

Taxes, redistribution and incentives: what changes when we take a dynamic perspective?

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Overview

- This lecture is based on two papers by Mike Brewer, Monica Costa Dias and Jonathan Shaw
 - “Lifetime inequality and redistribution” IFS WP12/23
 - “How taxes and welfare distort work incentives: static lifecycle and dynamic perspectives” IFS WP13/01
- With a lifetime perspective, we ask two questions about personal tax and benefit system:
 1. How much **redistribution** does it do?
 2. How does it affect **work incentives**?
- Recurring themes:
 - dynamics
 - choices now affect opportunities tomorrow
 - opportunities tomorrow affect choices now
 - lifecycle effects
 - opportunities change as people age, and family circumstances change
 - a lifetime perspective
 - not all poor individuals will be poor in future

Overview

- We focus on:
 - Women and their families
 - Working life (ages 19-59)
 - UK tax and benefit system
- We estimate a structural, dynamic model of women's education and labour supply
 - Women make choices over education, labour supply and savings
 - Experience gained through working
 - Evolving, but exogenous, family circumstances
 - Estimated to replicate behaviour of real individuals in Great Britain
- After estimation, use simulations of lifecycle profiles to
 - measure annual and lifetime inequality and how the tax system affects it
 - measure how taxes affect labour supply choices given static and dynamic perspectives
- We use simulated data to
 - overcome lack of long panels
 - Purge data on time and policy effects
 - Allow explicit simulation under alternative policy regimes

Motivation

- Inequality often viewed from annual perspective. This confounds:
 - true permanent individual differences
 - predictable lifecycle changes
 - decisions motivated by dynamic considerations
 - transitory shocks
- So inequality greater when viewed from annual snapshot
- Taxes based on annual income & current circumstances. This confounds:
 - redistribution across individuals
 - individual transfers across periods of the lifecycle
- May therefore shift attention from those most in need
- Most assessments of taxes take static view
 - Redistribution assessed on the basis of snapshots; ignores insurance
 - Distortionary impacts may be felt in future (if choices have future payoffs e.g. labour supply or education) or past (if individuals can anticipate) (Imai and Keane, 2004; Blundell et al, NBER w19007)

Literature (1)

- The impact of transfers systems on income distribution
 - Annual inequality is larger than lifetime inequality (e.g. Lillard, 1978; Bjorkland, 1993; Jenkins, 2010; Kopczuk et al, 2010)
 - Modern tax systems do reduce lifetime inequality but by less than they do annual inequality (Liebman, 2002; Bjorklund and Palme, 1997)
 - Annual progressivity of tax system higher than lifetime progressivity (Bengtsson et al., 2011)
- Inter vs intra personal transfers implied by the tax system
 - A large proportion of net taxes levied redistribute income across life-cycle (Bovenberg et al., 2008; O'Donoghue, 2001)
 - But if exclude retirement transfers, some conclude that most redistribution is interpersonal (van de Ven, 2005)
- Efficiency gains in making the taxes dependent on age or past choices (Fennel and Stark (2006), Weinzier (2010), Bovenberg et al. (2008), Laroque (2009))

Literature (2)

- Dynamic labour supply (with education and tax system)
 - e.g. Eckstein and Wolpin (1989), Keane and Wolpin (1997, 2010), Imai and Keane (2004), Eckstein and Lifshitz (2011), Adda et al (2011a,b)
- Work incentives in cross section
 - UK: Adam and Browne (2010); Brewer, Saez and Shephard (2010).
 - Elsewhere: Jara and Tumino (2013), OECD (various)
- Work incentives and labour supply across lifecycle
 - Evans and Eyre (2004), Evans and Williams (2009), Blundell et al (2013)

Rest of talk

- The model
- Inequality and redistribution
- Work incentives

The model: utility, constraints and uncertainty

- Women choose education, labour supply and consumption (savings) to maximise lifetime utility
 - Early years: investments in education
 - Working life: choose from not work; PT, FT
 - Human capital accumulates while working
 - family formation exogenous but stochastic
 - Retirement
- Features
 - interaction between education, labour supply and experience accumulation
 - unobserved heterogeneity in tastes for working (correlated with women's initial productivity)
 - detailed representation of UK personal tax and benefit system
 - uncertainty (over employment, wages and family composition), credit constraints and retirement generate need for savings

The model: early life

- Women “born” with random set of preferences and initial assets
- Chooses 1 of 3 levels of education to maximise expected lifetime utility given preferences for education and work, assets, and costs
 - Women can borrow to fund education
- Women finish education as single with no children, and enters labour market with productivity draw (correlated with tastes for work)

The model: family composition

- Men arrive and leave exogenously (given women's education) and stochastically
 - Rate depends on women's age & education & children
 - men's characteristics depend on women's education
- Male labour supply is stochastic; male wages depend on age, education and persistent shock
- Children arrive exogenously (given women's education) and stochastically (stork theory of childbirth...?), and leave home after 18 years

