Female Labor Supply, Human Capital, and Welfare Reform

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Motivating questions

1. How should we account for interactions between human capital and female labour supply decisions?
   - especially in the design of transfers to families in the form of 'in-work benefits' or 'earned income tax credits',
   - to what extent do dynamic issues and uncertainty change our view of the impact of these policies on female labour supply and earnings?
2. Can human capital investments explain the 'gender gap' in the earnings distribution?
3. What is the role of work experience and training?
   - work experience can enhance human capital and earnings throughout the life-cycle,
   - training could be used to offset human capital depreciation from lost work experience and partially reverse the gender gap,
   - incentives for training, implicit in tax-credits, can be quite different from incentives to work, see Heckman, Lochner and Cossa (2003).

Develop a life-cycle framework and examine

(i) how tax and welfare policies impact on human capital investment and female labour supply, *and*
(ii) how labour supply and human capital impact on earnings over the life-cycle - the modeling approach builds on BCMS, *Ecta* 2016.

Human capital investments:

- Education choices - before work.
- 'Learning *by* doing' - work experience and labour supply.
- Training during working life - 'learning *or* doing.'

Focus here on three issues:

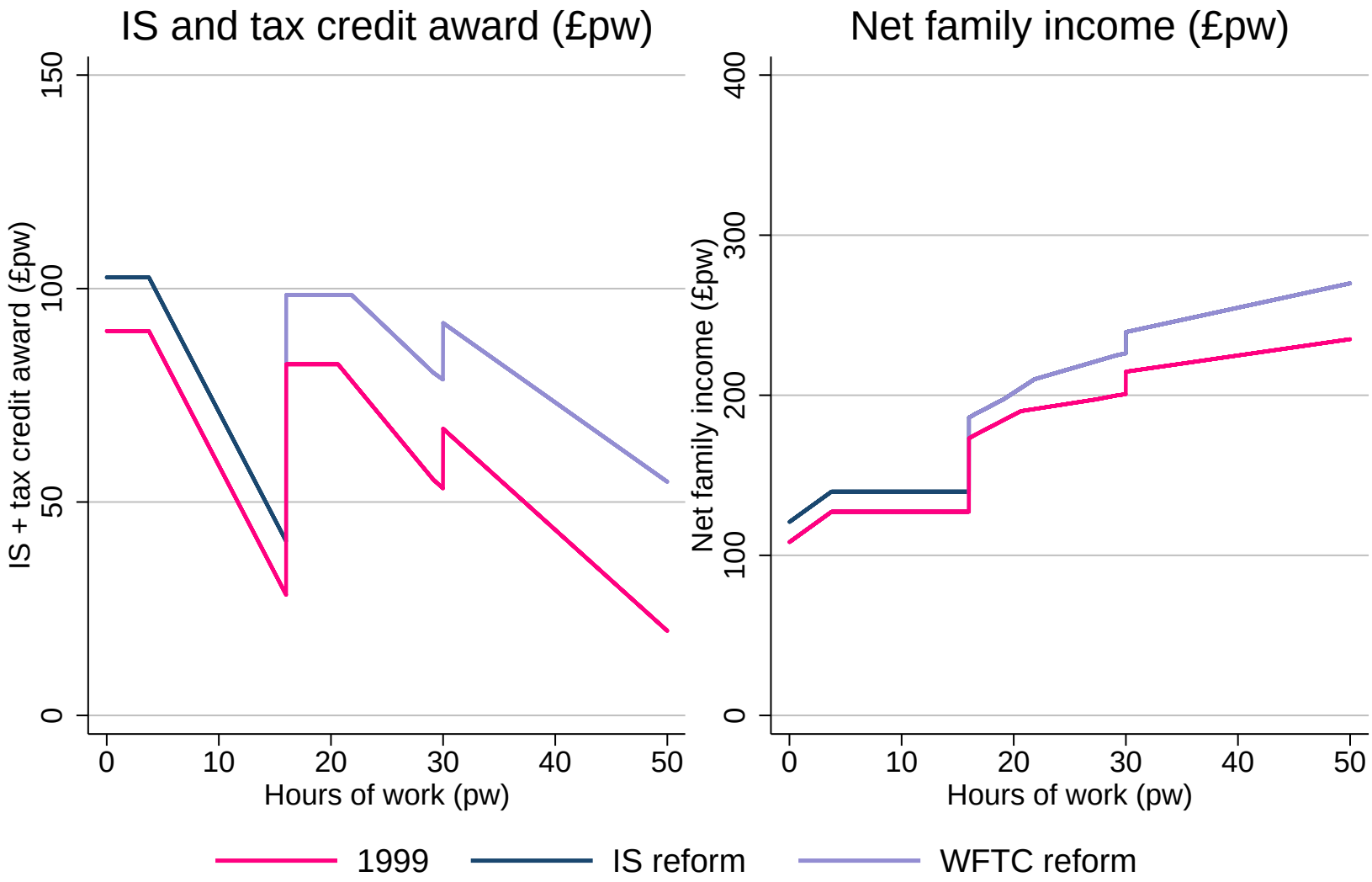
- > the *complementarity* of work experience and training with education,
- > the value of *part-time* work experience,
- > the role of training to offset human capital depreciation.

Welfare Policy Background

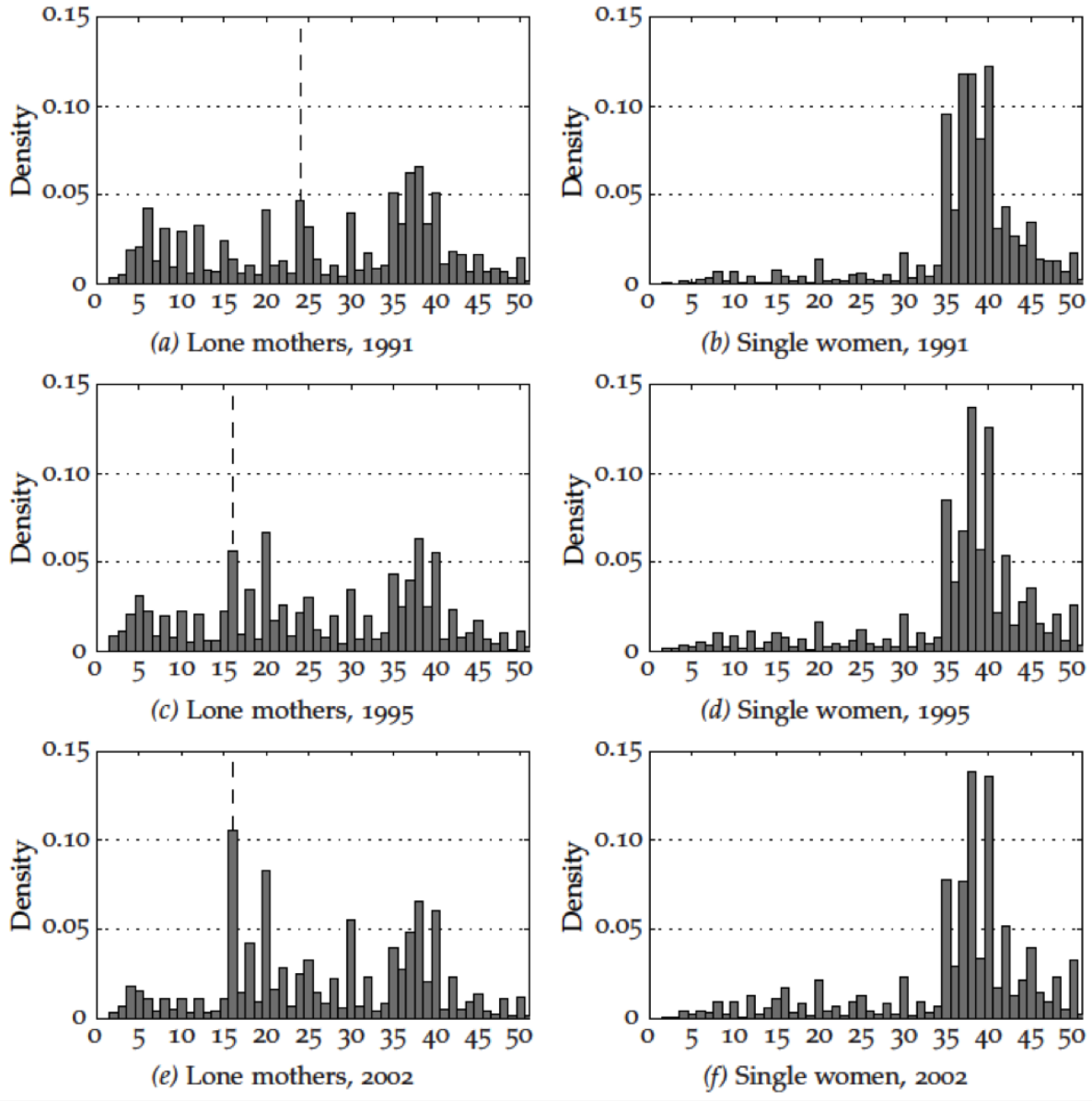
- Focus on a specific reform - Working Families Tax Credit (*WFTC*) and Income Support (*IS*) in 1999/2000.
- Use this reform for reduced form comparisons with the structural model predictions.
- The reform involved an increase in the generosity of welfare and of earned income tax credits for families with children.
- As in other countries, the motivation for these policies is that by incentivising women into work, even when they have young children, labour market attachment can be preserved, reducing skill depreciation and attenuating the gender gap.
- An additional peculiarity of the UK tax-credit system is the minimum hours eligibility rules that focus incentives on part-time work.

