A lifetime perspective on the distributional aspects of the tax system

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Motivation

- Transfer systems aim to reduce inequality
  - Tax reforms often motivated by will to shift tax burden
  - While minimising efficiency costs

- Inequality typically viewed from a static annual perspective
  - Different in nature from lifetime inequality
  - Mixes predictable lifecycle changes, decisions motivated by dynamic considerations and transitory shocks with true permanent individual differences
  - Inequality exacerbated when viewed from annual snapshot

Motivation

- Common practice: tax design and assessment relies on annual descriptions of behaviour and income distribution
  - May shift attention from those most in need
  - Distortions in the value of certain actions like labour supply or education mismeasured as these are (partly) driven by dynamic considerations
  - Confounds redistribution across individuals with individual transfers across periods of the lifecycle

- The redistribution and efficiency effects of a policy may look different from a LC perspective
  - Depending on whether it tackles permanent differences between individuals
  - And whether it has long-lasting effects

Motivation

- Moreover most assessments of tax reforms take isolated view of an instrument
  - Impacts may depend on the overall tax system
  - With interactions happening contemporaneously and over the life-cycle

- Consequences for welfare analysis
  - Role of public insurance
  - Redistribution assessed on the basis of life snapshots
  - Limited interaction between policy instruments affecting different stages of LC
  - Disregard for anticipation behaviour

Literature

- Inter vs intra personal transfers implied by the tax system
  - Most empirical studies find that a large proportion of the taxes levied in modern social transfer systems end up redistributing income across life-cycle periods

    (Bovenberg et al., 2008; O'Donoghue, 2001)
  - But some studies excluding retirement transfers conclude that most redistribution is interpersonal (van de Ven, 2005)

- The impact of transfers systems on income distribution
  - Simulation studies find that lifetime inequality is larger than annual inequality while modern tax systems do reduce lifetime inequality but to a less extent than annual inequality

    (Liebman, 2002, Bjorklund and Palme, 1997)

- Annual versus lifecycle tax progressivity
  - Annual progressivity higher than lifetime progressivity

    (Bengtsson et al., 2011)

Literature

- Potential efficiency gains in exploring dynamic links in individual decisions or making the transfer system dependent on age

  (Fennel and Stark, 2006, Weinzierl, 2010, Bovenberg et al., 2008, Laroque, 2009)

- Dynamic links in individual behaviour rarely explicitly considered in the (empirical) study of welfare system

  (Haan et al., 2010)

- Transfer system seldom considered as such when assessing the impact of specific reforms

  (Mirrlees Review; Blundell and Shephard, 2009; Bovenberg and Jacobs, 2005)

Some questions

- How redistributive is the UK taransfer system from an annual and lifetime perspectives? How progressive is it?
- What are the effects of tax reforms over the 90s and 00s on tax progressivity and inequality?
- How much of these changes are due to behavioural responses to incentives?
- What are the main sources of lifetime inequality (innate differences, education, earnings process)?
- How does the transfer system change the importance of these sources of inequality?
- What are the implied levels of redistribution and insurance of the UK tax system and how did they change over time?

What we do

- Develop a simulation model of the UK tax system including personal taxation and benefits
  - Focus on earned income
  - Analysis relevant for the bottom 90%-95% of the population
  - Exclude retirement pensions: education and working life
  - Include tax reforms occurying between 1991 to 2006

- Combine the tax simulation model with a lifecycle model of women educational choices and labour supply
  - Exogenous family formation
  - Focus on women, for whom behavioural responses more important
  - But consider distributional and incentives questions from a family perspective (where a woman is present)

What we do

- After estimation, use simulations of lifecycle profiles to measure lifetime and annual inequality and how the tax system affects it
  - Tax progressity and how it changed over time
  - Inequality in equivalised income and its sources
  - Changes in inequality induced by tax reforms if they were to affect individuals throughout their lives
  - Compare lifetime and annual measures of inequality

UK personal tax system

- Microsimulation model includes information on
  - Earnings taxation, social insurance and local taxes
  - Personal benefits including income support, unemployment insurance, tax credits, housing and council tax benefits, child benefits
- Most significant reforms over this period:
  - 1999 reform: FC replaced by WFTC
    - More generous maximum award
    - Higher earnings threshold
    - Lower withdrawal rate
    - Subsidy for childcare expenditure (instead of earnings disregard)
  - 2003 reform: WFTC (and other bits) replaced by WTC and CTC
    - Many of poorest households better off
    - Families without children eligible for WTC
    - Support extended further up income distribution
- Both reforms increased number of families entitled and generosity

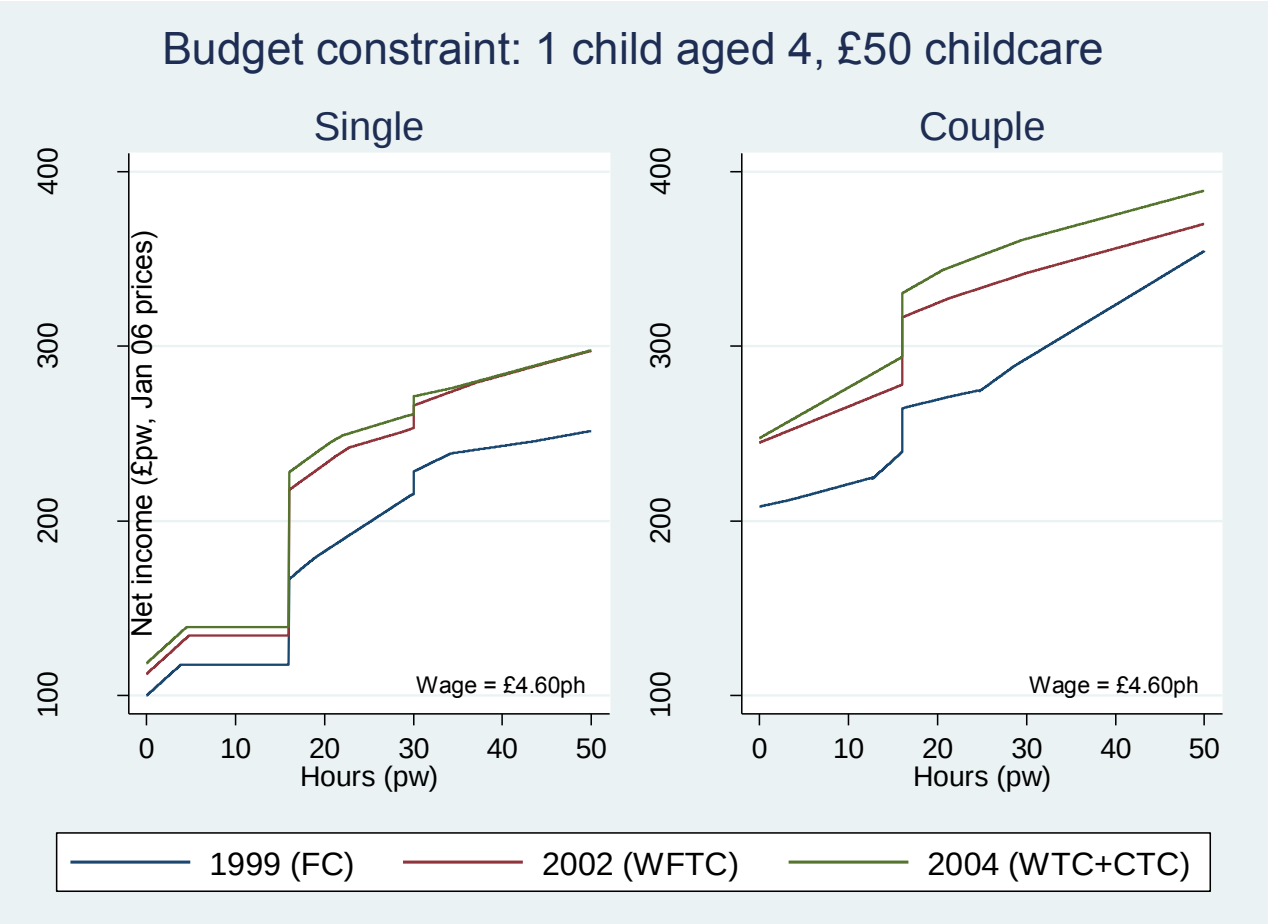
Uk personal tax system: tax credit award
couple or lone parent with one child (aged 4)

£ per week, nominal terms

	April 1999 (FC)	April 2002 (WFTC)	April 2004 (WTC and CTC)
Basic award	£64.95	£88.95	£131.82
30-hour premium	£11.05	£11.65	£12.31
Earnings threshold	£80.65	£94.50	£97.31 and £961.54
Taper rate	70% of net earnings	55% of net earnings	37% and 6.67% of gross earnings
Help with childcare	Disregard up to £60 childcare expenses	Maximum award increased by 70% of childcare expenses up to £135	Maximum award increased by 70% of childcare expenses up to £135

Note: Families with children are eligible if **at least one** adult works 16+ hours. Help with childcare requires **all** adults to work 16+ hours. The increase in generosity between WFTC and WTC/CTC is exaggerated because the reform also incorporated elements of other benefits.