The model: female labour supply

$$\max_{\{c_\alpha, l_\alpha\}} E_\alpha \left\{ \sum_{\alpha=a}^A \beta^{\alpha-a} U(c_\alpha, l_\alpha; s, m_\alpha, l_\alpha^m, k_\alpha, a_\alpha^k, \theta_{PT}, \theta_{FT}) \mid X_a \right\}$$

- Women choose no work, part-time (20 hours/wk), full-time (40 hours/wk) given own wage and male labour supply

$$\ln y_a = \ln W_s + \gamma_s \ln(e_a + 1) + v_a$$

$$v_a = \rho_s v_{a-1} + \mu_a$$

$$e_a = e_{a-1}(1 - \delta_s) + g_s(l_a)$$

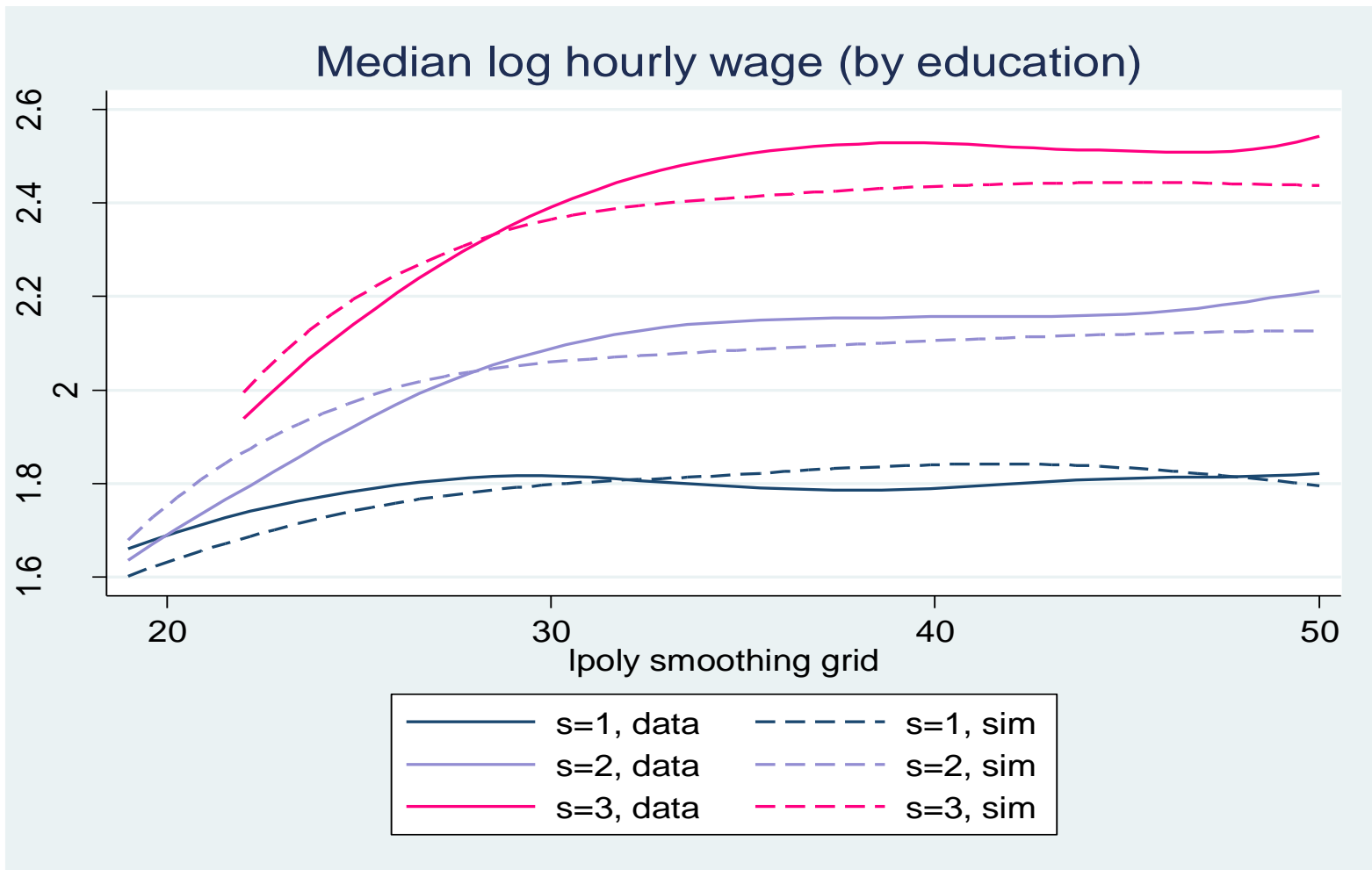
- Female wages depend on price of skill (education), accumulated experience and persistent individual shock
 - Accumulated experience depreciates if do not work, and PT work worth less than FT work
- Women need to provide childcare to cover work
- Utility depends on equivalised family consumption