The UK Tax Credit and Income Support Reform 1999

Figure 1: lone parent with 1 child



Do the hours rules impact on observed behaviour?



Question and approach

The key question we ask is:

- How do these tax-credit and welfare benefit reforms affect human capital accumulation, labour supply and life-cycle earnings?

Take a structural dynamic approach:

- Using the series of tax, tax credit, welfare benefit, and tuition cost reforms for new cohorts of women to identify parameters of preferences, human capital investment and wages,

  - conditioning on *life-history family background* variables,

  - using local/industry variation over time, in addition to tax and welfare reforms, to help identify the model.

- Comparing with quasi-experimental contrasts where possible:
  - e.g. diff-in-diff contrasts for employment effects.

The Household Panel Data

British Household Panel Survey (BHPS), much like an enhanced PSID

Unbalanced panel of 4,200 females aged<50 over 18 waves, 1991-2008

- Measures of education, labour market outcomes, detailed measures of training and training intensity, childcare, detailed demographics, and assets.

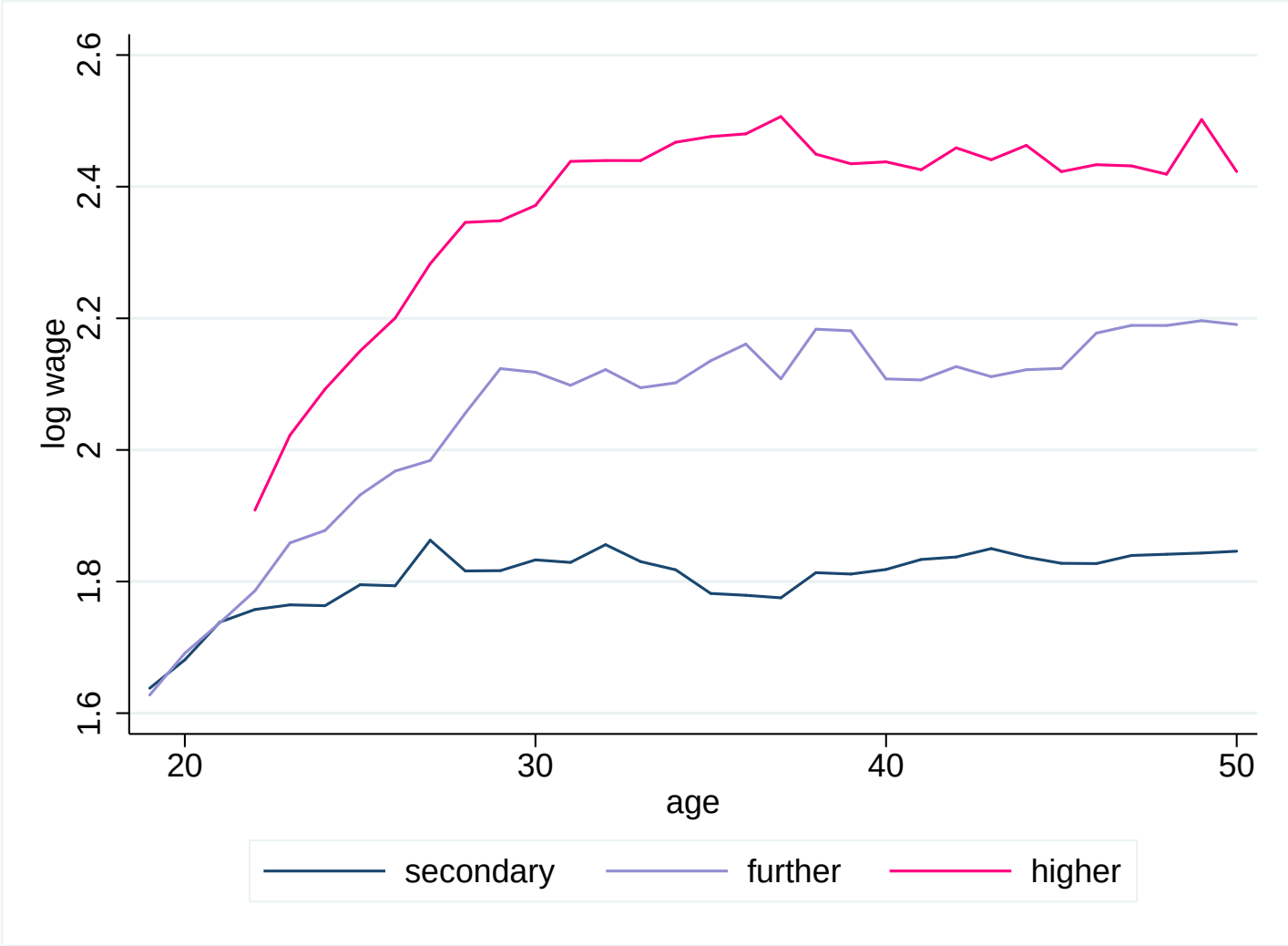
IFS taxben budget constraint simulation model working on every wave:

- Taxes: income tax, NI, council tax, tax credits
- Benefits: child benefit, maternity grant, income support, housing benefit, council tax benefit, free school meals.

Linked life histories capture choices at age 16: educational qualifications; and detailed background measures, including

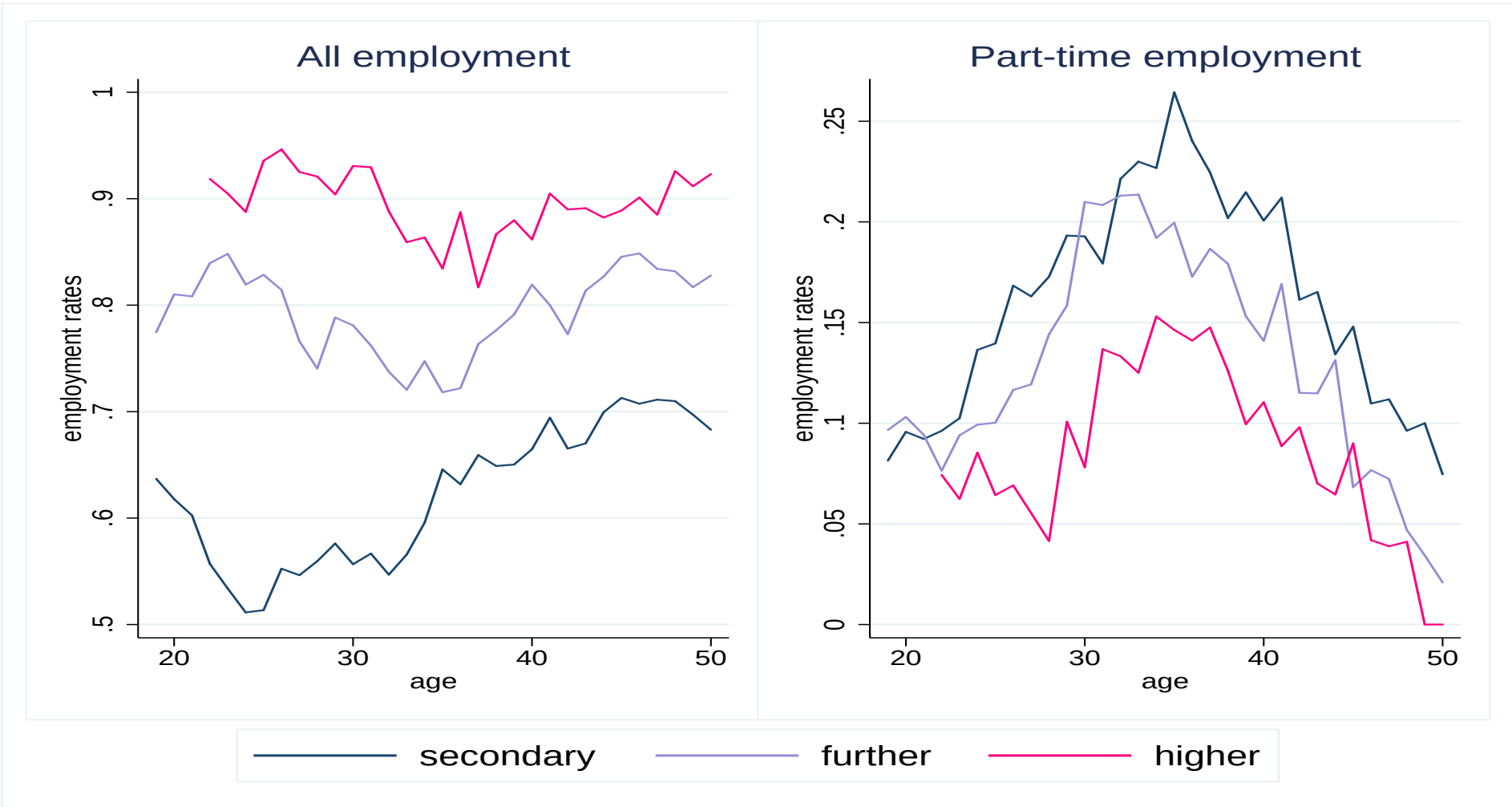
- parental education, number of siblings, sibling order, whether lived with parents when aged 16, books at home as a child, etc.
- detailed geocoded data mapping into local industrial composition.

