

Is the Motherhood Wage Penalty strongest for highly skilled Women?

Volker Ludwig

TU Kaiserslautern

Analytical Sociology
Venice International University, Nov 19th, 2019

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood
 - Skills: educational attainment, cognitive ability

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood
 - Skills: educational attainment, cognitive ability
- Using FE model to estimate these effects is a tedious strategy

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood
 - Skills: educational attainment, cognitive ability
- Using FE model to estimate these effects is a tedious strategy
 - Average MWP might be biased if time-constant confounder is related to heterogeneity of wage trajectories of mothers and childless women (Ludwig & Brüderl 2018; Mari 2019)

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood
 - Skills: educational attainment, cognitive ability
- Using FE model to estimate these effects is a tedious strategy
 - Average MWP might be biased if time-constant confounder is related to heterogeneity of wage trajectories of mothers and childless women (Ludwig & Brüderl 2018; Mari 2019)
 - Interaction effect of a time-constant (skills) and a time-varying variable (motherhood) will often be biased

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual “skills” and motherhood
 - Skills: educational attainment, cognitive ability
- Using FE model to estimate these effects is a tedious strategy
 - Average MWP might be biased if time-constant confounder is related to heterogeneity of wage trajectories of mothers and childless women (Ludwig & Brüderl 2018; Mari 2019)
 - Interaction effect of a time-constant (skills) and a time-varying variable (motherhood) will often be biased
 - Problem: time-constant variable varies only between persons, might therefore be related to unobserved confounders

- Recent articles claim variation of the Motherhood Wage Penalty (MWP) by women's level of skills
 - Strongest penalty for highly skilled women (England, Bearak, Budig & Hodges 2016; Wilde, Batchelder & Ellwood 2010)
 - Does the Motherhood Wage Penalty vary by skill ?
- Previous studies used Fixed Effects (FE) models with various specifications
 - to estimate average (per child) penalty
 - to estimate interaction effects of individual "skills" and motherhood
 - Skills: educational attainment, cognitive ability
- Using FE model to estimate these effects is a tedious strategy
 - Average MWP might be biased if time-constant confounder is related to heterogeneity of wage trajectories of mothers and childless women (Ludwig & Brüderl 2018; Mari 2019)
 - Interaction effect of a time-constant (skills) and a time-varying variable (motherhood) will often be biased
 - Problem: time-constant variable varies only between persons, might therefore be related to unobserved confounders
- This study: use FE model with Individual Slopes (FEIS) to test and correct for these biases

- Large degree of heterogeneity for women's wage trajectories
 - not just different wage levels, but different slopes

- Large degree of heterogeneity for women's wage trajectories
 - not just different wage levels, but different slopes
- Heterogeneity of wage trajectories might be related to motherhood
 - Women sorted into occupations with low wage growth (Polachek 1981), more likely with strong preference for motherhood
 - Women with strong career motivation stay childless and have stronger wage growth (Hakim 2002)
 - If women with low wage growth select themselves into motherhood, standard FE will overestimate the average motherhood penalty

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)
 - Human capital depreciation / non-accumulation due to employment breaks

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)
 - Human capital depreciation / non-accumulation due to employment breaks
 - Employer discrimination / stereotyping

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)
 - Human capital depreciation / non-accumulation due to employment breaks
 - Employer discrimination / stereotyping
- Causal effect might be stronger for highly skilled women (England et al. 2016)

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)
 - Human capital depreciation / non-accumulation due to employment breaks
 - Employer discrimination / stereotyping
- Causal effect might be stronger for highly skilled women (England et al. 2016)
 - highly skilled have shorter employment breaks after child birth (endowment)

- Strong arguments (and evidence) for a causal effect of motherhood (Budig & England 2001)
 - Human capital depreciation / non-accumulation due to employment breaks
 - Employer discrimination / stereotyping
- Causal effect might be stronger for highly skilled women (England et al. 2016)
 - highly skilled have shorter employment breaks after child birth (endowment)
 - highly skilled loose more with equal length of break (differential returns)