The model: Data

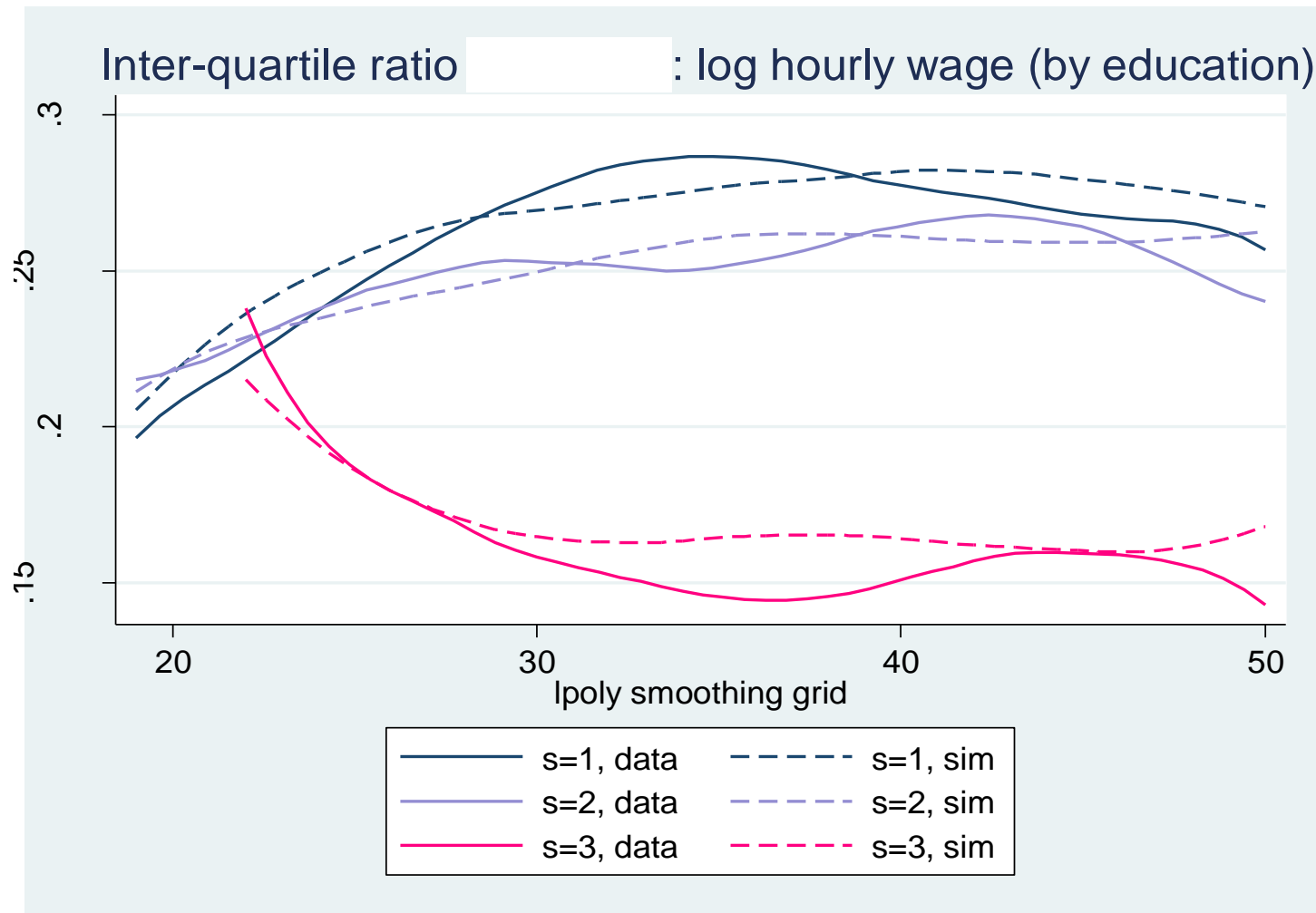
- BHPS, the main UK household panel dataset
- Started in 1991 with around 5,500 households
- We use unbalanced panel of c5,300 females over 16 waves
 - 12% observed in all 16 periods; 56% in 6 or fewer periods; 17% observed leaving education and entering working life
 - labour market outcomes, income, demographics,

- Calibrate interest and discount rates, intertemporal preferences parameter
- Estimate exogenous parameters outside structural model (family transitions, childcare costs, model for men's employment)
- For other parameters, use indirect inference (method of simulated moments) (Smith, 1990, Gourieroux, Monfort and Renault, 1993, De Nardi, French and Jones, 2008, Guneven and Smith, 2008)
 - Calculate moments of real data
 - 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 paying for childcare
 - Given set of parameters, solve model and calculate same moments of simulated data
 - draw exogenous shocks (e.g. for productivity, family composition, ability) and use model to determine choices made at each age
 - Minimise distance between real and simulated moments
- Parametric specification
 - Family composition: uniformly distributed shocks
 - Unobserved heterogeneity in preferences : discrete distribution
 - Productivity level and innovation: normally distributed given education & preferences
 - Unobserved preferences for education: normal distribution
 - Males productivity and selection into work: normal conditional on education