Uk personal tax ssystem: tax credit reforms



Existing empirical evidence on effects of tax credits

- Perceived to effectively move unskilled workers with high working costs into work and out of poverty

- Empirical evidence for the UK: 1999 WFTC reform
  - employment rates among lone parents may have increased by 2 to 7% (Brewer et al., 2006; Blundell et al, 2004; Francesconi and van der Klaauw, 2004)
  - Other groups may have benefited by less: +0.6% in couples with one earner and -0.2% in couples with 2 earners (Brewer et al., 2006)

- Empirical evidence for the US: 1998 EITC reform
  - 3 to 4% increase in employment rates among unskilled lone parents (Eissa and Liebman, 1996; Liebman, 1998; Meyer and Rosenbaum, 2000)
  - small negative effects on employment rates of second earner in couples (Eissa and Hoynes, 2004)

- SSP in Canada: +ve effects on job takeup of welfare recipients

  (Card and Robins, 2005; Michalopoulos, 2002)

The model: overview

- Life-cycle model of female human capital, employment and savings withe exogeneous family formation

- Education and working life in three stages
  - Early years, up to 22: investments in education
    - Three possible levels: below A-levels, A-levels or vocational, university degree
  - Working life: from moment leaves education till retirement
    - Absorbing state
    - Three labour supply points: unemployment, part-time and full-time employment
    - Human capital accumulates while working but depreciates with age
  - Retirement: happens deterministically at the age of 60

The model: overview (2)

- Dynamic links
  - Family and working life run in parallel: family composition changes stochastically
  - Human capital formation happens during course of life, with education, on the job learning and depreciation
  - Productivity (health) is a persistent process
- Other features
  - Heterogeneity and heterogeneous preferences
  - Income risk and risk aversion (Low, Meghir and Pistaferri, 2008)
    - Savings and human capital as private insurance vehicles
    - Role of public policy in mutualising risk
  - Credit constraints
  - Detailed policy environment
- X: state space

  Family composition (male and child), female education, human capital, productivity and preferences, tax schedule and prices

The model: family composition

- Exogenous family formation
- Child
  - Characterised by age, a^k
  - 1 child model: Arrives to a women with probabillity $p^k(X)$ where X includes age of youngest child in household; it is assumed tha only the age of the youngest child is relevant for the decision process
  - And depart with certainty when 18
- Males
  - Characterised by (s^m, l^m, w^m): education, employment status and earnings
  - New couple with male of education s^m formed at rate $p_0(s^m; X)$
  - On-going couple dissolution: $p_1(s^m, X)$

The model: family earnings income (1)

- Male's employment and earnings: reduced form selection model
- Employment selection

$$l_{ia}^{m} = \begin{cases} 40 * 1\left(\varepsilon_{ia} > H_0(a, s_i^m)\right) & \text{new couples} \\ 40 * 1\left(\varepsilon_{ia} > H_1(a, s_i^m, l_{ia-1}^m)\right) & \text{ongoing couples} \end{cases}$$

- And earnings

$$\ln w_{ia}^{m} = \ln W_{s^m}^{m} + \alpha_{s^m}^{m} \ln\left(h(a)\right) + v_{s^m ia}^{m}$$

$$v_{s^m ia}^{m} = v_{s^m ia-1}^{m} + u_{s^m ia}^{m} \qquad \text{in ongoing couples}$$

$$u_{s^m ia}^{m} \sim N(0, \sigma_{u,s^m}^{2})$$

$$v_{s^m ia}^{m} \sim N(0, \sigma_{v,s^m}^{2}) \qquad \text{in new couples}$$

The model: family earnings income (2)

- Female's employment: endogenous
- Female's earnings and human capital after leaving education

$$w_{sia} = \ln W_s + \alpha_s \ln(e_{ia} + 1) + v_{sia}$$

$$e_{ia+1} = e_{ia}(1 - \delta_{sU} 1(l_{ia} = 0) + \delta_{sP} 1(l_{ia} = 20) + \delta_{sF} 1(l_{ia} = 40)$$

$$v_{sia} = \rho v_{sia-1} + u_{sia}$$

  - w: female earnings
  - W_s: market wage for skills (education) s
  - e: working experience
  - l: hours of work (0,20,40)
  - (v,u): persistent productivity and innovation

The model: budget constraint after education

$$k_{ia+1} = Rk_{ia} + y_{ia} - c_{ia}$$

$$y_{ia} = l_{ia}w_{ia} + d_{ia}^{m} l_{ia}^{m} w_{ia}^{m} - T(X_{ia}) - C_{ia}\left(a_{ia}^{k}\right)$$

$$k_{ia+1} \geq min\{0, Rk_{ia}\}$$

$$k_A \geq 0$$

- *k*: savings
- *y*: total household income
- (d^m,s^m,l^m,w^m): partner information
- *T*: tax/benefit schedule
- *C*: childcare costs

The model: utility after education

- Women choose consumption and employment to maximise lifetime utility
  - Subject to the budget constraint and dynamics of state variables
  - As well as terminal conditions

$$U(c_{ia}, l_{ia}; X_{ia}) = \frac{\left(c_{ia}/n_{ia}\right)^{\mu}}{\mu} e^{\left(\hat{U}\left(l_{ia}, d^{m}_{ia}, l^{m}_{ia}, d^{k}_{ia}, d^{k}_{ia}\right) + \theta_i(l_{ia})\right)}$$

$$V_a(X_{ia}) = \max_{[c,l]_{a,\ldots,A}} E\left\{\sum_{\alpha=a}^{A} \beta^{\alpha-a}\, U(c_{i\alpha}, l_{i\alpha}; X_{i\alpha}) \middle| X_{ia}\right\}$$

  - X: state space, including prices, observed and unobserved characteristics
  - (c,l): decision variables – consumption and labour supply
  - n: equivalence scale for family dimension
  - Θ: unobserved heterogeneity in tastes for working (correlated with initial productivity)
  - β: discount rate

The model: education decisions

- Education investments decided at 17 on expected life time utility

  Depending on personal tastes, assets, parents 'assets and its cost

- Working life: starts at 19 (low/medium education) or 22 (university)

$$U(c_{ia}, l_{ia} = S; X_{ia}) = \frac{c_{ia}^{\mu}}{\mu} e^{\left(\bar{U}(l_{ia}=S,0,0,0,0)+\theta_i(l_{ia}=S)\right)}$$

$$V_s(X_{i,17}) = \max_{[c,l]_{19,\dots,A}} \mathrm{E}\left(\sum_{a=19}^{A} \beta^{a-a_s} U(c_{ia}, l_{ia}; X_{ia}) \middle| X_{i,17} \right) + \omega_{si}$$

- Female finishes education single with no children
- Draws her idiosyncratic productivity from taste-dependent distribution
- And starts working life at age *a* with assets:

$$k_{ia} = R^{a-17}\left(k_{i,17} - \sum_{\alpha=19}^{a-1} R^{17-\alpha} c_{i\alpha} \right) - C_s\left(k_{i,17}^{p}\right) - \pi_{si}$$

Data: BHPS

Background

- The main UK household panel dataset
- Started in 1991 with around 5,500 households
- 17 waves currently available
- From 2009, part of the new ‘Understanding Society’ survey

Our dataset

- Unbalanced panel of around 5,300 females over 16 waves
  - 12% observed in all 16 periods
  - 56% in 6 or fewer periods
  - 17% observed leaving education and entering working life
- Labour market outcomes during working life, income information, detailed demographics, limited assets information

Estimation

- Use multi-step procedure
  - Calibrate interest and discount rates, intertemporal preferences parameter
  - Estimate exogenous parameters outside structural model
    - Family transitions
    - Childcare costs
    - Male's employment selection model
  - For all other parameters use indirect inference
    (Smith, 1990, Gourieroux, Monfort and Renault, 1993, De Nardi, French and Jones, 2008, Guneven and Smith, 2008)

- Lengthy procedure: not final estimates yet
  - Explore policy changes
  - Use data moments over 200 moments, mostly education-specific:

    employment rates and hours of work by family characteristics, transition rates by past earnings, earnings regressions and process of earnings residuals, moments for distribution of earnings by working hours, change in earnings by past employment status, moments for distribution of initial earnings, distribution of education, proportion familiespaying for formal childcare

Estimation: distributional assumptions

- Fully parametric specification
- Familiy composition: uniformly distributed shocks
- Unobserved heterogeneity in preferences (θ): discrete, two point distribution (θ_1, θ_2, p)
- Productivity level and innovation: normally distributed conditional on education and preferences (θ,s)
- Unobserved preferences for education (in excess of θ): normal distribution
- Males productivity and selection into work: joint normal distribbution conditional on males' education

Estimates: females earnings

	educ=1	educ=2	educ=3
wage rates	4.38	4.84	6.23
returns to experience	0.14	0.24	0.27
persistence of productivity	0.95	0.95	0.92
se productivity innovation	0.12	0.13	0.11
mean deviation initial earnings (theta=1)	0.06	0.07	0.19
se initial productivity	0.30	0.29	0.27
accumulation experience while on PTE	0.12	0.15	0.13
depreciation rate	0.10	0.10	0.10

Estimates: males earnings and employment

	Below A-levels	A-levels and vocational	University
Wage rates (logs) (female aged 19)	1.792 (0.133)	1.865 (0.138)	2.033 (0.139)
Returns to experience (ln(a))	0.242 (0.087)	0.422 (0.086)	0.689 (0.132)
SE innovation productivity	0.184 (0.009)	0.146 (0.008)	0.095 (0.015)
SE initial productivity	0.192 (0.072)	0.192 (0.072)	0.192 (0.072)