Wage Profiles by Education by Age

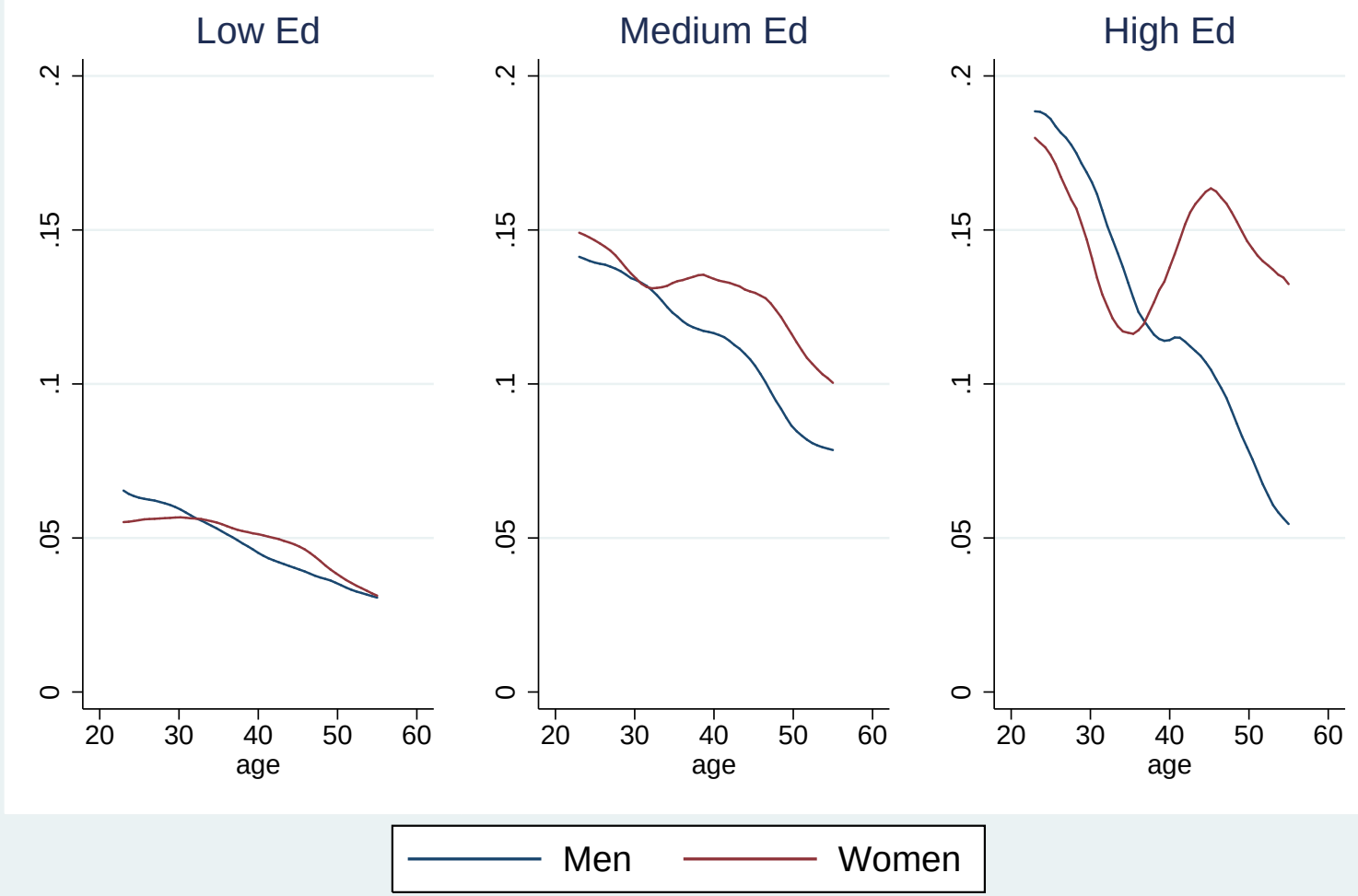


Male and Female Wage Age Profiles: University Graduates

Employment over the life-cycle



Work-related training participation rates (50h+)



- Appears to be strong complementarity with education.
- Mincer/Ben-Porath assumption: investments drop with age.
- Offset human capital depreciation in part-time work and non-employment?

Training Questions in the BHPS

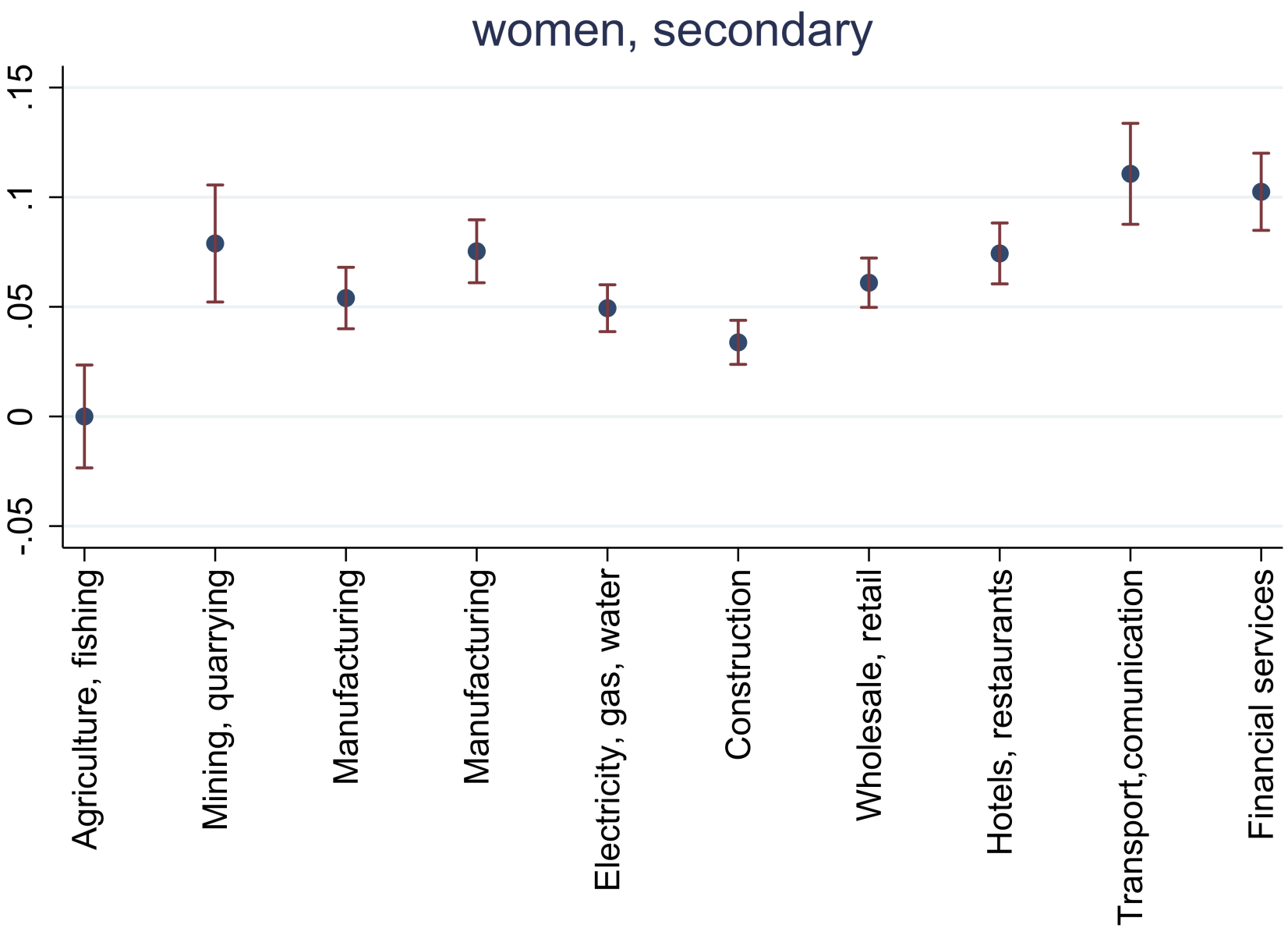
READ OUT
I would like to ask some details about all of the training schemes or courses you have been on since September 1st 1999, (other than those you have already told me about), starting with the most recent course or period of training even if that is not finished yet.