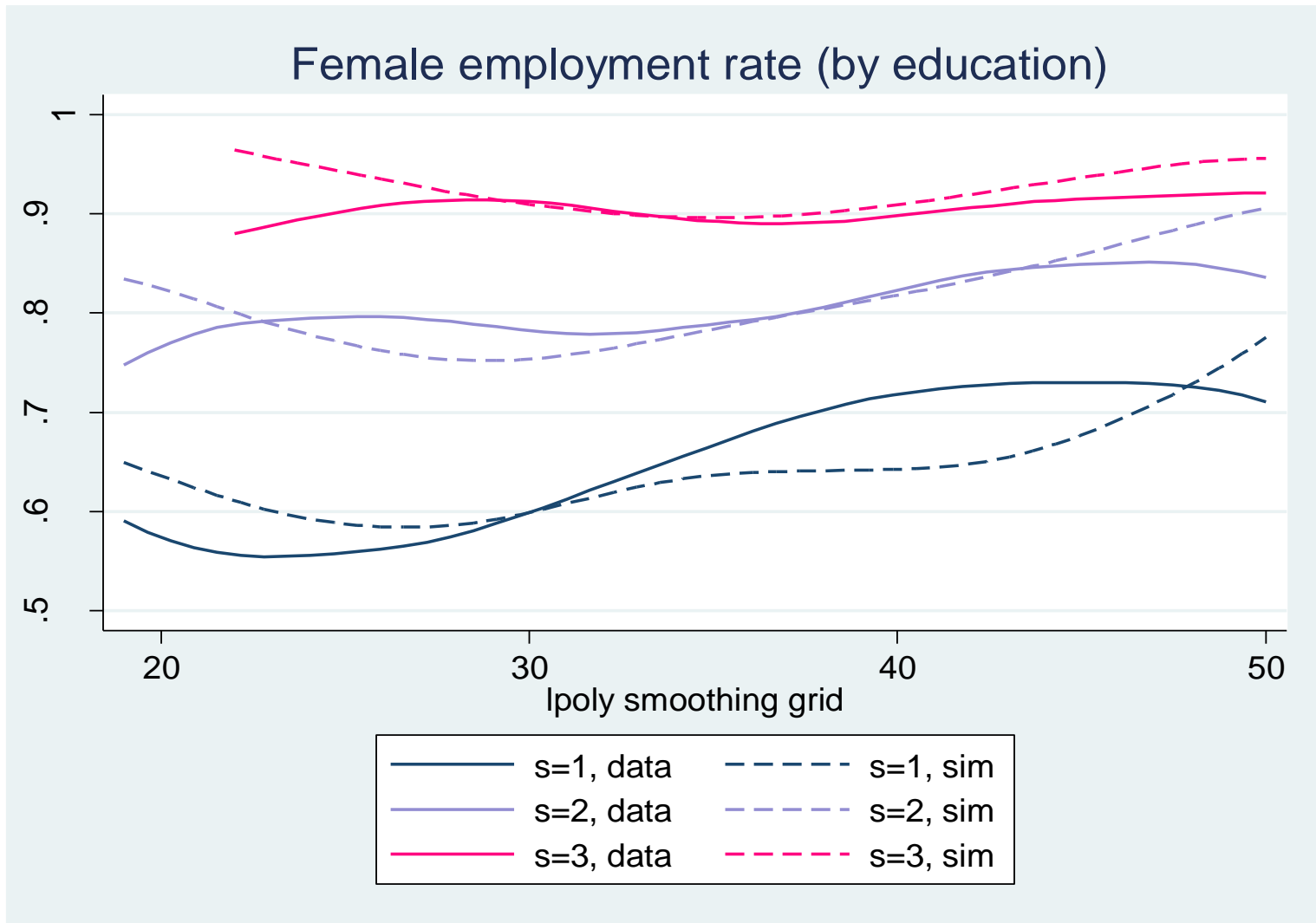
Model fit: hourly wages



Model fit: wage dispersion

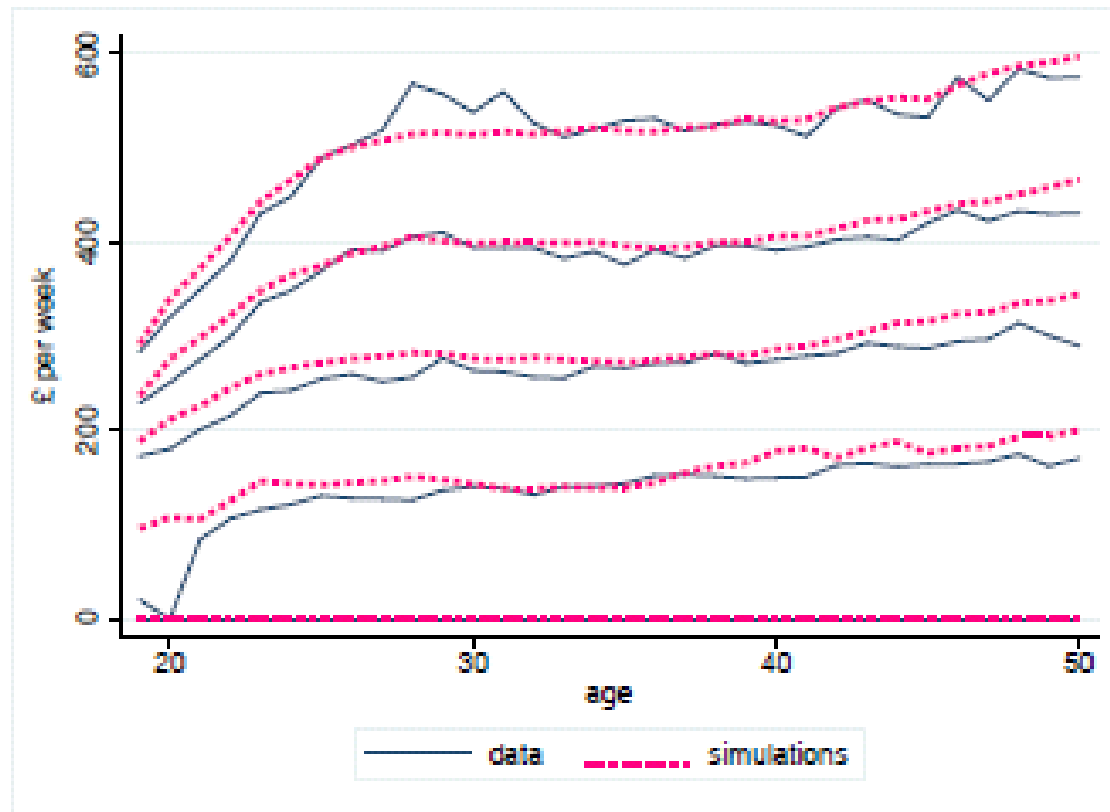


Model fit: employment



Model fit: family income

Figure 2: Distribution of earned equivalised family income over the life-cycle of women; data versus simulations



Notes: Lines in the graph correspond to the 10th, 25th, 50th, 75th and 90th percentiles of the distribution of equivalised earned family income in the real (solid blue) and simulated (dotted pink) datasets.

Model fit: income dynamics

Table 3: Transition probabilities in equivalised earned family income; data versus simulations

	Same quintile		Same or neighbouring quintile	
	data	simulations	data	simulations
year-to-year, annual income	66.3%	73.2%	91.8%	95.6%
3-year transitions, 3-year mean income	57.3%	59.0%	90.6%	92.2%
5-year transitions, 5-year mean income	52.6%	52.0%	89.5%	89.3%

Model: conclusion

- Key features
