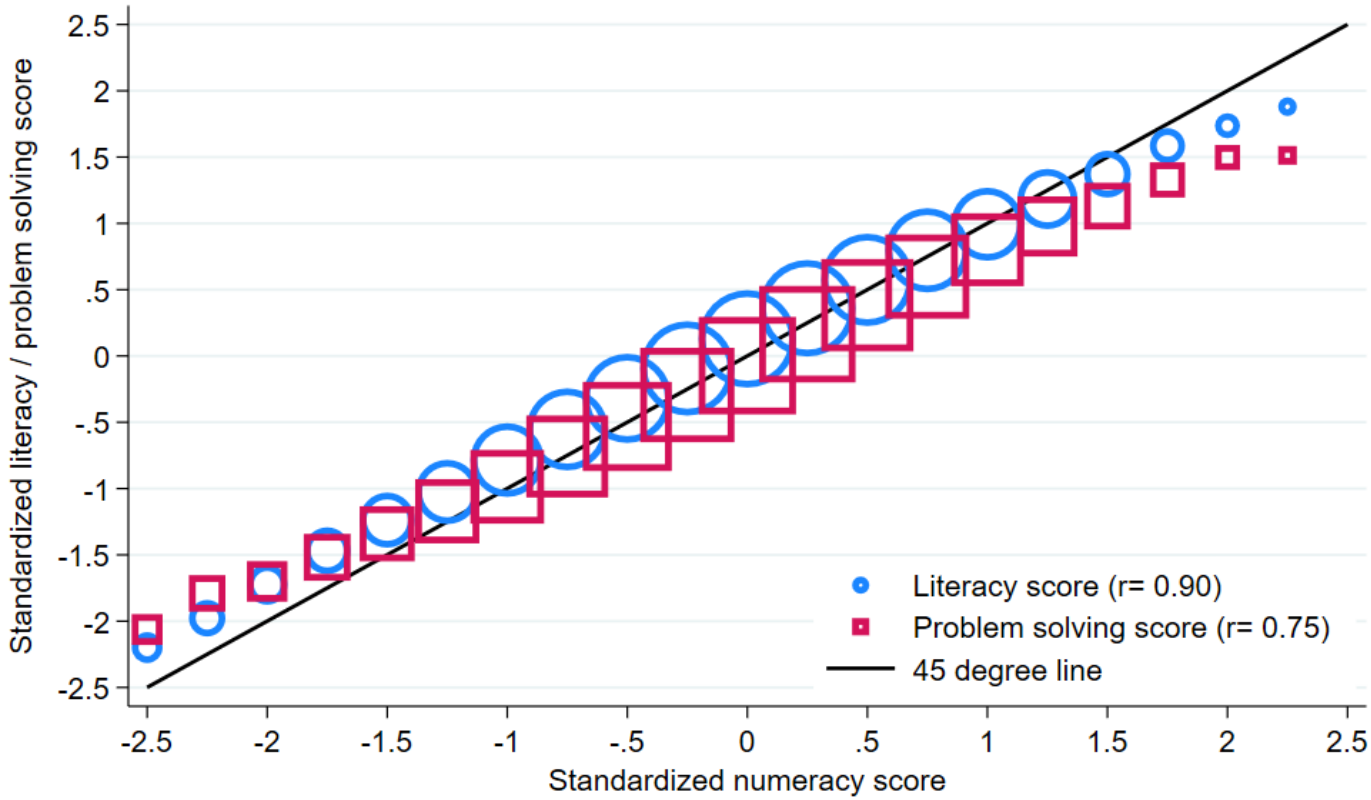
Table notes first-time parents PIAAC

back

Notes: Education levels: 1-lower secondary or less, 2-upper secondary, 3-post-secondary/non-tertiary, 4-tertiary - professional degree, 5-tertiary - bachelor degree, and 6-tertiary - master/research degree; (A) denotes countries where individual age is only available in 5-year intervals, (W) indicates missing monthly earnings (Hungary, Peru, and Singapore) or monthly earnings only reported in deciles (Sweden).