Estimates: utility function

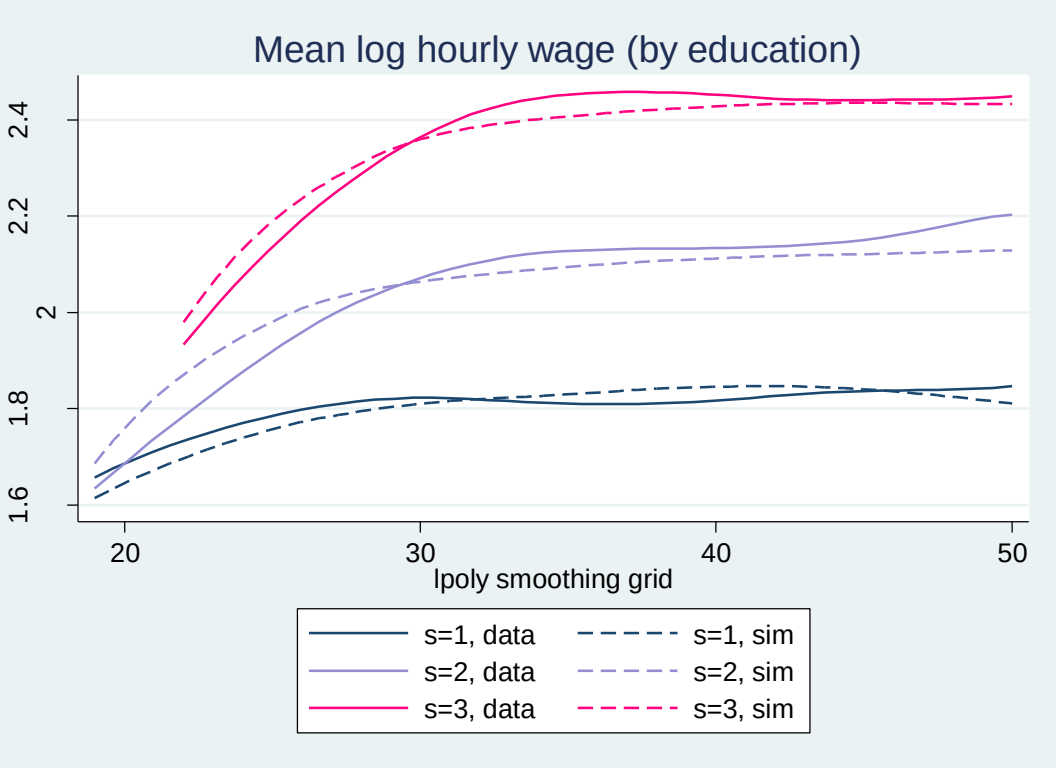
	all work	PTE
low education	-0.01	0.02
medium education	-0.01	0.01
kids * low education	0.00	0.00
kids * medium education	-0.02	0.02
kids * high education	0.04	-0.02
kid 0-2	0.10	-0.07
kid 3-5	0.03	-0.05
kid 6-10	-0.03	0.01
kid 11-18	-0.11	0.06
male	-0.02	0.01
working male	-0.13	0.08

Estimates: other parameters

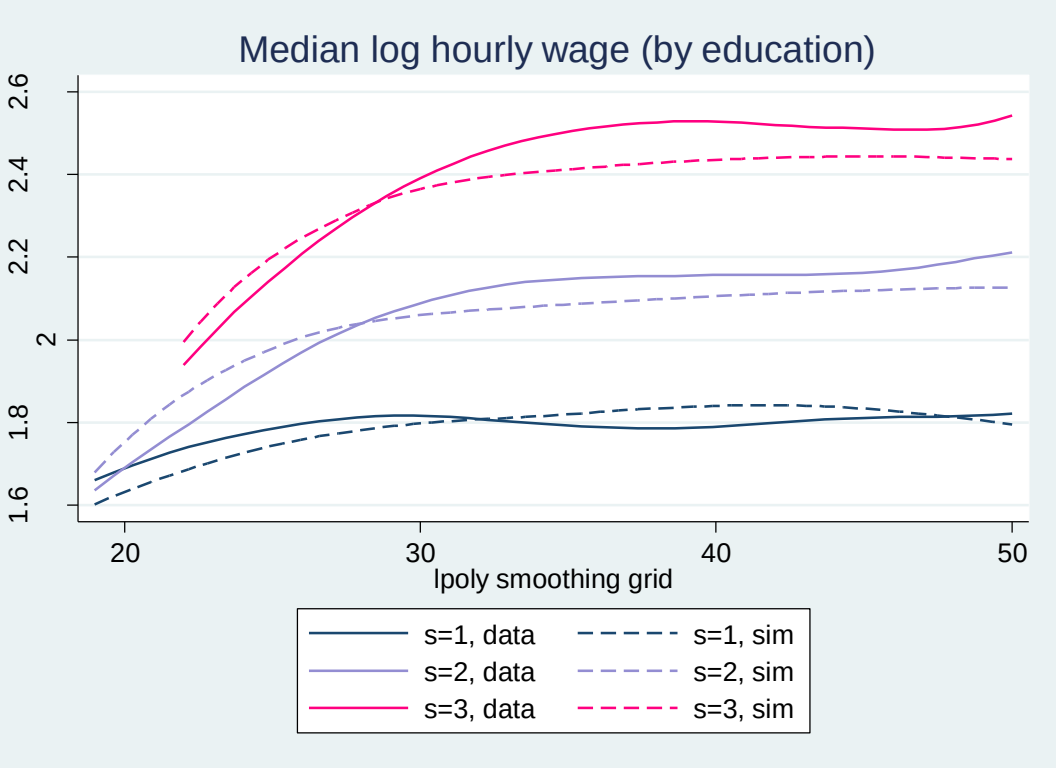
	type 1	type 2
preference (distaste) for PTE	0.16	0.26
preference (distaste) for FTE	0.33	0.60
mass of type 1	0.51	

	mean	se
Preference for medium education	-0.06	1.16
Preference for high education	1.36	1.12
Probability positive CC cost	0.46	

Model fit


Mean log hourly wage (by education)
1.6
1.8
2
2.2
2.4
20
30
40
50
lpoly smoothing grid
s=1, data
s=1, sim
s=2, data
s=2, sim
s=3, data
s=3, sim

Model fit


Median log hourly wage (by education)
2.6
2.4
2.2
2
1.8
1.6
20
30
40
50
lpoly smoothing grid
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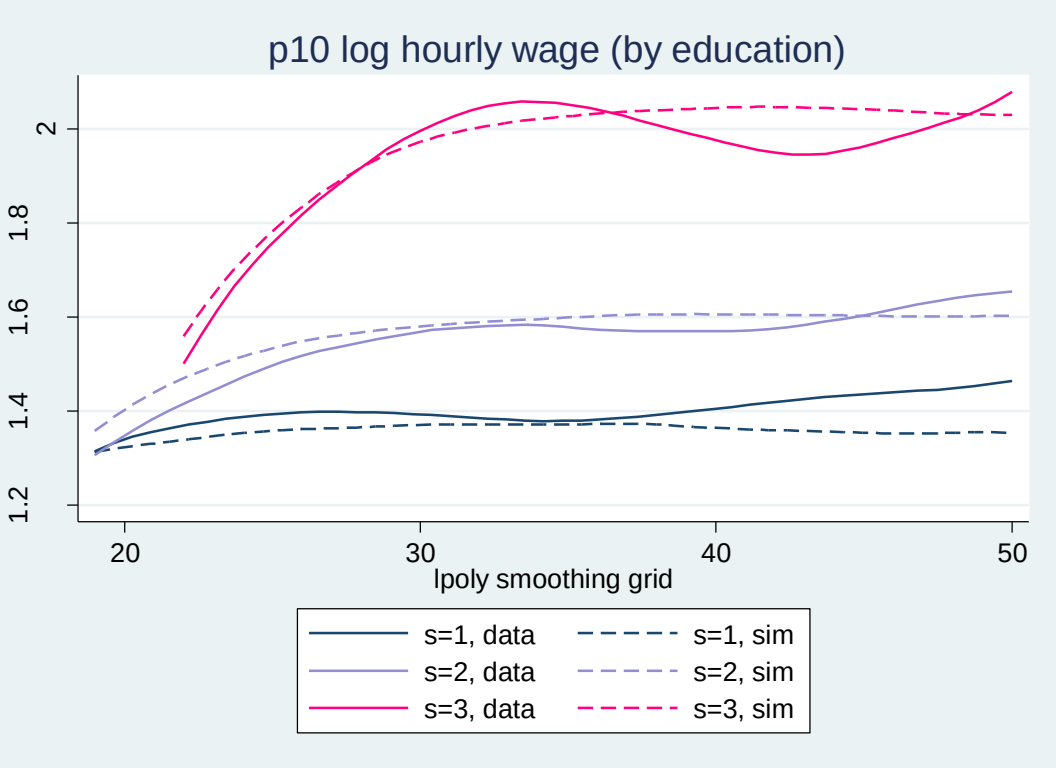
s=2, data
s=2, sim
s=3, data
s=3, sim