Event no.	D69. **SHOWCARD D13** Where was the main place that this course or training took place?	D70. Was this course or training. . . **READ OUT AND CODE FOR EACH**	D71. Since September 1st 1999 how much time have you spent on this course or training in total?	D72. **SHOWCARD D14** Which statement or statements on this card describe how any fees were paid, either for the course or for examinations? **CODE ALL THAT APPLY**
1	**WRITE IN MAIN PLACE AND ENTER CODE FROM SHOWCARD CODE ONE ONLY** **WRITE IN PLACE** _____ _____ **ENTER CODE FROM SHOWCARD** ☐☐ JTRPLCE1	**Yes No** To **help** you get started in your current job?.....1.....2 JTRWHYA1 To **increase** your skills in your current job for example by learning new technology?.....1.....2 JTRWHYB1 To **improve** your skills in your current job?.....1.....2 JTRWHYC1 To **prepare** you for a job or jobs you might do in the future?.....1.....2 JTRWHYD1 To **develop** your skills generally?.....1.....2 JTRWHYE1	**ENTER NUMBER** ☐☐☐ JTRQ1 **CODE UNIT** Hours.....1 Days.....2 Weeks.....3 Months.....4 Other (SPECIFY) _____ 5 JTRU1	No fees.....01 JTRFEEA1 Self/family.....02 JTRFEEB1 Employer/ future emp.....03 JTRFEEC1 New Deal scheme.....05 JTRFEEE1 Training for work, Youth/Emp training/ TEC.....06 JTRFEEF1 Other arrangement (SPECIFY) _____07 JTRFEEG1

A Note on Our Measure of Training

- Respondents may report training spell lengths in any unit (hours, days, weeks, or months).
- We convert these measures into hours, assuming 8 hours in a day for full-time workers and 4 hours in a day for part-time workers and sum across multiple training spells.
- **The training variable is an indicator for whether the respondent received more than 50 hours of training in the previous year.**
  - Results are shown to be robust to using continuous measure.
- Here we focus on work-related training, i.e. training which helps get started or increase or improve skills.
  - In robustness checks, we use non-induction-only work-related training and all training. Results are robust.
- **In addition to the tax and benefit variation, use variation by location/industry and time as 'instruments' for training....**

Training Intensity by Industry: High school women



Baseline model: mixed discrete-continuous life-cycle model

Life in three stages:

- Education 's=0,1,2': sequential discrete choice model
  - secondary (GCSE-level at 16), further/high school (A-levels or vocational at 18), higher (university and college at 21)
  - allow for borrowing constraints, tuition costs and student loans.
- Working life:
  - consumption 'c' and asset 'a' accumulation
  - labour supply 'l' (0, part-time and full-time)
  - experience accumulation and training
  - partnering and childbearing
- Retirement: pension incomes take effect exogenously at age 60 (see Fan/Sheshadri/Taber paper).

Focus in this talk on labour supply, work experience and life-cycle earnings with some preliminary results on training.

Model: female wages

Wage equation: for woman 'i', age 't', in each birth cohort;
with school level 's', experience 'e', labour supply 'l'

$$\begin{aligned} lnw_{sit} &= \ln W_{sit} + \gamma_{si} \ln\left(e_{sit}+1\right) + v_{sit} + \xi_{sit} \\ v_{sit} &= \rho_s v_{sit-1} + \mu_{sit} \\ e_{sit} &= e_{sit-1}\left(1-\delta_s\right) + g_s\left(l_{sit}\right) \end{aligned}$$

* γ_{si} varies with schooling level s *and* background factors x_i.
* persistence of shocks - distinguish heterogeneity from state experience effects.
* ξ_{sit} is a transitory shock.
* correlation of initial permanent shock with preferences.
* $g_s(l_{sit}) = 1$ full-time, the part-time experience value $g_s(PT)$ is estimated.
* δ_s depreciation of human capital - cost of not working.

.... extension for training investments

we add training to experience dynamics:

$$\begin{aligned} \ln w_{sit} &= \ln W_{st} + \gamma_s \ln(e_{sit}+1) + v_{sit} + \xi_{sit} \\ v_{sit} &= \rho_s v_{si,t-1} + \mu_{sit} \\ e_{sit} &= e_{si,t-1}(1-\delta_s) + g_s(l_{si,t-1}) + h_{sl}(k_{si,t-1}) \end{aligned}$$

where

k_{sit}: proportion of working time dedicated to on-the-job training,
$h_{sl}(k_{sit})$: additional experience accumulated through training.

Training investment takes time away from working time, so earnings:

$$y_{sit} = w_{sit} l_{sit} (1 - k_{sit})$$

- the worker pays for the training in lost earnings (and possibly fees).

- First, results for the life-cycle model with education and work experience

Family formation dynamics, flexible Markov models

Children:

- Children are born with an (weakly) exogenous arrival rate

$$\text{Prob}\left[t^k = 0 \,\middle|\, t, s, k_{t-1}, t^k_{t-1}, m_{t-1}\right]$$

Partner:

- Arrival and splitting rate depending on level of education and age,
  - characterised by education, employment, prior marriage, children,
  - arrival rate for male with given education depends on female age and education; the departure probability depends on female age, presence of child and male education.
  - his wages and employment are uncertain:

- Fertility and marriage behavior are 'weakly exogenous',
  - however, there is feedback - individuals account for the implications of their choices on marriage and fertility.

Model for post-education choices:

$\{c_{it}, l_{it}\}_{t=\underline{t},....,\bar{t}}$ are chosen over the life-cycle with preferences

$$V_{\underline{t}}(X_{i\underline{t}}) = E\left[\sum_{t=\underline{t}}^{\bar{t}} \beta^{t-\underline{t}} \frac{(c_{it}/n_{it})^{\mu}}{\mu} \exp\left(U(l_{it}, l_{it}^m, X_{it}) + \theta_i l_{it}\right) \middle| X_{i\underline{t}}\right]$$

subject to the budget constraint (including taxes and childcare costs):

$$a_{it+1} = (1+r)a_{it} + l_{it}w_{sit} + d_{it}^m l_{it}^m w_{it}^m - T(X_{it}, l_{it}, l_{it}^m) - Q\left(t_{it}^k, l_{it}, l_{it}^m, X_{it}\right) - c_{it}$$

where

- $U(l_{it}, l_{it}^m, X_{it})$ is a flexible parametric function of family composition, education, partner, partner labour supply, and background factors.
- θ_i unobserved heterogeneity types.
- net worth liquidity constraint: $a > a_s$.
- uncertainty: family composition, earnings (own and partner's).
- childcare costs (Q) and housing benefits (in T) vary by location and time.

Structural Estimation

1. Estimate processes for male earnings and employment, family dynamics and childcare costs, recursively 'outside' the model.
2. Method of Simulated Moments for the remaining parameters: Simulate individuals under different tax regimes; compute overall moment to match with those in the data.

$$\hat{\Theta} = argmin_{\Theta}\{\Sigma_{k=1}^{K}[(M_{kN}^{d} - M_{ks}^{m}(\Theta))^{2} / Var(M_{kN}^{d})]\} \quad (1)$$

- Matched moments include: employment rates by family type, employment and hours transition rates, means, variances and percentiles of earnings distribution, earnings at entrance in working life, change in earnings by past hours, education achievement,...
- Joint consumption and labor supply decisions - the former is a continuous choice while the latter is discrete. The value function is piecewise concave with kinks, see appendix in *BCMS*.