 - Human capital (through education and returns to experience) and savings are the main dynamic processes
 - Uncertainty, credit constraints and retirement generate need for savings
 - Uncertainty over employment, wages and family composition
 - Heterogeneity and heterogeneous preferences
 - Detailed policy environment
 - Model appropriate for all but top 5-10%

- Inequality and redistribution

Inequality and redistribution: reminder

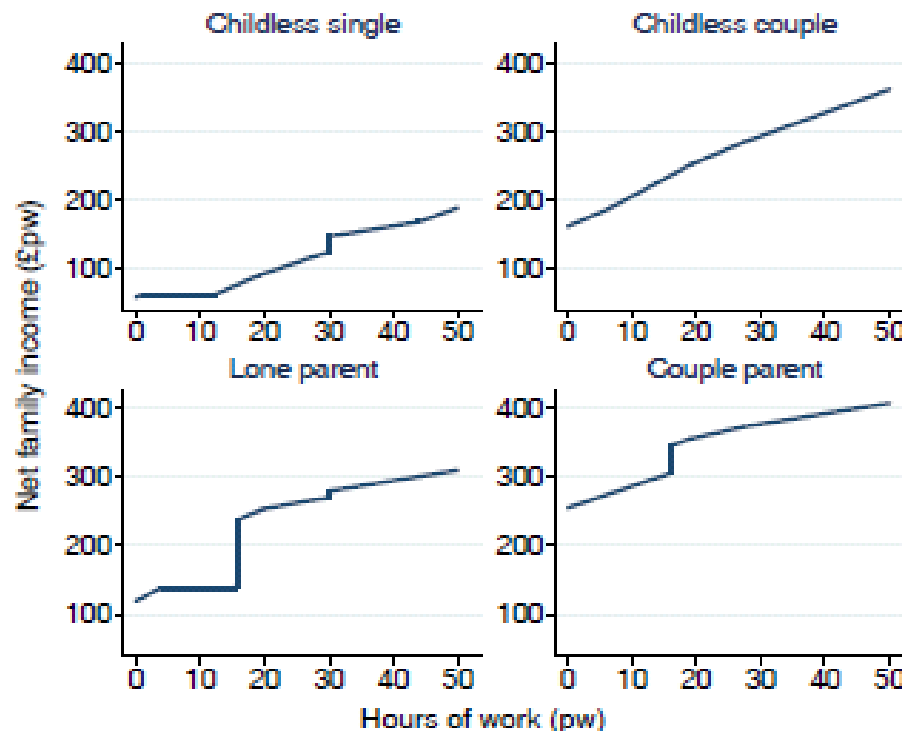
- Look at lifetime **inequality** in income among women in families
- And the **lifetime redistribution** properties of the UK tax and benefits system
 - Measures how taxes and benefits reduce inequality, moderating persistent differences between individuals
- Why?
 - To learn about determinants of lifetime inequality
 - Because lifetime perspective gives better impression of ability of taxes and benefits to reduce true economic disparities