Model fit


p10 log hourly wage (by education)
1.2
1.4
1.6
1.8
2
20
30
40
50
lpoly smoothing grid
s=1, data
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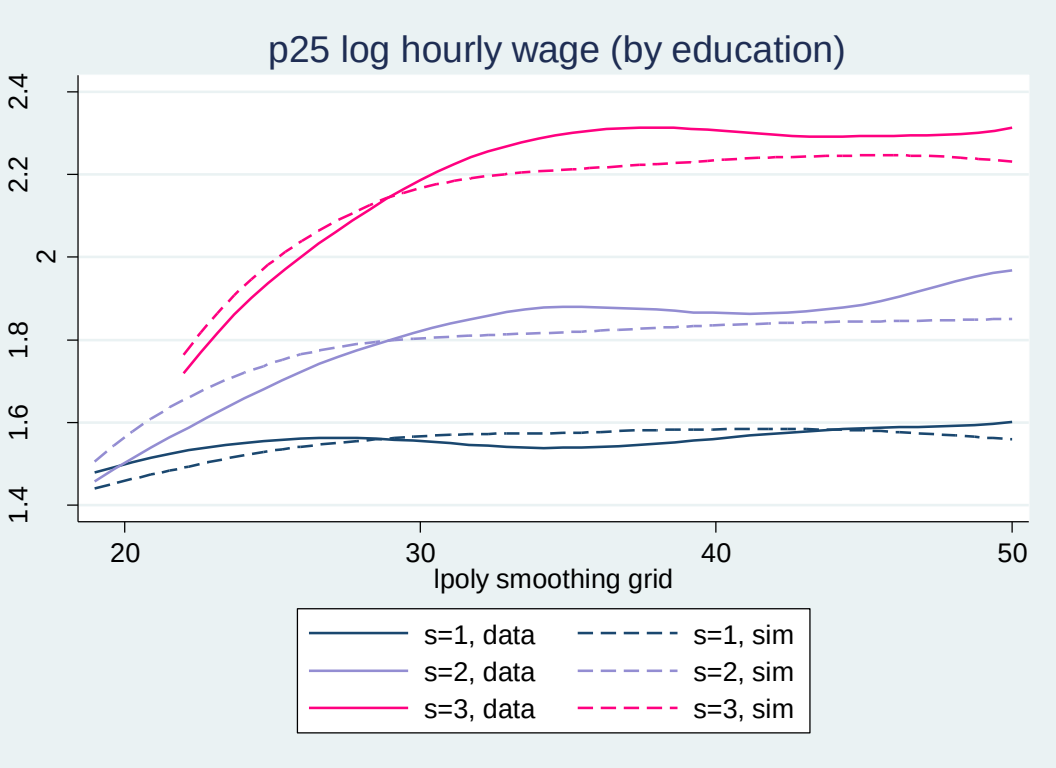
s=2, data
s=2, sim
s=3, data
s=3, sim

Model fit


p25 log hourly wage (by education)
2.4
2.2
2
1.8
1.6
1.4
20
30
40
50
lpoly smoothing grid
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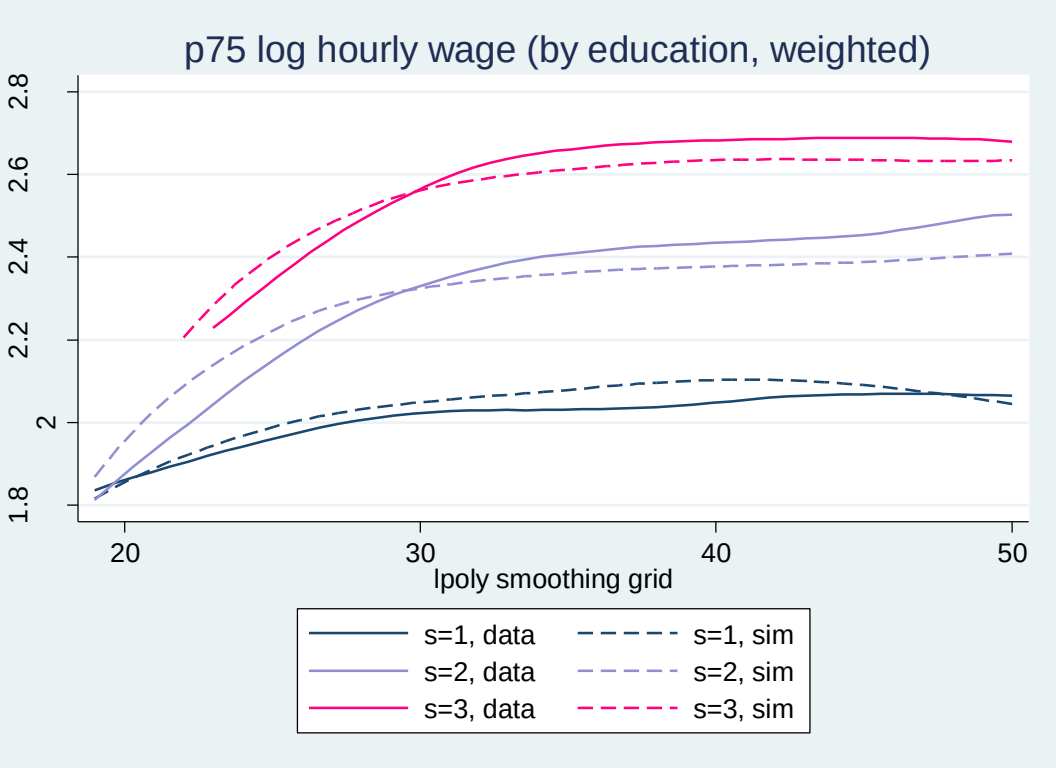
s=3, data
s=1, sim
s=2, sim
s=3, sim

Model fit


p75 log hourly wage (by education, weighted)
2.8
2.6
2.4
2.2
2
1.8
20
30
40
50
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s=3, data
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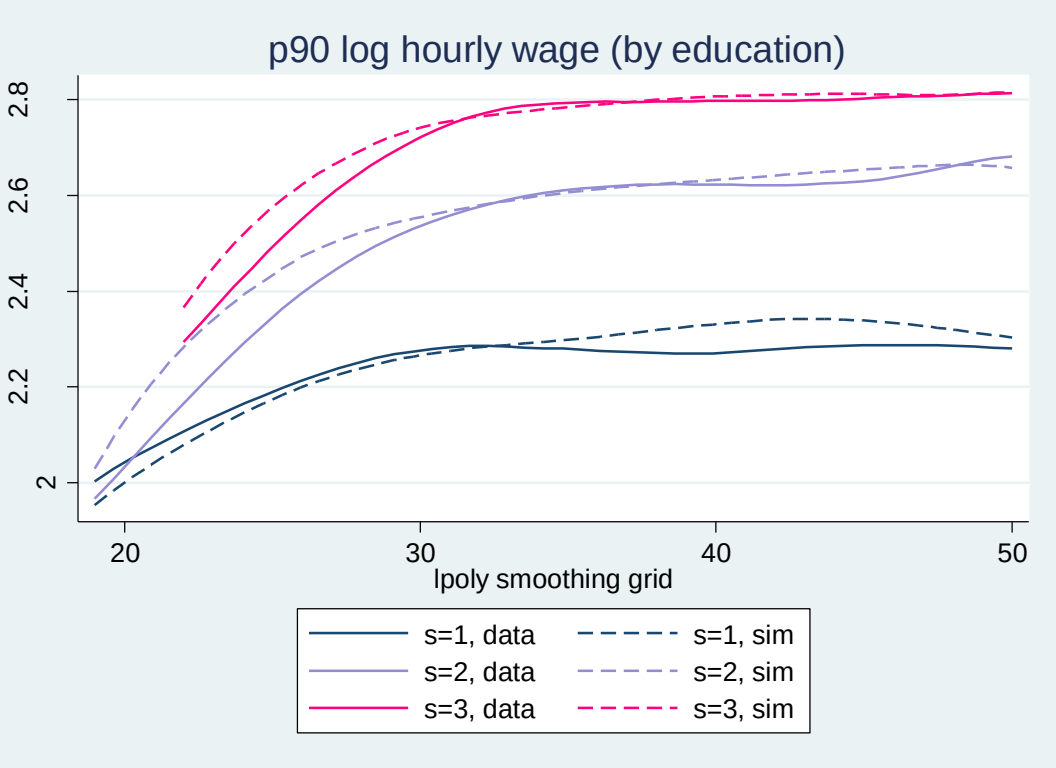
s=3, sim

Model fit


p90 log hourly wage (by education)
2
2.2
2.4
2.6
2.8
20
30
40
50
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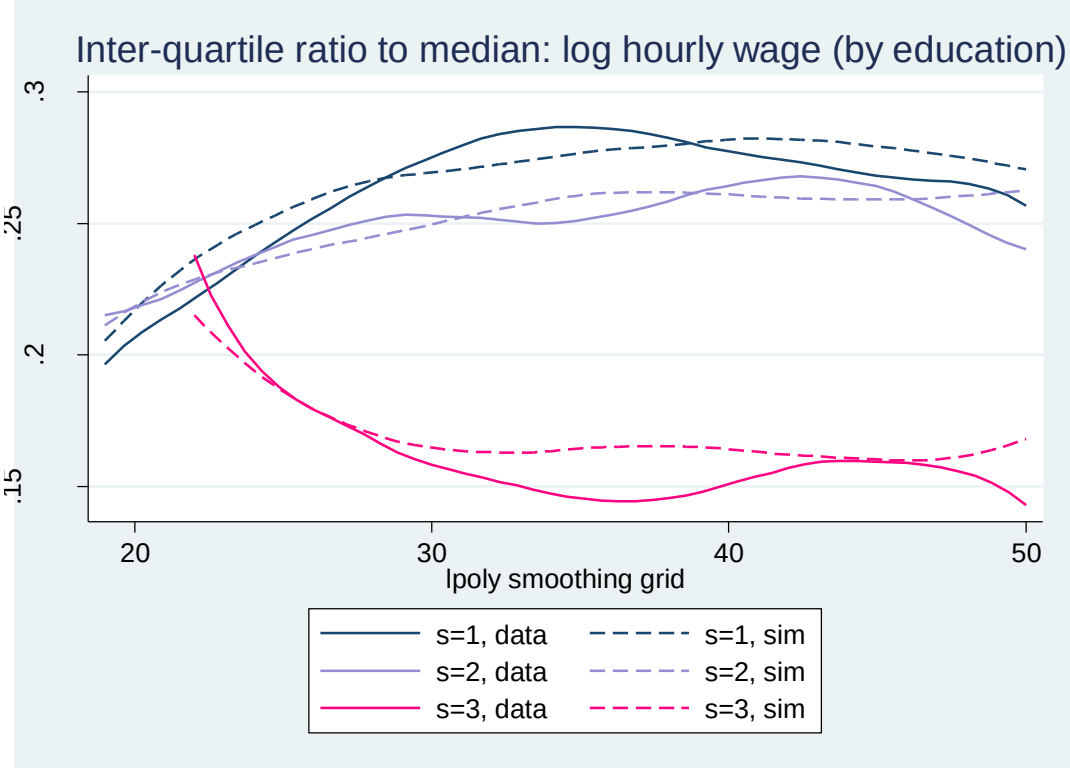
s=1, sim
s=2, sim
s=3, sim