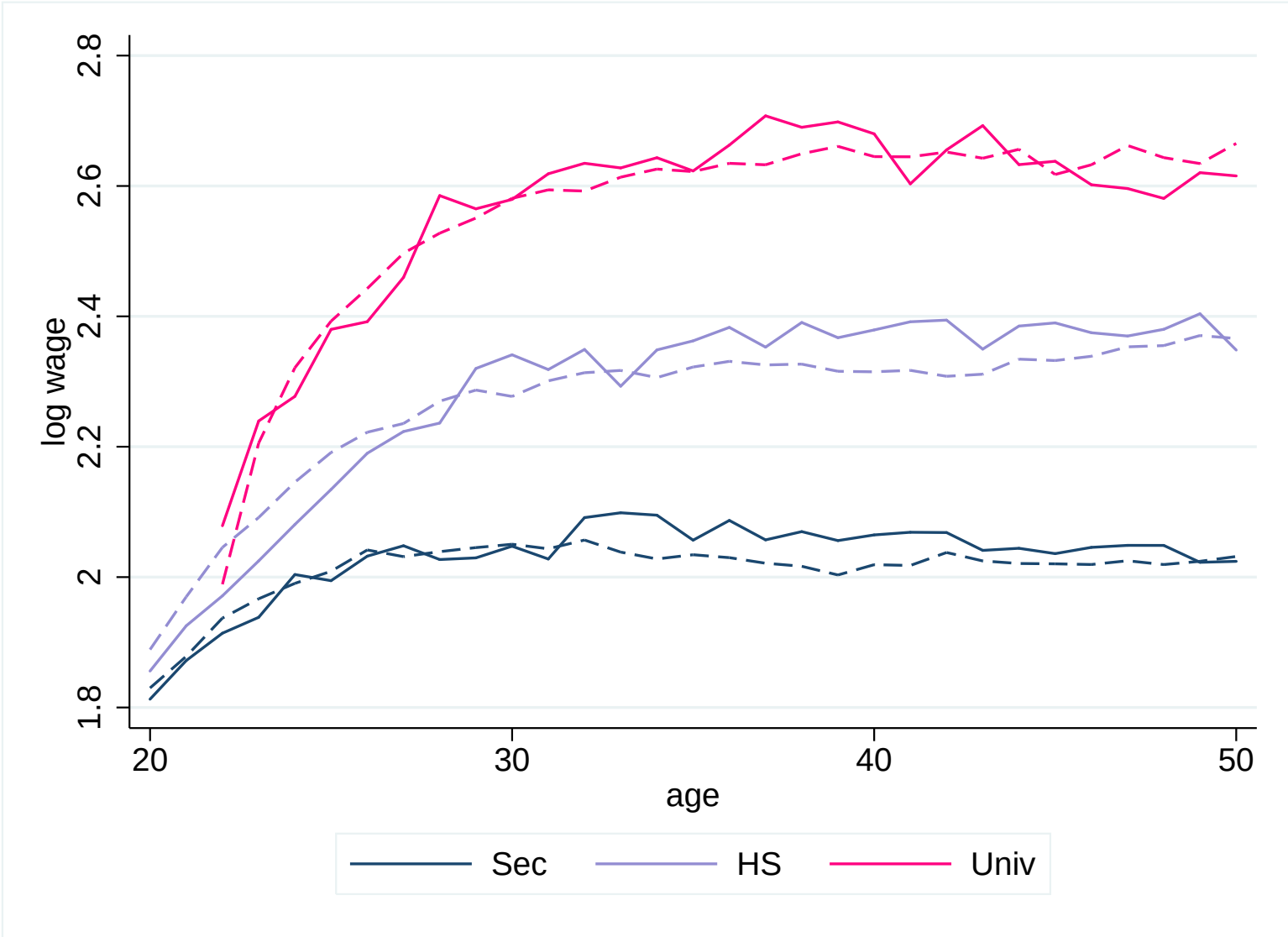
Structural parameter estimates: Female wage equation

log hourly wage	Secondary		Further		Higher	
baseline at age 25	7.19	(.050)	8.64	(.067)	10.55	(.31)
returns to experience (γ_s)	.15	(.01)	.23	(.01)	.31	(.02)
autocorrelation coef (ρ_s)	.92	(.01)	.92	(.01)	.88	(.02)
se innovation	.12	(.01)	.15	(.01)	.14	(.01)
initial prod	.14	(.01)	.13	(.01)	.31	(.03)
initial productivity: se	.14	(.02)	.20	(.02)	.23	(.03)
depreciation rate (δ_s)	.08	(.01)	.06	(.01)	.07	(.01)
accumulation of HC in PT work	.15	(.02)	.10	(.02)	.12	(.02)

Notes: Full results with interactions of background factors etc at end of slides.

Model fit

Life-cycle profiles of wages



Model fit

Employment over life-cycle

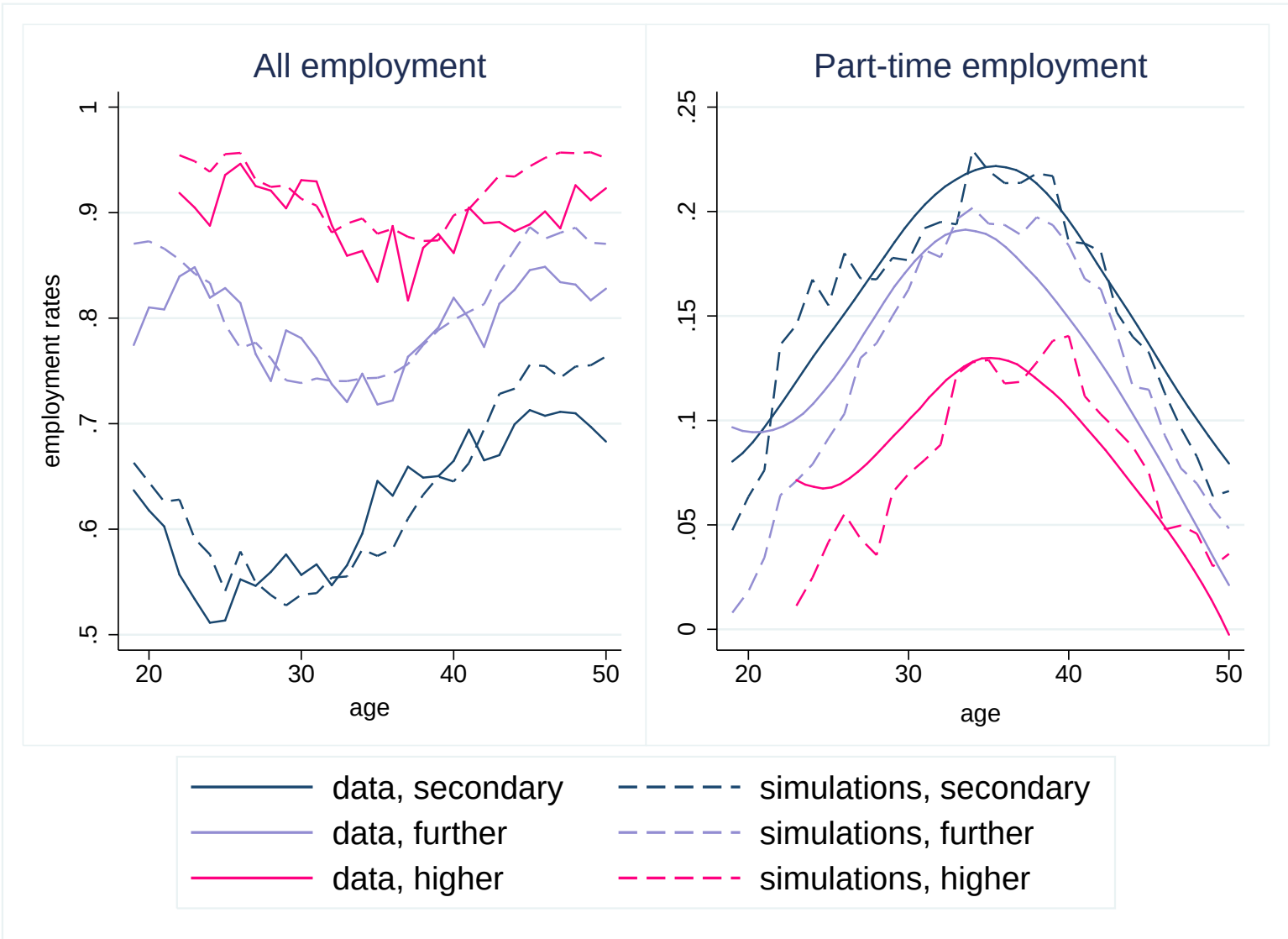


Table: Female labor supply elasticities

	Frisch			Marshall		
	extensive		intensive	extensive		intensive
	elasticity	deriv	elasticity	elasticity	deriv	elasticity
All women	0.627	0.510	0.240	0.475	0.386	0.210
By education						
Secondary	**0.914**	0.675	**0.327**	**0.689**	0.509	**0.280**
High school	0.567	0.469	0.223	0.428	0.354	0.198
University	0.427	0.375	0.180	0.331	0.291	0.158
By family composition						
Single no kid	0.532	0.486	0.159	0.419	0.383	0.055
Lone mother	1.740	1.275	0.452	**1.362**	0.775	**0.378**
Couples no kid	0.264	0.242	0.163	**0.220**	0.203	**0.167**
Couples w kid	0.688	0.522	0.316	0.553	0.419	0.304

Notes: See Table 14, BCMS.
Counterfactual policy simulations show offsetting impact of tax credit policy on education choices.

Table: Gender Gap: The effect of work experience on female wages at age 50

	No part-time 'penalty'	Equalising experience
Secondary (%)	5.3	9.5
High School (%)	7.0	13.2
University (%)	8.7	16.3

Notes:

The first column shows the effect on wages at 50 if the amount of *experience gained from part-time work is the same as that of full time work*.

The second column shows the effect on wages at 50 *if the amount of experience gained was the same as that for men*.

Male and Female Wage Age Profiles: University Graduates

Model: Estimate an extended wage equation with training.

- Estimate using tax instruments for part time and full time simulated incomes, also use interactions of time$*$local area.
- Instead of adding directly to the stock of human capital we enter the recent history of training:

$$\begin{aligned}
\ln w_{sit} &= \ln W_s + \gamma_s \ln\left(e_{sit}+1\right) + \phi_{s0} K_{sit} + \phi_{s1} K_{si,t-1} + ... + v_{sit} + \xi_{sit} \\
v_{sit} &= \rho_s v_{si,t-1} + \mu_{sit} \\
e_{sit} &= e_{si,t-1}\left(1-\delta_s\right) + g_s\left(l_{si,t-1}\right)
\end{aligned}$$

- $>$ the aim is to explore the impact of allowing for training in this 'semi-structural' wage equation.

- $>$ in the initial results assume training K_{sit} is at the beginning of the period, the wage and hours of work are measured later in the period. δ_s is from Table above.