Story in 1 slide

- Lifetime vs annual measures
 - Lifetime inequality is lower than annual inequality
 - Tax and benefit system is less progressive on lifetime basis than annual basis
 - Periods of zero earnings contribute a lot to inequality, but are well compensated-for by tax and benefit system
- Inequality and redistribution over the lifecycle
 - UK tax and benefits particularly good at reducing inequalities at bottom during main child-rearing ages
 - But circumstances at this time of life are good predictor of lifetime income, so redistribution to parents with low earnings is well targeted at reducing lifetime inequalities
 - Encouraging low-wage lone mothers to work is also effective in reducing lifetime inequalities

Budget constraints for low wage women

Figure 1: Budget constraints by family type and female working hours: UK 2006 tax and benefits system



Notes: The plotted lines represent family income by female working hours under the 2006 tax and benefits system. All adults are assumed to earn the 2006 minimum wage (5.05 per hour), and males in couples are assumed to be working full time (40 hours per week). Families with children are assumed to have one child aged 4 and spend 50 on childcare. All families assumed to pay no rents for housing.

The tax and benefits system reduces annual inequality

	Annual inequality		Lifetime inequality	
	Gross earnings	Net income	Gross earnings	Net income
All women	0.37	0.28	0.24	0.18
By education				
Basic	0.42	0.24	0.27	0.15
Intermediate	0.32	0.25	0.21	0.16
High	0.28	0.26	0.15	0.13

Gini coefficients for gross and net annual and lifetime income.

And it also reduces lifetime inequality

	Annual inequality		Lifetime inequality	
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By education				
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Gini coefficients for gross and net annual and lifetime income.

The impact is particularly strong where disparities are larger: for women with basic education

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Gini coefficients for gross and net annual and lifetime income.

The tax system is more progressive on annual basis (especially at bottom)

Table 5: Income shares, tax shares and aggregate tax rate by income quintile under the 2006 tax system

	Pooled annual				Life-cycle			
	earned income (1)	disposable income (2)	tax liability (3)	aggregate tax rate (4)	earned income (5)	disposable income (6)	tax liability (7)	aggregate tax rate (8)
Poorest	4.3%	8.5%	-10.7%	-55.3%	9.8%	12.5%	-0.2%	-0.6%
2nd	14.5%	14.9%	13.3%	20.2%	15.6%	16.5%	13.2%	18.1%
3rd	20.3%	19.5%	22.8%	24.8%	19.8%	19.5%	20.6%	22.5%
4th	24.7%	23.7%	28.5%	25.4%	23.5%	22.6%	26.9%	24.8%
Richest	36.2%	33.4%	46.1%	28.1%	31.2%	28.8%	39.6%	27.5%

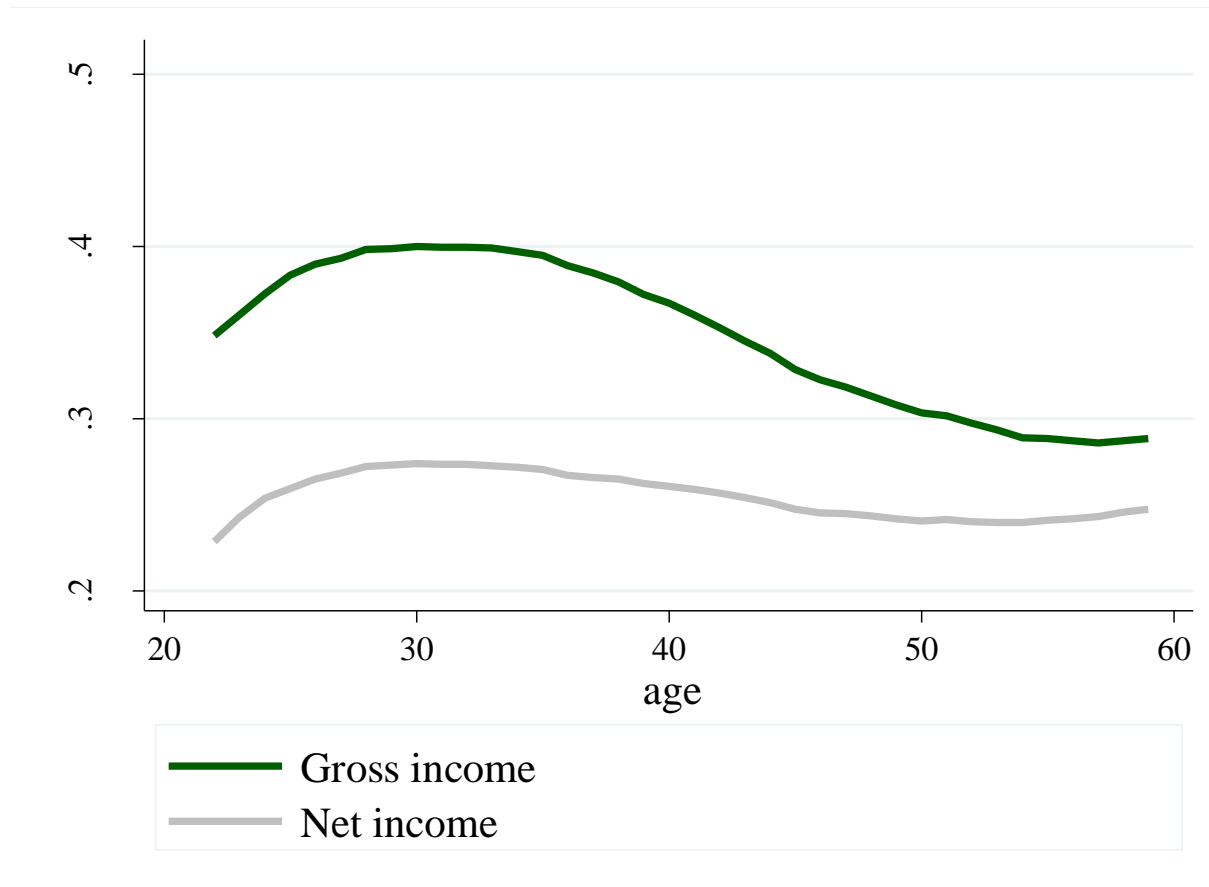
Notes: The Aggregate ATR in columns 4 and 8 is the income quintile tax liability as a proportion of total pre-tax income.