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age
 - But skills partly unobserved (B)
 - FE returns biased estimates of motherhood penalties by (observed) level of skills

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age
 - But skills partly unobserved (B)
 - FE returns biased estimates of motherhood penalties by (observed) level of skills
- Skill-based heterogeneity of wage trajectories might NOT be related to motherhood
 - Even then, need to control for interaction of skills and age

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age
 - But skills partly unobserved (B)
 - FE returns biased estimates of motherhood penalties by (observed) level of skills
- Skill-based heterogeneity of wage trajectories might NOT be related to motherhood
 - Even then, need to control for interaction of skills and age
 - But unobserved skills (B) likely correlated with observed skills (A, ED)

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age
 - But skills partly unobserved (B)
 - FE returns biased estimates of motherhood penalties by (observed) level of skills
- Skill-based heterogeneity of wage trajectories might NOT be related to motherhood
 - Even then, need to control for interaction of skills and age
 - But unobserved skills (B) likely correlated with observed skills (A, ED)
 - FE returns biased estimates because $B \# \text{age}$ correlated with $ED \# \text{age}$ and $A \# \text{age}$

- Strong arguments (and evidence) for skill-based wage profiles
 - steeper with (observed) higher formal education (ED)
 - steeper with (sometimes observed) cognitive ability (A)
 - steeper with (usually unobserved) non-cognitive ability, motivation (B)
- Skill-based heterogeneity of wage trajectories might be related to motherhood
 - Need to control for interaction of skills and age
 - But skills partly unobserved (B)
 - FE returns biased estimates of motherhood penalties by (observed) level of skills
- Skill-based heterogeneity of wage trajectories might NOT be related to motherhood
 - Even then, need to control for interaction of skills and age
 - But unobserved skills (B) likely correlated with observed skills (A, ED)
 - FE returns biased estimates because $B \# \text{age}$ correlated with $ED \# \text{age}$ and $A \# \text{age}$
- FE with Individual Slopes (FEIS) (Wooldridge 2010) returns unbiased estimates of motherhood penalties

Stata

Installation	<code>ssc install xtfeis</code>
Estimation	<code>xtfeis y x , slope(t) cluster(id)</code>
ART	<code>xtart [FEIS] [, fe re]</code>
BSHT	<code>xtbsht FEIS FE, seed(123) reps(100)</code>

R

Installation	<code>install.packages("feisr")</code>
Estimation	<code>feis(y ~ x t, data=df, id="id", robust=TRUE)</code>
ART	<code>feistest(FEIS, robust=TRUE, type="all")</code>
BSHT	<code>bsfeistest(FEIS, seed=123, rep=100, type="all")</code>

- Rüttenauer & Ludwig (2019)

- National Longitudinal Survey of Youth (NLSY79), waves 1979-2012
 - Sample restricted to women, childless and never-married at first observation, currently working, at least 4 valid person-years
 - $N = 3,150$, $NT = 39,706$

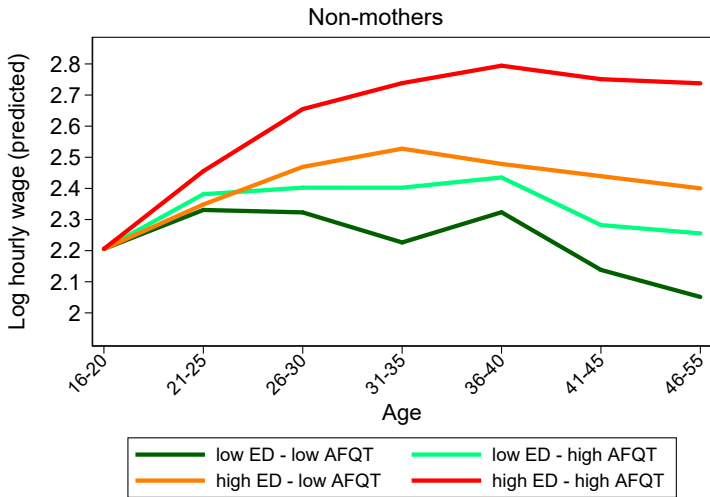
- National Longitudinal Survey of Youth (NLSY79), waves 1979-2012
 - Sample restricted to women, childless and never-married at first observation, currently working, at least 4 valid person-years
 - $N = 3,150$, $NT = 39,706$
- Dep var: Log of hourly wage (U.S. Dollars, 2010)