Table: Female log wages, training and work experience

	Endogenous experience and selection		
	Secondary	High school	University
training (ϕ_{s0})	0.0651	0.0284	0.018
	(.0167)	(.0117)	(.0181)
training (ϕ_{s1})	0.0082	0.0501	-0.016
	(.0016)	(.0113)	(.0150)
experience (γ_s)	0.157	0.197	0.238
	(.0073)	(.0078)	(.0098)
family background	yes	yes	yes
region and time dummies	yes	yes	yes
N	8478	8986	3713

Notes: Results using twa*time instruments, results in differences and results with further lags of training available on request.

Summary of main findings:

1. The returns to work experience display strong dynamic complementarity with education,

   $=>$ *lower returns to experience* for *low educated* and those in part-time work.

   $=>$ *lower education mothers with young children* have more elastic labour supply and larger income effects.

2. There is a significant, but small, adverse effect of tax credit/welfare reform on education, *attenuating* some of the employment gains.

3. Work experience and the part-time penalty explain a large part (70%) of the gender gap in wages - *especially for college educated women*.

4. A role for training to offset human capital depreciation from part-time work and non-employment, especially for middle education levels,
   $=>$ developing the empirical training model to allow cost of training to be shared...

Future Work: On-the-job investments and incidence

- Classical competitive labor market: workers pay for general training, wages fully reflect returns to investment (Becker 1964)
  $=>$ not the case with frictional competition (Acemoglu, Pischke 1999; Flinn, Genmici, Laufer 2016; Lentz, Roys 2015)
- Extend Bagger, Fontaine, Postel-Vinay and Robin (2014)
  $=>$ search model with learning-by-doing and training to understand wage incidence, HC accumulation and investment choices
  - bargaining model: wages depend on the worker's outside options,
  - productive HC accumulates with working experience and training,
  - depreciation results in HC losses during non-working periods,
  - returns to HC *gradually included in wages as workers receive competing offers and move up the job ladder*,
  - varying participation costs drive career breaks, - *resulting HC losses induce investments in training later in life*.

Extra Slides

Table: Detailed female wage equation and experience accumulation

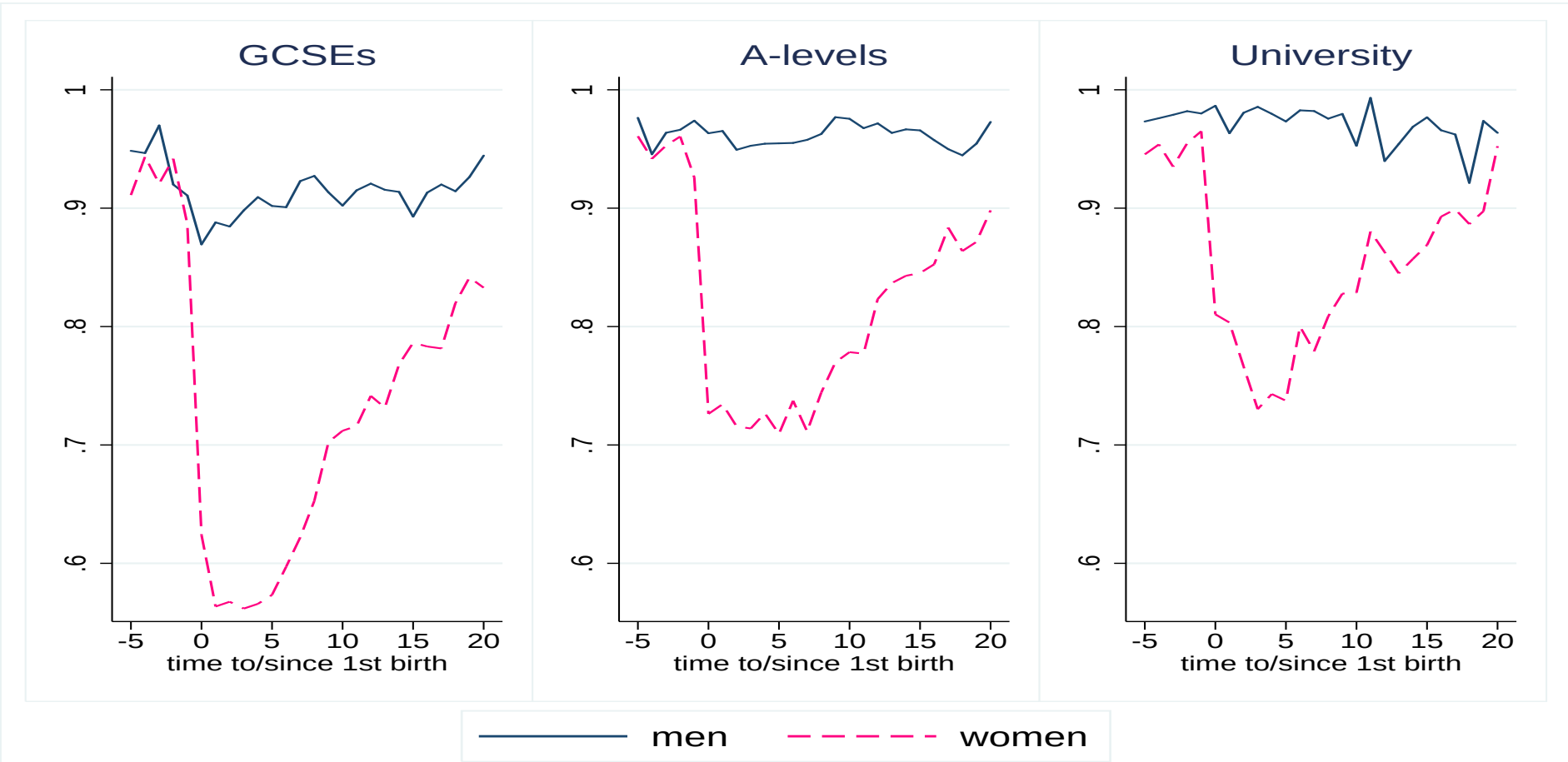
		Education		
		Secondary (1)	High school (2)	University (3)
(1)	Intercept ($b_{s,0}$)	5.406	5.547	6.949
		(0.030)	(0.038)	(0.071)
(2)	high factor 1 ($b_{s,1}$)	0.005	0.018	0.061
		(0.040)	(0.038)	(0.066)
(3)	high factor 2 ($b_{s,2}$)	0.014	-0.186	0.045
		(0.036)	(0.031)	(0.048)
(4)	Mean wage at 25	7.19	8.64	10.55
		(.050)	(.067)	(.317)
		Returns to experience		
(5)	baseline ($\gamma_{s,0}$)	0.152	0.229	0.306
		(0.006)	(0.009)	(0.011)
(6)	high factor 1 ($\gamma_{s,1}$)	0.054	0.014	-0.002
		(0.009)	(0.009)	(0.010)
(7)	high factor 2 ($\gamma_{s,2}$)	-0.002	0.029	-0.006
		(0.008)	(0.008)	(0.008)
(8)	Mean coeff experience	0.16	0.25	0.30
		(.008)	(.012)	(.014)

Table: Female wage equation and experience accumulation (cont..)

		Education		
		Secondary (1)	High school (2)	University (3)
(9)	autocorrelation coefficient: ρ_s	0.925	0.916	0.880
		(0.006)	(0.006)	(0.008)
(10)	productivity $\sqrt{\text{Var}(\zeta_s)}$	0.125	0.154	0.139
		(0.005)	(0.005)	(0.005)
		Human capital dynamics		
(13)	while in Part-Time work: $g_s(P)$	0.150	0.096	0.116
		(0.015)	(0.022)	(0.013)
(14)	depreciation rate: δ_s	0.081	0.057	0.073
		(0.008)	(0.008)	(0.009)