Table 6: Within group (intra-personal) share of log income variation

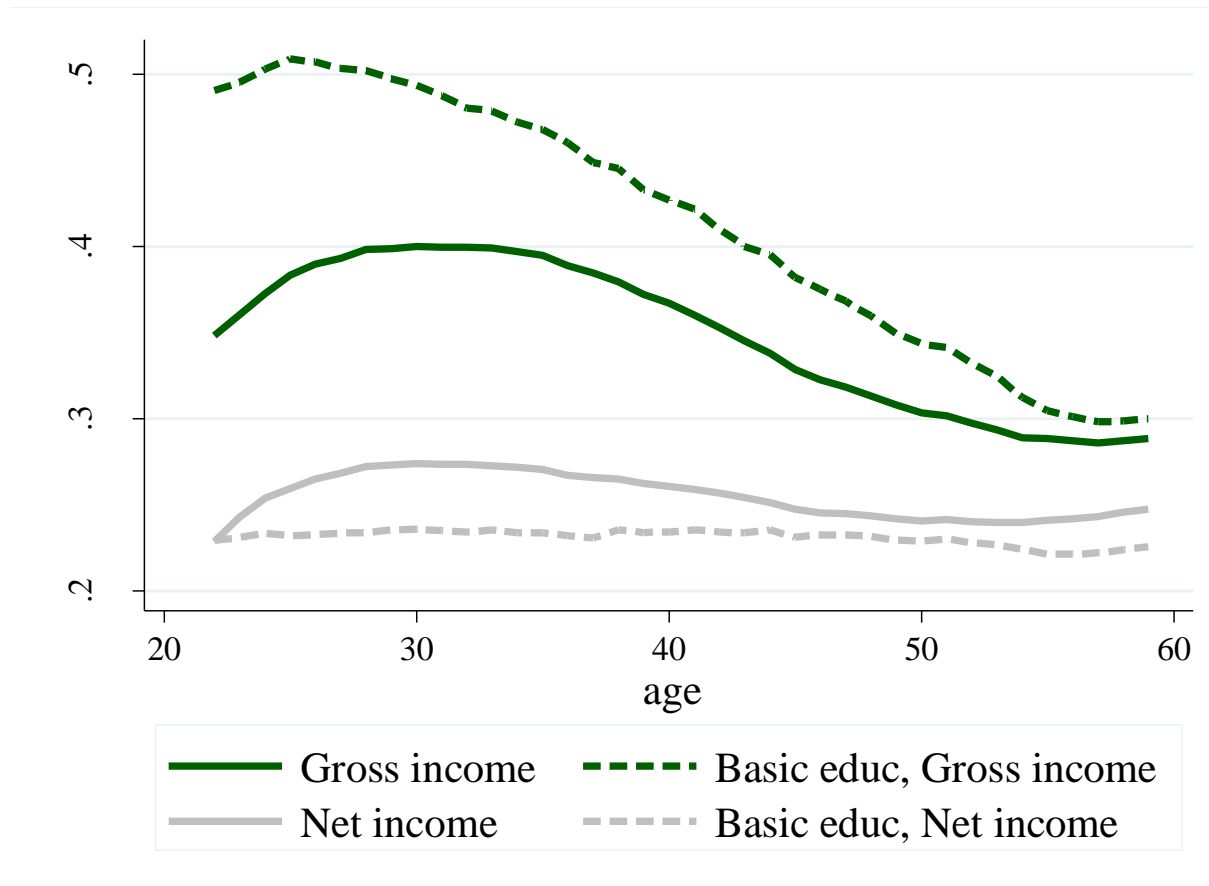
	earned income (1)	disposable income (2)	change in total variance (3)
(1) Including zeros	63%	53%	-90%
(2) Excluding zeros	50%	53%	-17%

Notes: To include periods of no earned income, we have used the variance of $\log(\text{income}+1)$. This makes no difference to the variance decomposition excluding zeros in row (2).