Model fit


Inter-quartile ratio to median: log hourly wage (by education)
.15
.2
.25
.3
20
30
40
50
lpoly smoothing grid
s=1, data
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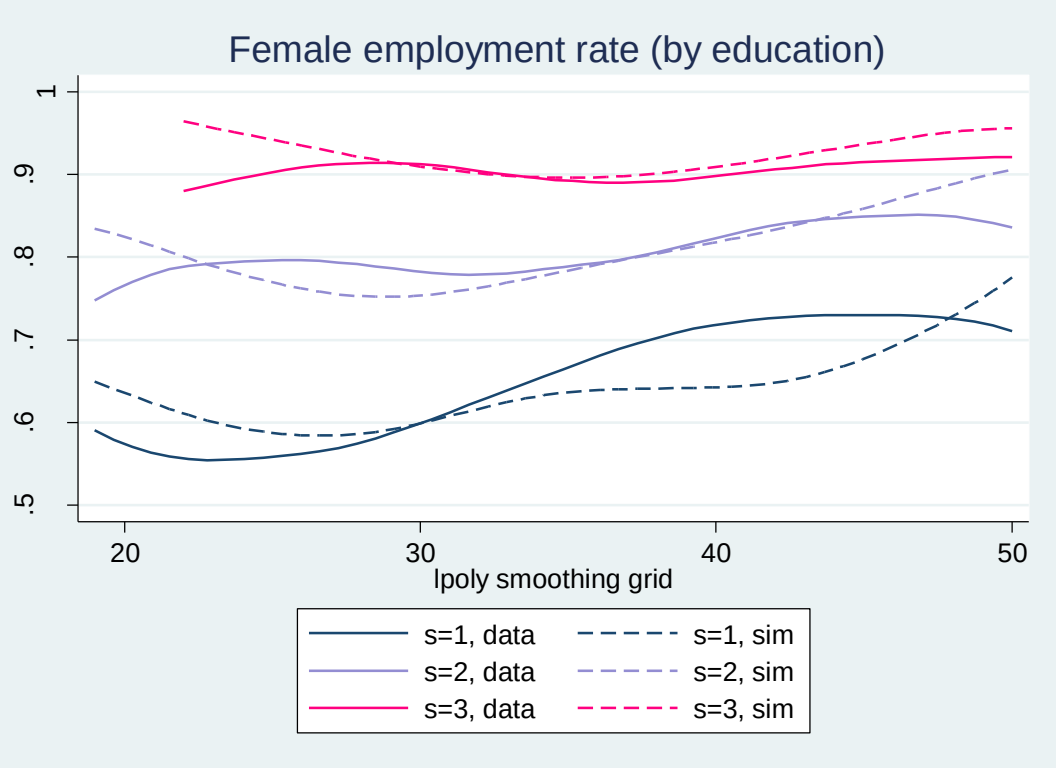
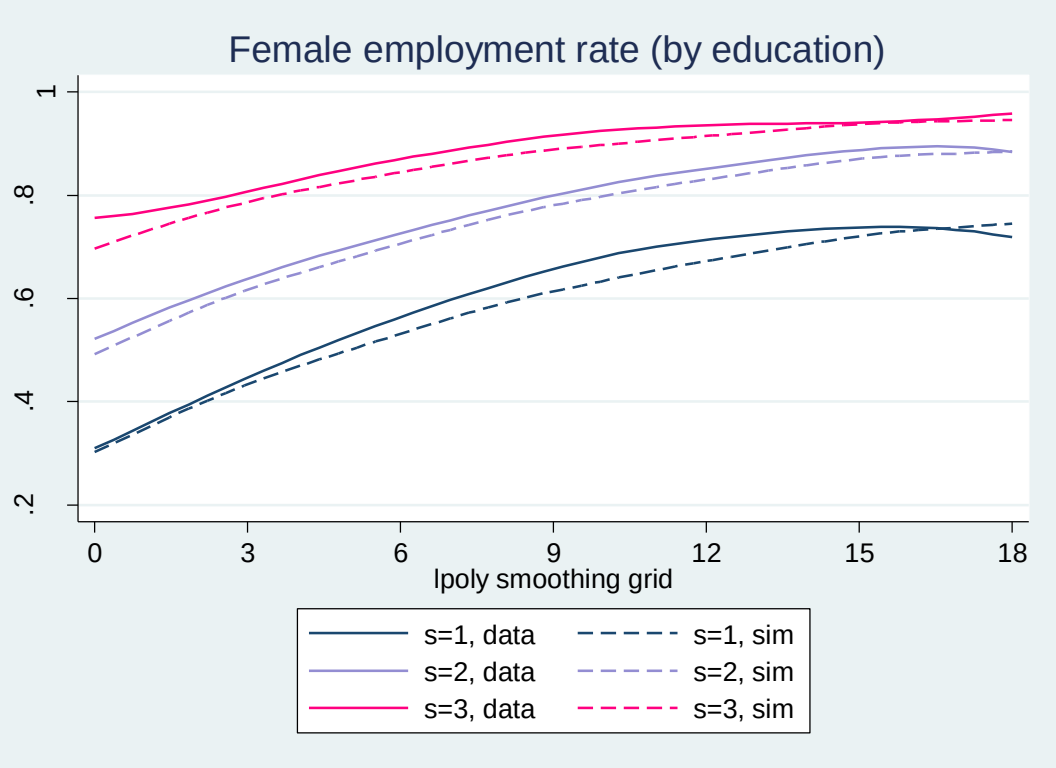
s=2, data
s=2, sim
s=3, data
s=3, sim

Model fit


Female employment rate (by education)
.5
.6
.7
.8
.9
1
20
30
40
50
lpoly smoothing grid
s=1, data
s=2, data
s=3, data
s=1, sim
s=2, sim
s=3, sim

Model fit


Female employment rate (by education)
.2
.4
.6
.8
1
0
3
6
9
12
15
18
lpoly smoothing grid
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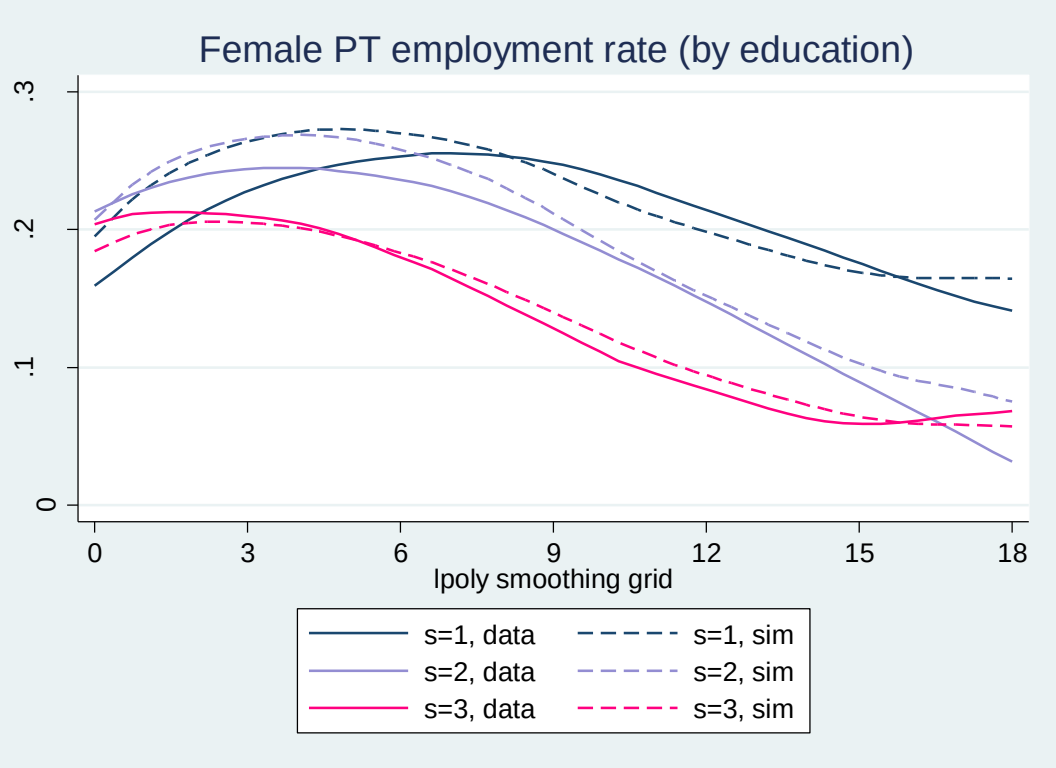
s=3, data
s=3, sim

Model fit


Female PT employment rate (by education)
0
.1
.2
.3
0
3
6
9
12
15
18
lpoly smoothing grid
s=1, data
s=1, sim
s=2, data
s=2, sim
s=3, data
s=3, sim