Correlation of PIAAC scores

back



Notes: Size of scatters indicates number of observations per bin. The correlation coefficient refers to the correlation between standardised numeracy score and the respective measures. If the scores were perfectly correlated ($r = 1$) all observations would lie on the 45 degree line. Source: PIAAC international PUF

The Evolution of Skills

back

Skills: competencies you need to advance in a certain environment, e.g. the workplace, rather than innate ability

- skill production during education influenced by many factors (Hanushek, 1986; Woessmann, 2016)
- depreciation of skills if not used (Dinerstein et al., 2022; Edin and Gustavsson, 2008; Ortego-Marti, 2017)
- parenthood affects stress & sleep (Parfitt and Ayers, 2014) which has impact on cognitive functioning (Duarte-Guterman et al., 2019; Minkel et al., 2012; Orchard et al., 2023; Pilcher and Huffcutt, 1996)

Child penalties in adult skills not as obvious since skill depreciation might/should not be immediate

- Some evidence on skill depreciation during unemployment (Cohen et al., 2023; Dinerstein et al., 2022), but unemployment $\neq$ parenthood (without employment)

Validation with PIAAC, including controls

back

Figure: Any employment, PIAAC 2012

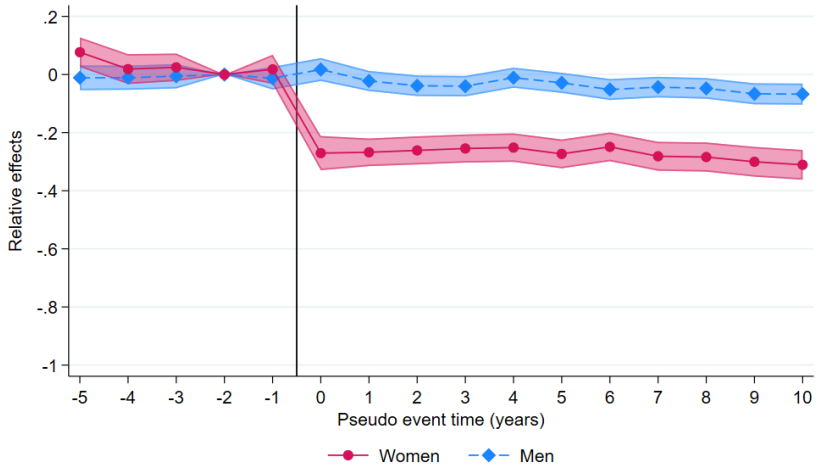
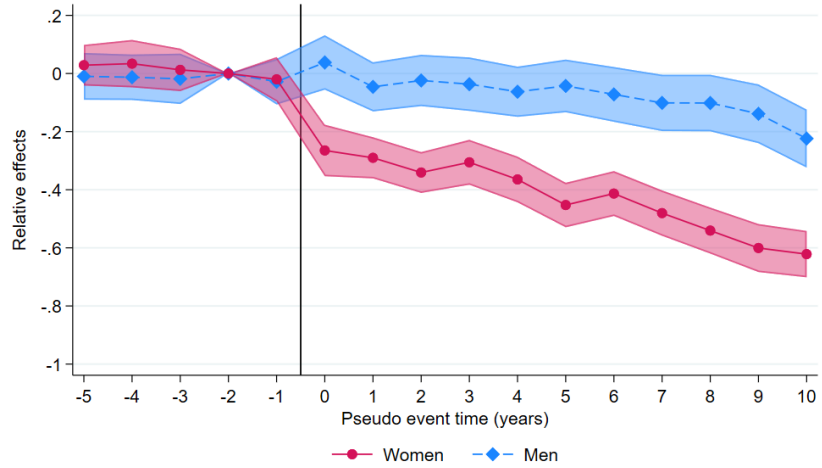