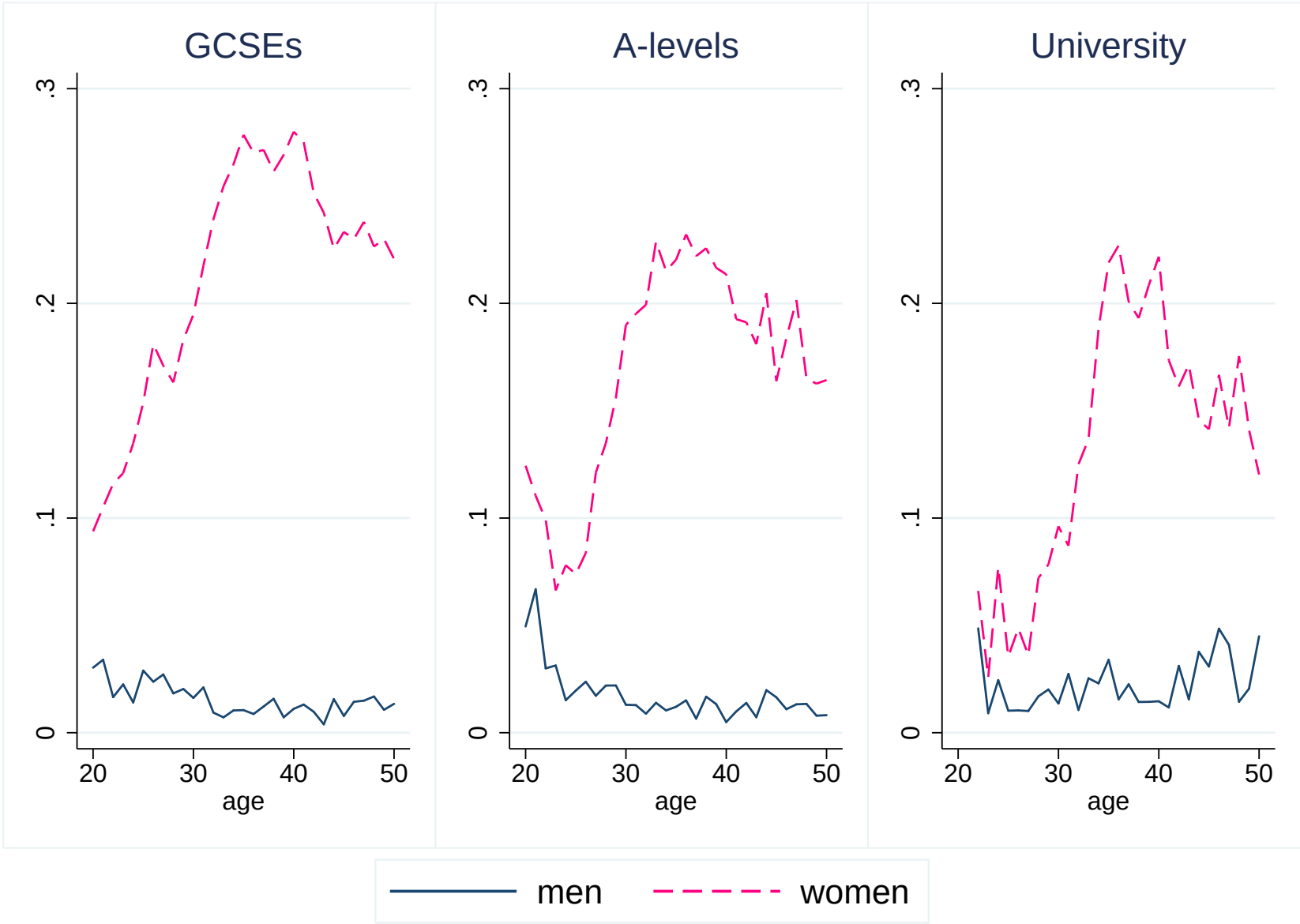
Labour supply among parents: employment rates

The differences in labour supply widen with the first birth.



BHPS 1991-2008, 22 or older at first birth.

Part-time employment by age and sex



Model: education decisions

- Sequential discrete choice model
  - risk averse preferences,
  - future earnings and family composition are uncertain.
- Allow for borrowing constraints, tuition costs and student loans.
- Condition on factors formed of many family background variables at age 16, including
  - parental education/occupation, financial circumstances, siblings, region of birth, books in the home, whether lived with parents at 16, etc.
  - financial shocks at 16 used to 'instrument' education.

Taxes, Assets and Partner Income

Detailed model of tax and benefit system - FORTAX (Shephard, 2011)

- Taxes: income tax, NI, council tax
- Benefits: child benefit, maternity grant, in-work tax credits, income support, housing benefit, council tax benefit, free school meals.

Assets:

- Initial period assets from the survey.
- Deal with the initial conditions problem by simulating from the start of life.
- Transfers implicit through funding of education.

His wages and employment are uncertain:

$$\begin{aligned} \ln w^m_{s^m it} &= \ln W^m_{s^m it} + \gamma^m_{s^m} \ln (t-18) + v^m_{s^m it} + \zeta^m_{it} \\ v^m_{s^m it} &= \rho^m_{s^m} v^m_{s^m it-1} + \mu^m_{s^m it} \end{aligned}$$

- Male employment depends on education and on whether he worked in the previous period or not.
- Linked administrative data on earnings will be key here.

Effects of the 1999 reform on education

Table: The impact of the WFTC and Income Support reforms on education attainment – model simulations versus 'reduced form' data estimates.

		High school	University
(1)	Estimates based on BHPS data	-.012	-.005
	St. Error	(.005)	(.005)
(2)	Model simulation	-.008	-.005

Effects of 1999 reform on employment of lone mothers

Table: The impact of the WFTC and Income Support reforms on Employment of Lone Mothers

1999 - 2002	Average Impact
Simulations	+4.4 (0.09)
Matched Diff-in-diff	+4.2 (0.11)

Notes: % point employment impact for low-ed lone parents.

Use the model to conduct counterfactual policy simulations of introduction of tax credit reforms, from a baseline standard welfare system.

=> Find large employment effects for low educated single mothers with some off-setting effects on education investments at 18 and for mothers in couples.

=> Relatively small long-term employment and wage effects.

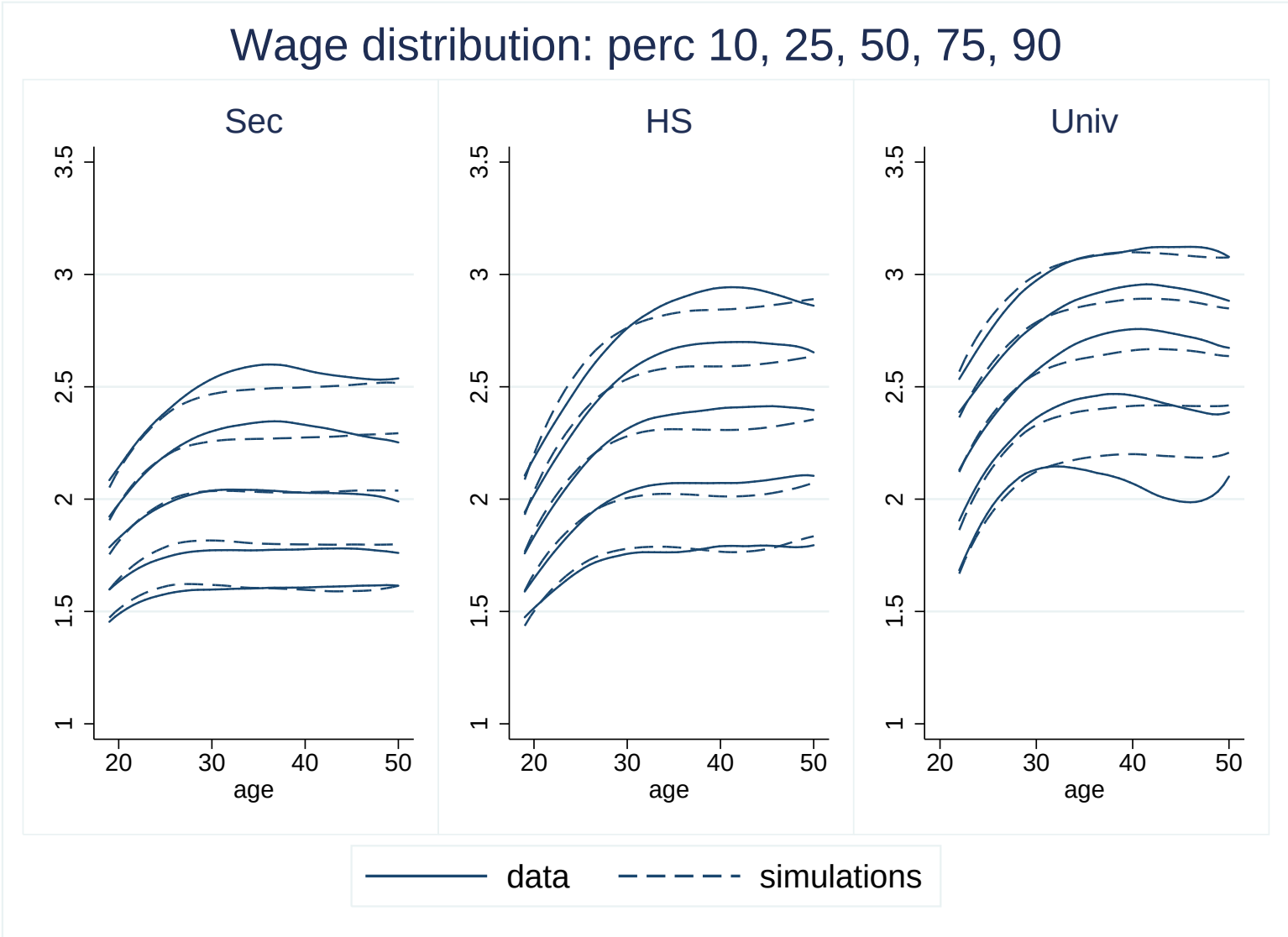
Structural parameter estimates: Labor supply preferences

	all employment			part-time employment		
	secondary	further	university	secondary	further	university
intercept	0.41 (.00)	0.41 (.00)	0.47 (.01)	-0.15 (.01)	-0.16 (.01)	-0.20 (.02)
children		0.05 (.01)			-0.06 (.01)	
child aged 0-2		0.15 (.01)			-0.05 (.01)	
child aged 3-5		0.07 (.01)			-0.06 (.01)	
child aged 6-10		-0.02 (.01)			0.03 (.01)	
child aged 11-18		-0.07 (.01)			0.06 (.01)	
male		-0.06 (.01)			-0.02 (.02)	
male working		-0.17 (.01)			0.09 (.01)	