Model fit

Impact of WFTC reform on employment

Combined effect of WFTC and other reforms between 1999 and 2002

	Our model	BBS (2005)	FRK (2009)	BDSS (2006)
Lone mothers	+4.4%	+3.6%		+3.7%
Women in couples				
All	-2.0%		+0.7%	-0.4%
Partner working	-3.0%	-0.1%	+0.1 to +0.6%	
Partner not working	+4.1%	+2.6%	+3.1%	

BBS (2005) = Blundell, Brewer and Shephard (2005); reduced form estimate

FRK (2009) = Francesconi, rainer and van der Klaauw (2009); reduced form estimate

BDSS (2006) = Brewer, Duncan, Shephard and Suarez (2006); static structural estimate

Model fit

Table 8: Wage elasticities of labour supply: simulations of unexpected changes in wages

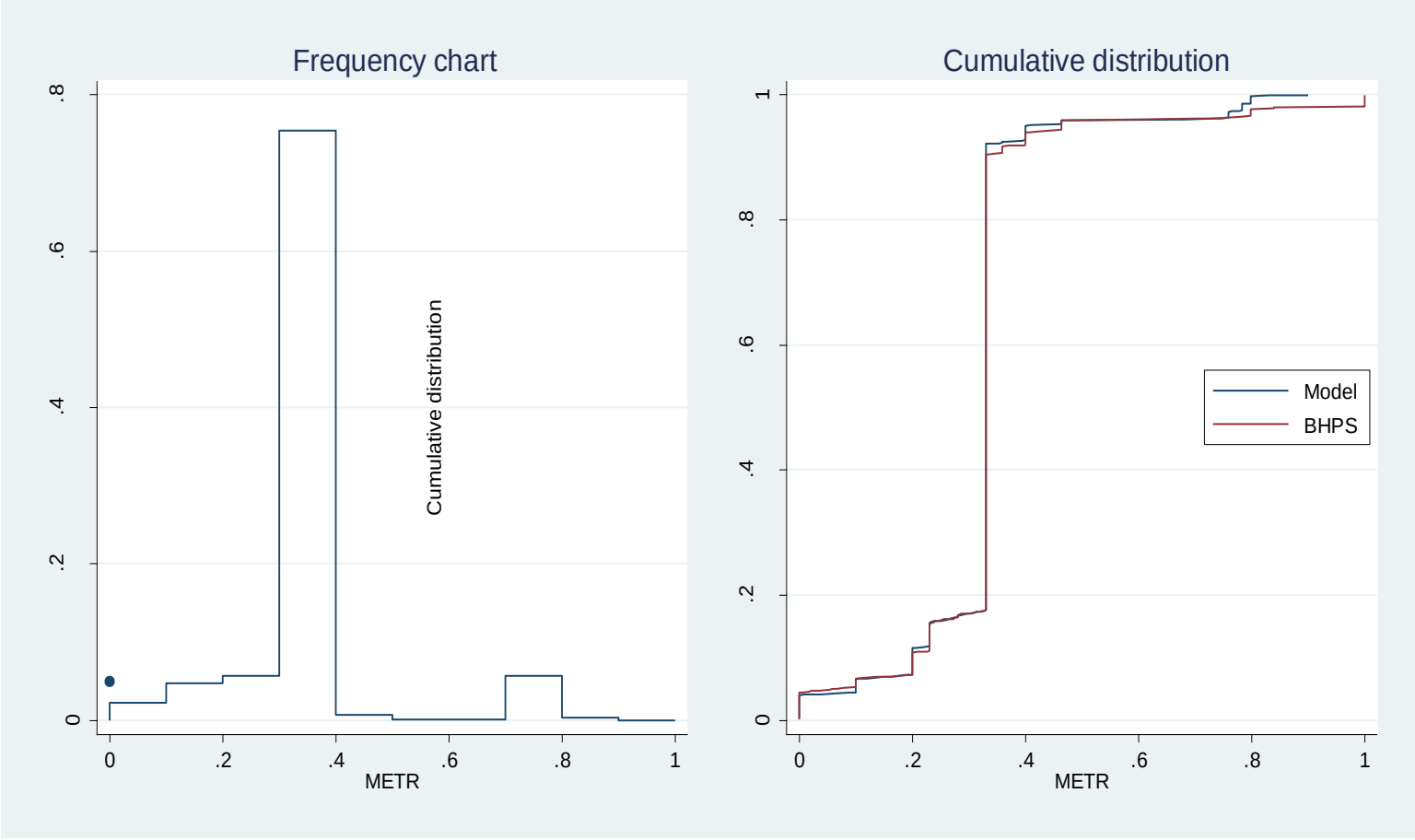
		Effect in period wage changes				LC effect	
		transitory shift		permanent shift		permanent shift	
		participation	hours	participation	hours	participation	hours
		(1)	(2)	(3)	(4)	(5)	(6)
Single women							
(1)	all	0.62	0.06	0.39	0.05	0.54	0.05
(2)	no children	0.47	0.00	0.29	0.00	0.42	-0.03
(3)	mothers	1.04	0.31	0.69	0.25	0.93	0.38
Women in couples							
(4)	all	0.53	0.42	0.47	0.19	0.26	0.25
(5)	no children	0.40	0.28	0.40	0.11	0.16	0.19
(6)	mothers	0.71	0.70	0.57	0.36	0.47	0.40
By age when wage changes							
(7)	29 or less	0.75	0.36	0.75	0.18	0.50	0.19
(8)	30 to 39	0.69	0.30	0.48	0.20	0.26	0.21
(9)	40 to 49	0.48	0.30	0.34	0.17	0.16	0.15
(10)	50 plus	0.31	0.09	0.15	0.00	0.13	0.08
(11)	all	0.57	0.27	0.44	0.18	0.34	0.18
(12)	low educated	0.93	0.50	0.73	0.21	0.46	0.19

Simulations

- Simulated life cycle decisions from age 17 till retirement at 59
- Use initial conditions (age 17) as in BHPS
- Allow for possibility of becoming mother and/or finding partner
- Simulate each individual 5 times
- Consider case without rent expenditures
- Income groups defined on equivalised income

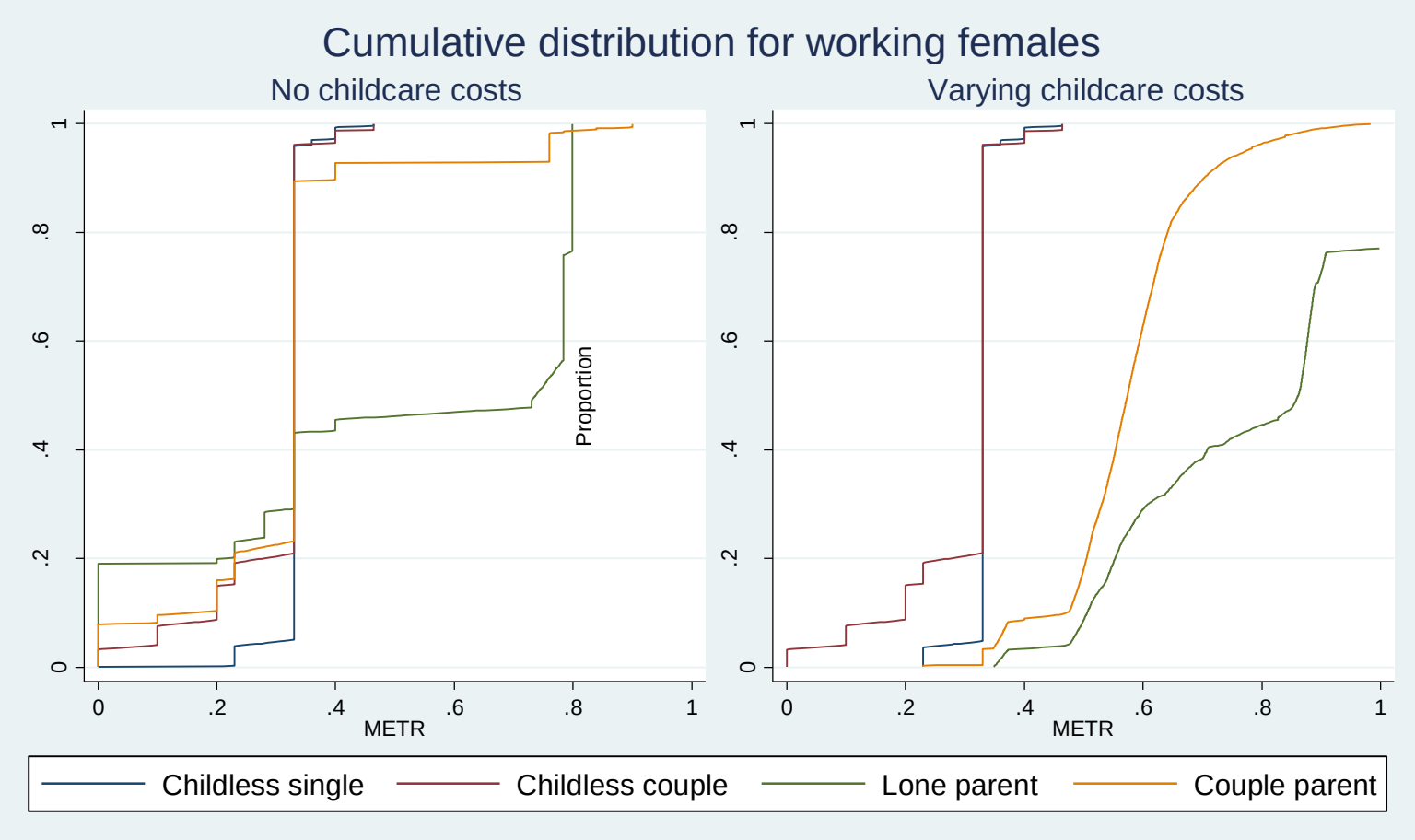
METR for working females (no childcare costs)