Figure: Monthly Gross Earnings, PIAAC 2012



Cohort differences in education

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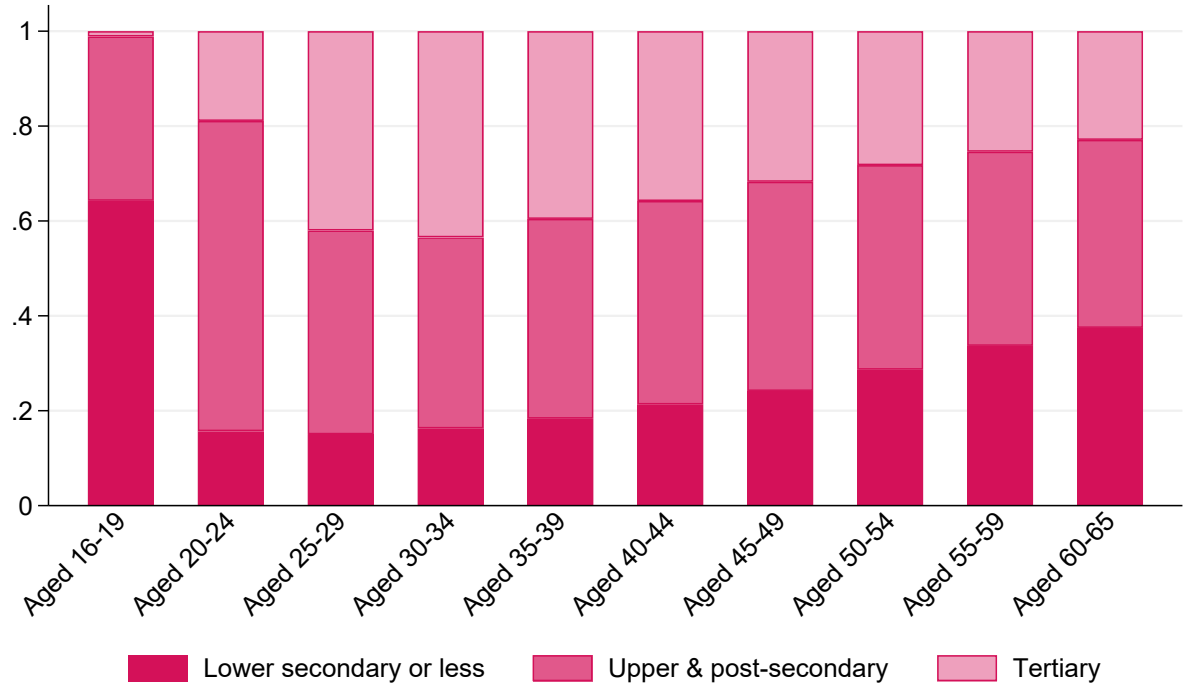


Numeracy Skills (standardized) around Childbirth

Table: Summary estimates for child penalties in numeracy (with matching controls)

	Men	Women	Women-Men
	(1)	(2)	(3)
Pre-birth	-0.0137	0.0047	0.0184
	(0.0290)	(0.0252)	(0.0384)
Short-term effect	-0.1175***	-0.1515***	-0.0340
	(0.0254)	(0.0217)	(0.0334)
Long-term effect	-0.1204***	-0.1851***	-0.0647*
	(0.0270)	(0.0234)	(0.0357)
Observations	13,624	17,693	31,317

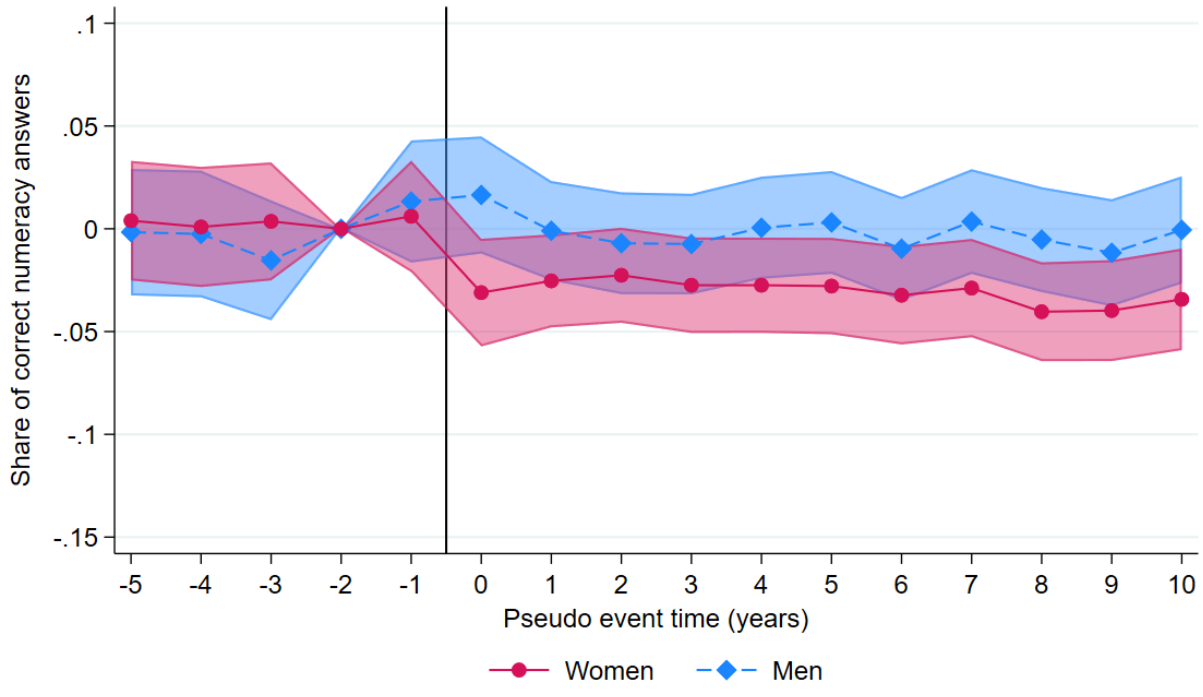
Notes: Table shows summary estimates for child penalties in numeracy scores corresponding to event-time coefficients. The omitted category is two years before birth. Source: PIAAC international PUF