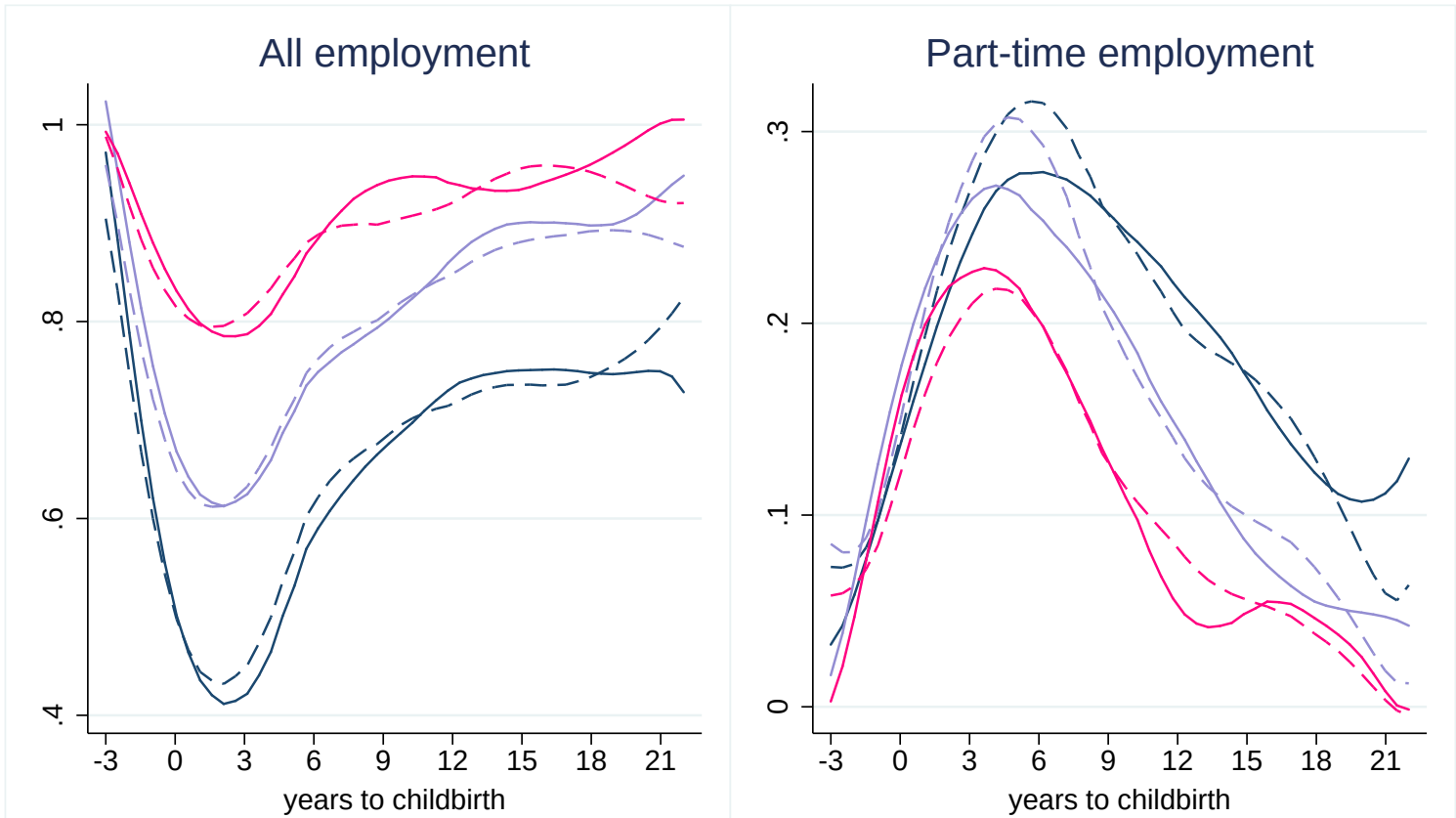
Notes: Table with full interactions available on request.

Model fit: distribution of wages

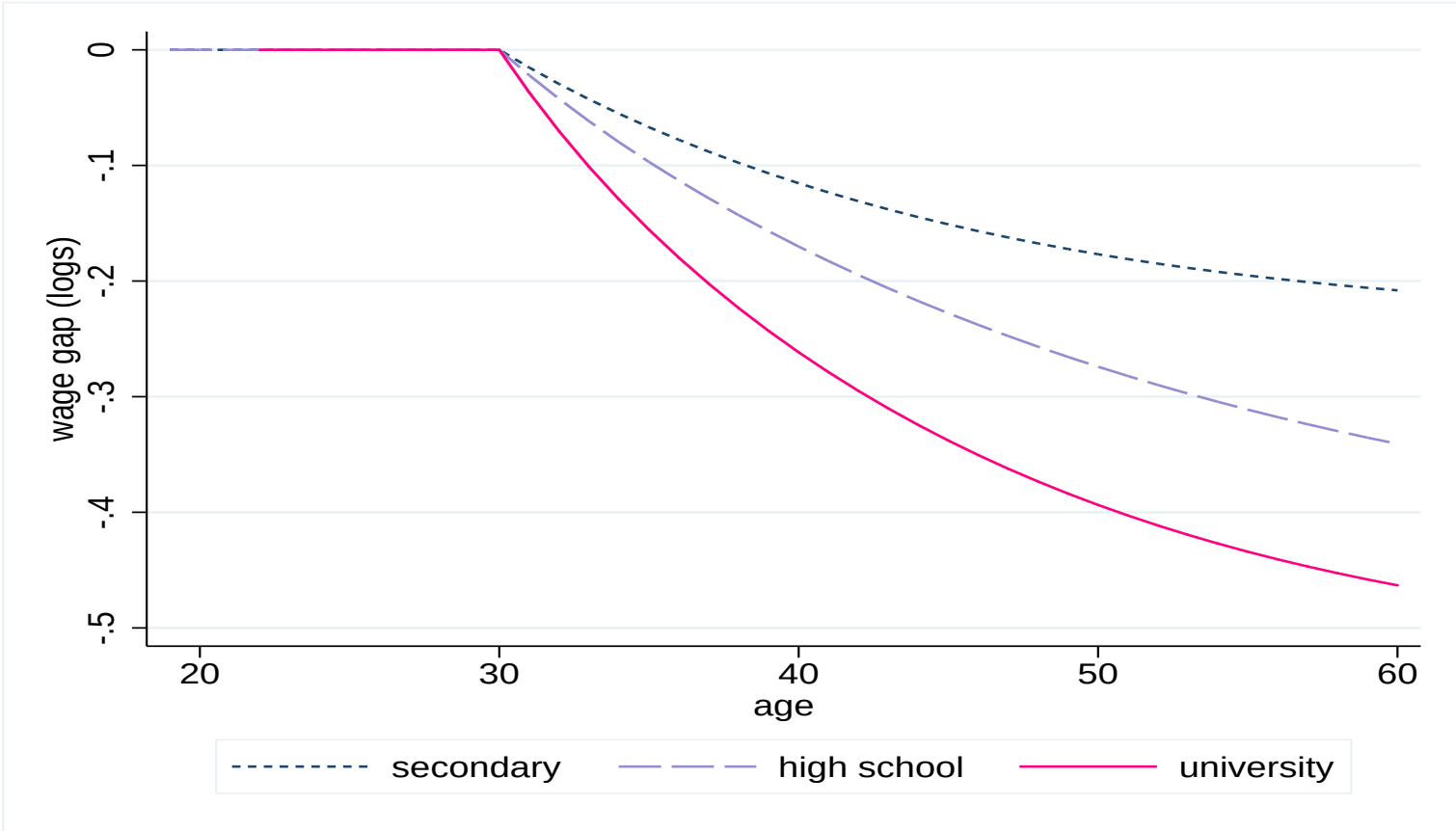
Distribution of female wage rates by age



Employment of mothers



Implication for Part-time Experience Penalty



Counterfactual Policy Simulations

Table: Introducing WFTC

	Pre-reform education					
	Secondary		High School		University	
	(a) Impact on Employment: Mothers of Dependent Children (0-18)					
	Single	Married	Single	Married	Single	Married
All (pp)	20.4	-6.6	14.9	-3.6	5.5	-1.0
Full-time(pp)	9.3	-3.6	6.5	-2.4	-2.1	-1.1
Part-time(pp)	11.1	-3.0	8.4	-1.2	6.6	0.1
	(b) Impact on Employment: Mothers of Adult Children (19+)					
All (pp)	0.4		0.3		0.0	
	(c) Impact on Education					
Education (pp)	0.54		-0.19		-0.16	

Reform is revenue neutral by adjusting the income tax rate.

See BCMS for DiD comparisons for 1999 reform.