Model versus BHPS data



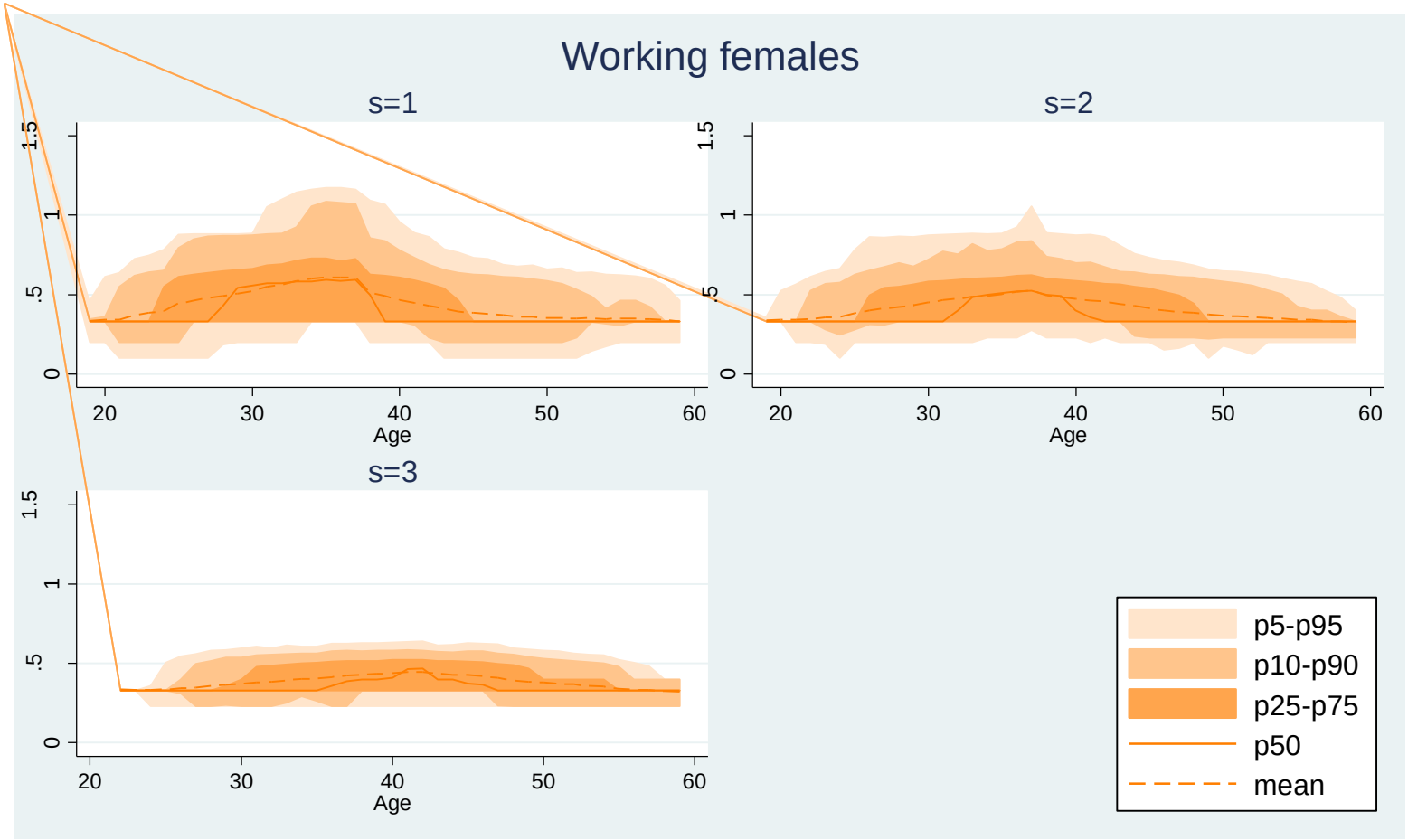
METR by family type

1999 tax system



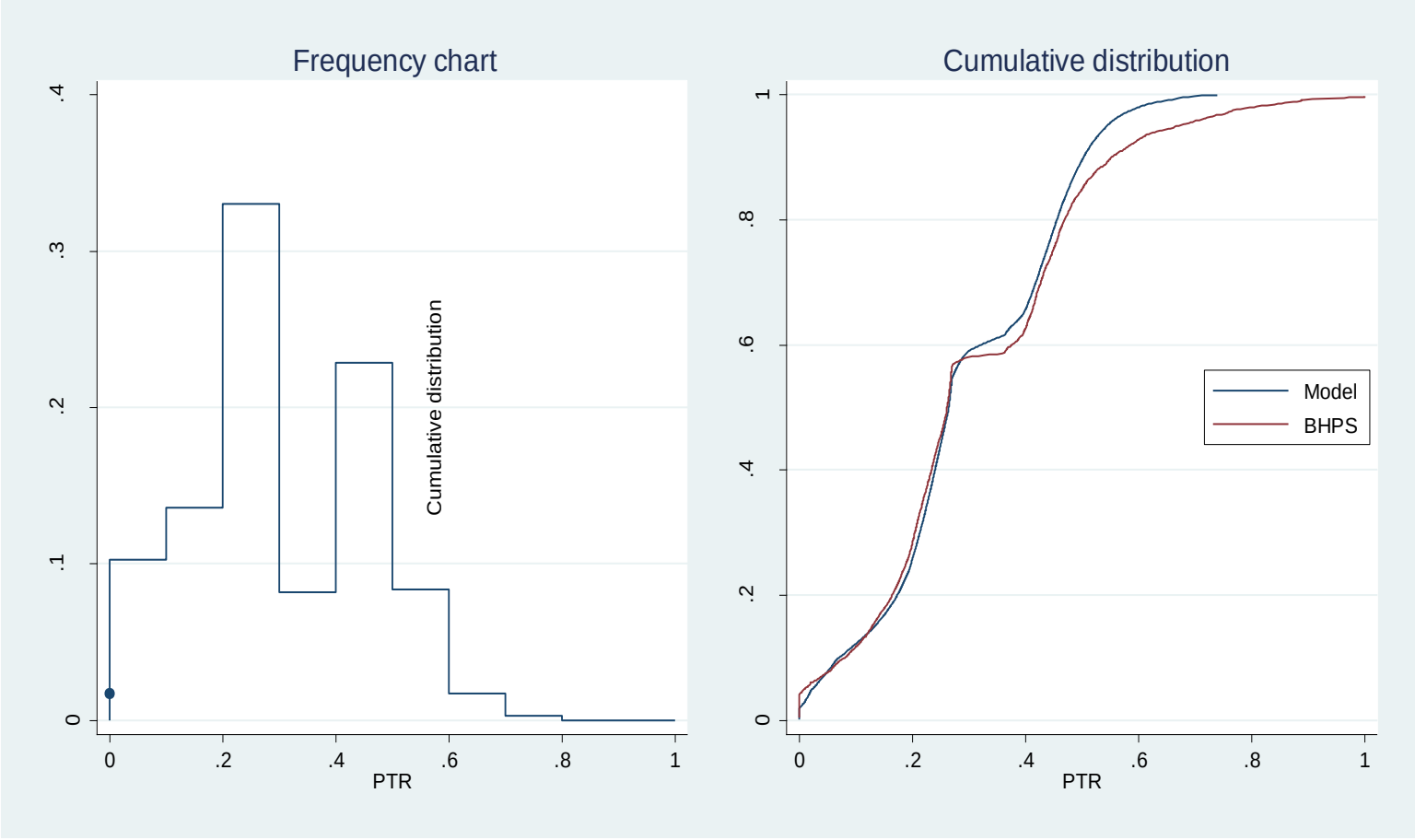
METR by age and education

Varying childcare,1999 tax system



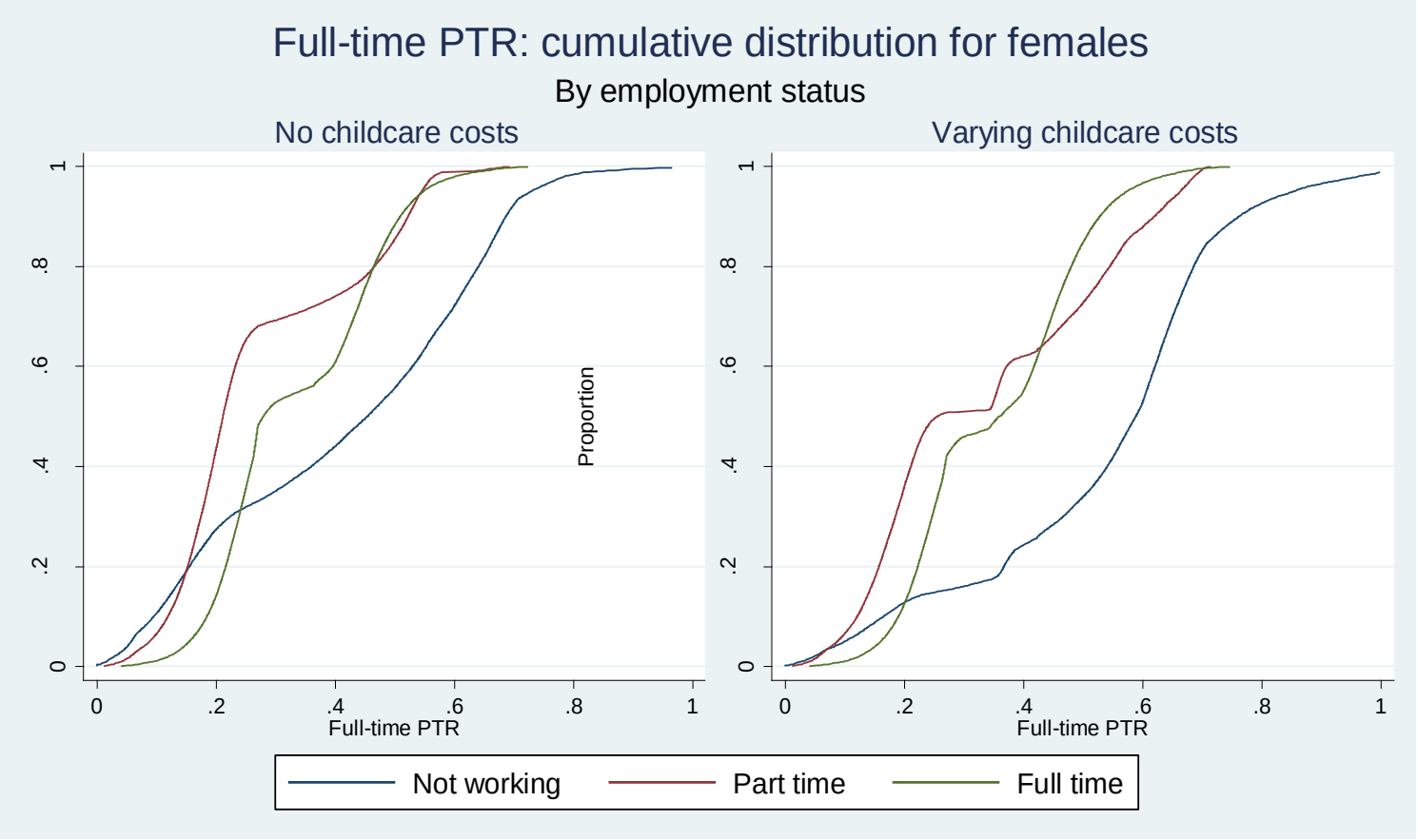
PTR for all females (no childcare costs)

Model versus BHPS data

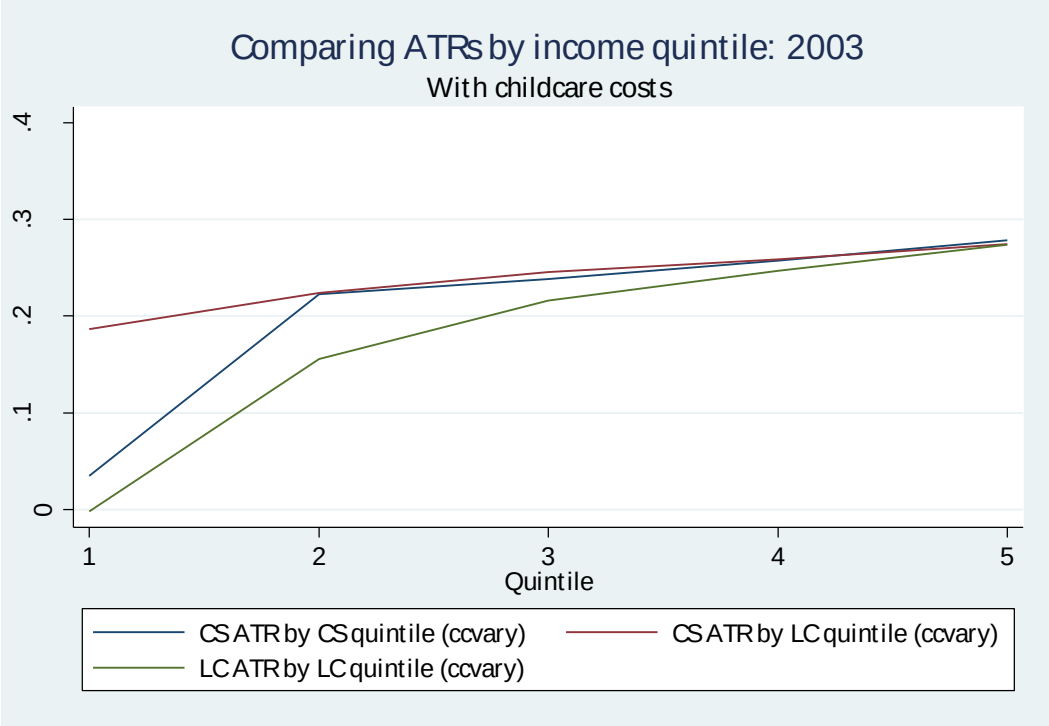