- National Longitudinal Survey of Youth (NLSY79), waves 1979-2012
 - Sample restricted to women, childless and never-married at first observation, currently working, at least 4 valid person-years
 - $N = 3,150$, $NT = 39,706$
- Dep var: Log of hourly wage (U.S. Dollars, 2010)
- Main Indep vars:
 - Number of biological children, dummy currently married
 - Cognitive Skills: AFQT test score (Armed Forces Qualification Test), dummy for low / high IQ
 - Educational attainment: years of formal schooling, dummy for low / high attainment at labor market entry (before 1st child birth)

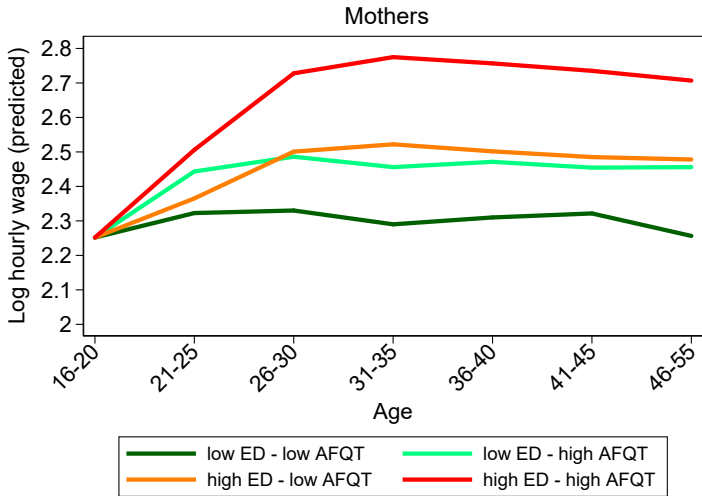
- National Longitudinal Survey of Youth (NLSY79), waves 1979-2012
 - Sample restricted to women, childless and never-married at first observation, currently working, at least 4 valid person-years
 - $N = 3,150$, $NT = 39,706$
- Dep var: Log of hourly wage (U.S. Dollars, 2010)
- Main Indep vars:
 - Number of biological children, dummy currently married
 - Cognitive Skills: AFQT test score (Armed Forces Qualification Test), dummy for low / high IQ
 - Educational attainment: years of formal schooling, dummy for low / high attainment at labor market entry (before 1st child birth)
 - Age, Age squared, Experience full-time and part-time, tenure

- National Longitudinal Survey of Youth (NLSY79), waves 1979-2012
 - Sample restricted to women, childless and never-married at first observation, currently working, at least 4 valid person-years
 - $N = 3,150$, $NT = 39,706$
- Dep var: Log of hourly wage (U.S. Dollars, 2010)
- Main Indep vars:
 - Number of biological children, dummy currently married
 - Cognitive Skills: AFQT test score (Armed Forces Qualification Test), dummy for low / high IQ
 - Educational attainment: years of formal schooling, dummy for low / high attainment at labor market entry (before 1st child birth)
 - Age, Age squared, Experience full-time and part-time, tenure
- Control vars: Dummy educational enrollment, Survey year (grouped)