back

Child Penalty in Actually Answered Numeracy Questions

back

Figure: Numeracy score of actual responses (with controls)



Child Penalty in Numeracy Score Components

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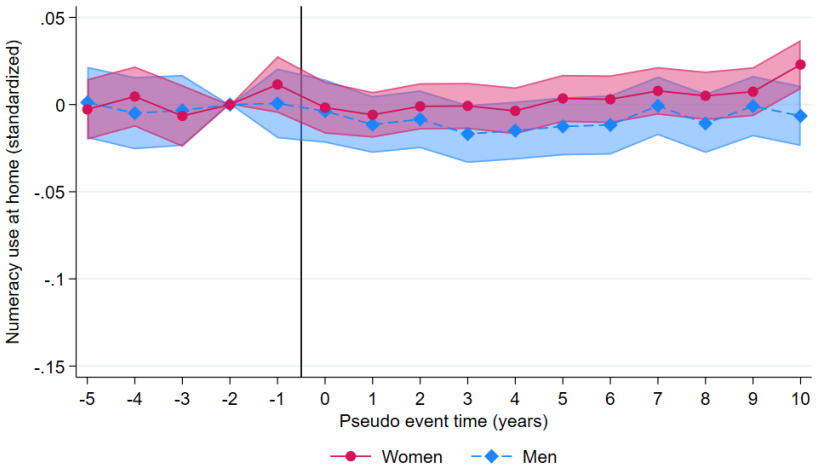
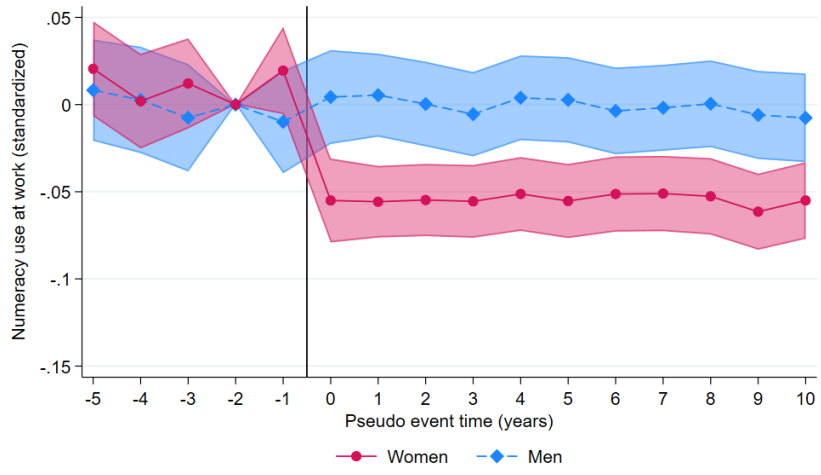


Numeracy score in non-work related questions (with controls)



Numeracy score in work-related questions (with controls)