PTR by employment status: full-time work

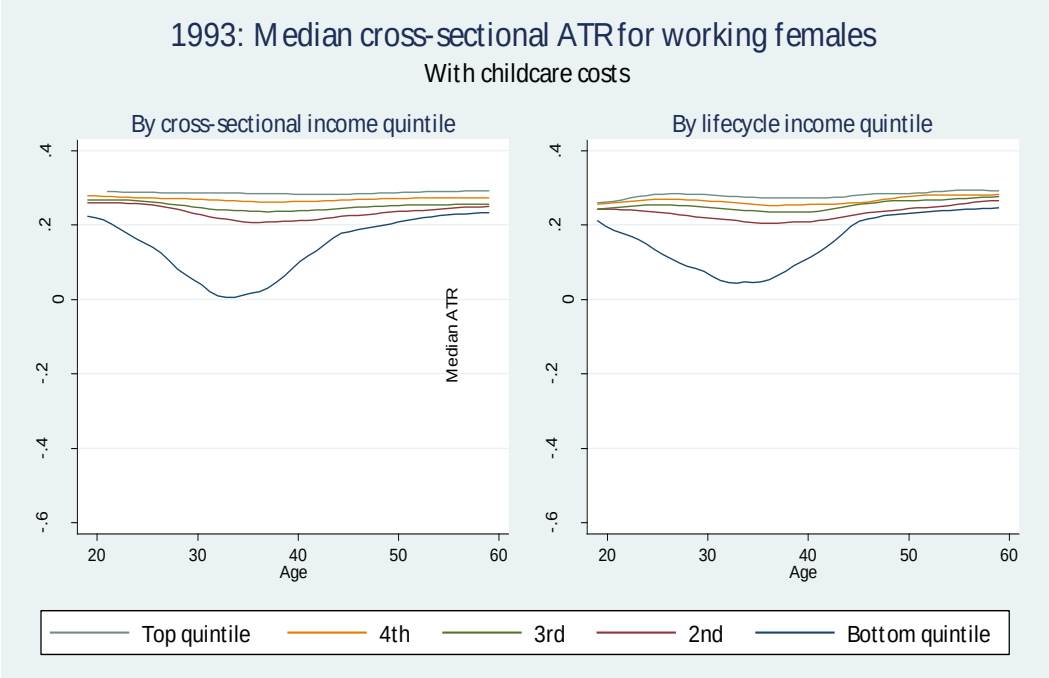
All females, 1999 tax system



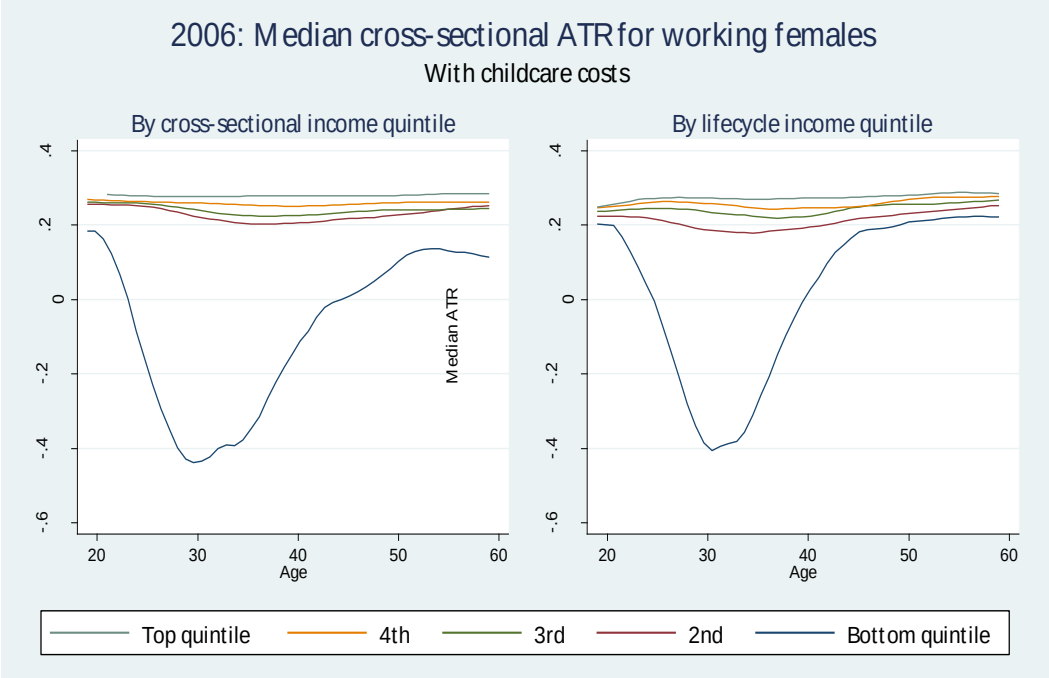
Simulations: ATR in 2003 by income quintile



Simulations: tax burden over the lifecycle by income quintile: 1993



Simulations: tax burden over the lifecycle by income quintile: 2006



Simulations: tax progressivity 1993 to 2006