Results: Wage profiles by women's level of skills

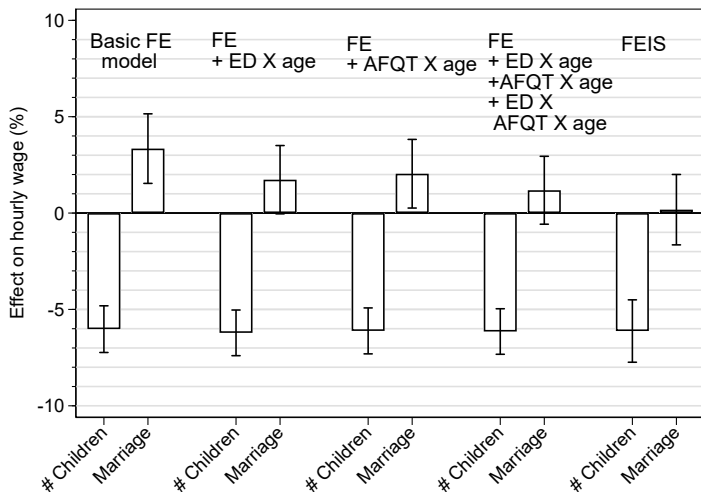


Results: Wage profiles by women's level of skills



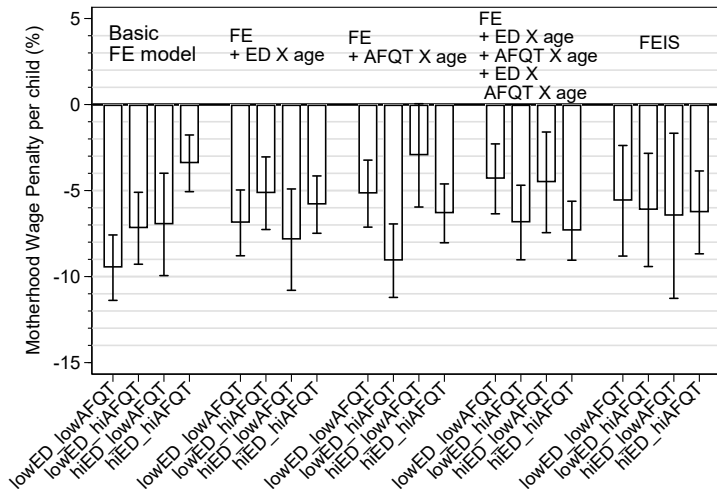
Results: Effect of Motherhood and Marriage across Models

- Marriage: standard FE models biased, Motherhood: FE unbiased
- Artificial Regression Test: no need for FE or FEIS models to estimate effect of motherhood



Results: Effects of Motherhood by Skill level

- FE models: motherhood penalty does vary by skill, results heavily depend on specification
- FEIS model: motherhood does not vary by skill



- Findings show little evidence for stronger motherhood penalty of highly skilled women (England et al. 2016)
- Standard FE model sufficient for estimation of average penalty

- Findings show little evidence for stronger motherhood penalty of highly skilled women (England et al. 2016)
- Standard FE model sufficient for estimation of average penalty
 - no evidence in favor of selection arguments (Polachek 1981)

- Findings show little evidence for stronger motherhood penalty of highly skilled women (England et al. 2016)
- Standard FE model sufficient for estimation of average penalty
 - no evidence in favor of selection arguments (Polachek 1981)
- But standard FE returns biased estimates for interaction of motherhood and (observed) skills

- Findings show little evidence for stronger motherhood penalty of highly skilled women (England et al. 2016)
- Standard FE model sufficient for estimation of average penalty
 - no evidence in favor of selection arguments (Polachek 1981)
- But standard FE returns biased estimates for interaction of motherhood and (observed) skills
 - Likely reason is correlation of observed and unobserved skills that determine wage growth
 - FE is biased even without skill-based selection into motherhood

- Findings show little evidence for stronger motherhood penalty of highly skilled women (England et al. 2016)
- Standard FE model sufficient for estimation of average penalty
 - no evidence in favor of selection arguments (Polachek 1981)
- But standard FE returns biased estimates for interaction of motherhood and (observed) skills
 - Likely reason is correlation of observed and unobserved skills that determine wage growth
 - FE is biased even without skill-based selection into motherhood
- FEIS model allows for consistent estimation of interaction effects of (time-constant) skill and (time-varying) motherhood