Over the life-cycle, taxes and benefits are more redistributive when differences are more marked

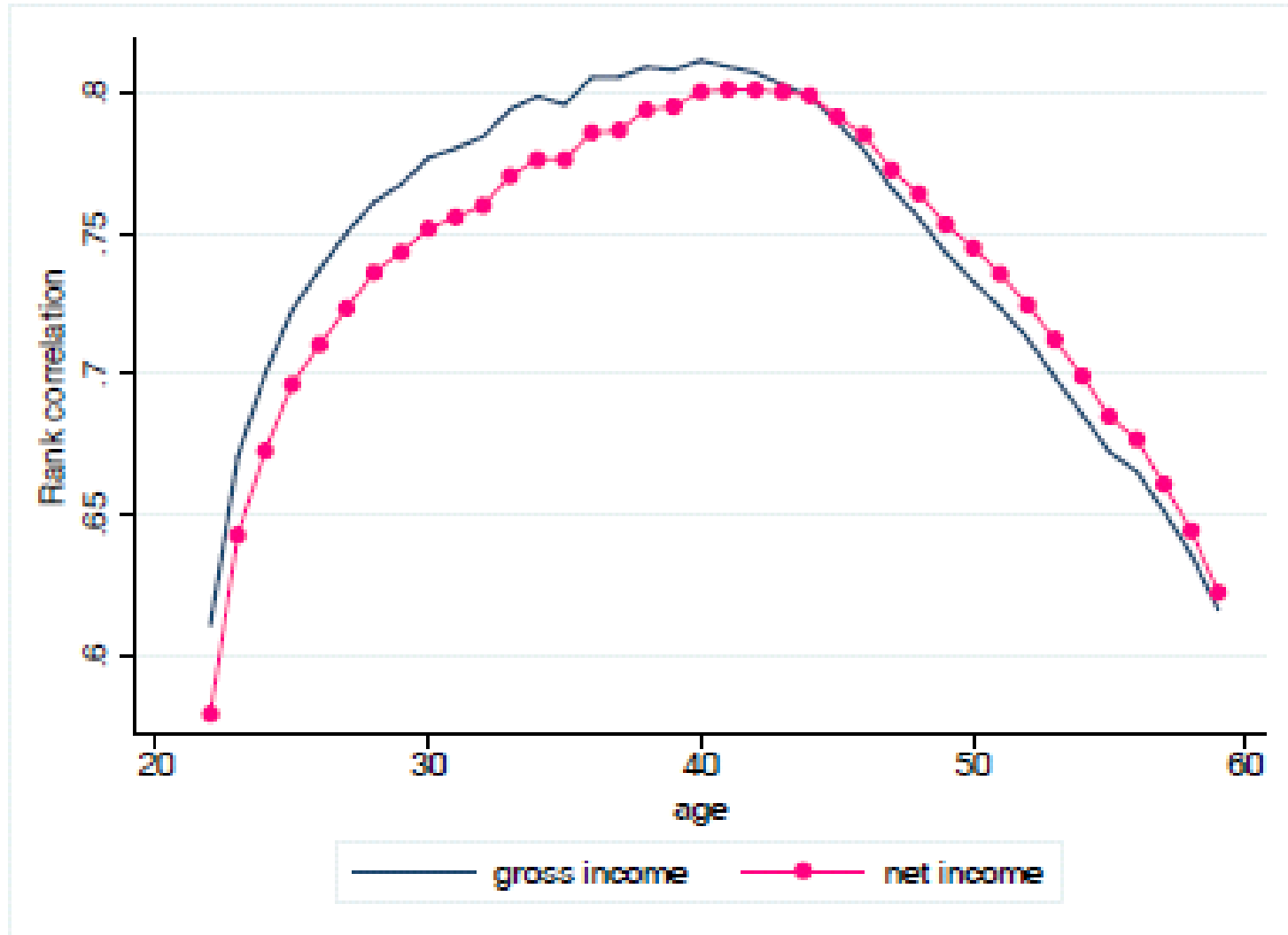


...particularly for those exposed to greater disparities



Relative income in child-bearing years correlates well with lifetime income

Figure 7: Rank correlation between annual and lifetime income



Decompose lifetime inequality in its main building blocks

	Initial wealth and education	Family history			
		Partner	Children	Lone mother	Total
Gross income	34.1%	3.4%	6.0%	8.7%	18.1%
Net income	39.5%	3.1%	7.2%	1.1%	11.4%

Share of variation in lifetime income explained by each factor.

Largest share of lifetime inequality established early in adult life

	Initial wealth and education	Family history			
		Partner	Children	Lone mother	Total
Gross income	34.1%	3.4%	6.0%	8.7%	18.1%
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Share of variation in lifetime income explained by each factor.

But tax and benefits system ensures the impact of lone-motherhood does not persist

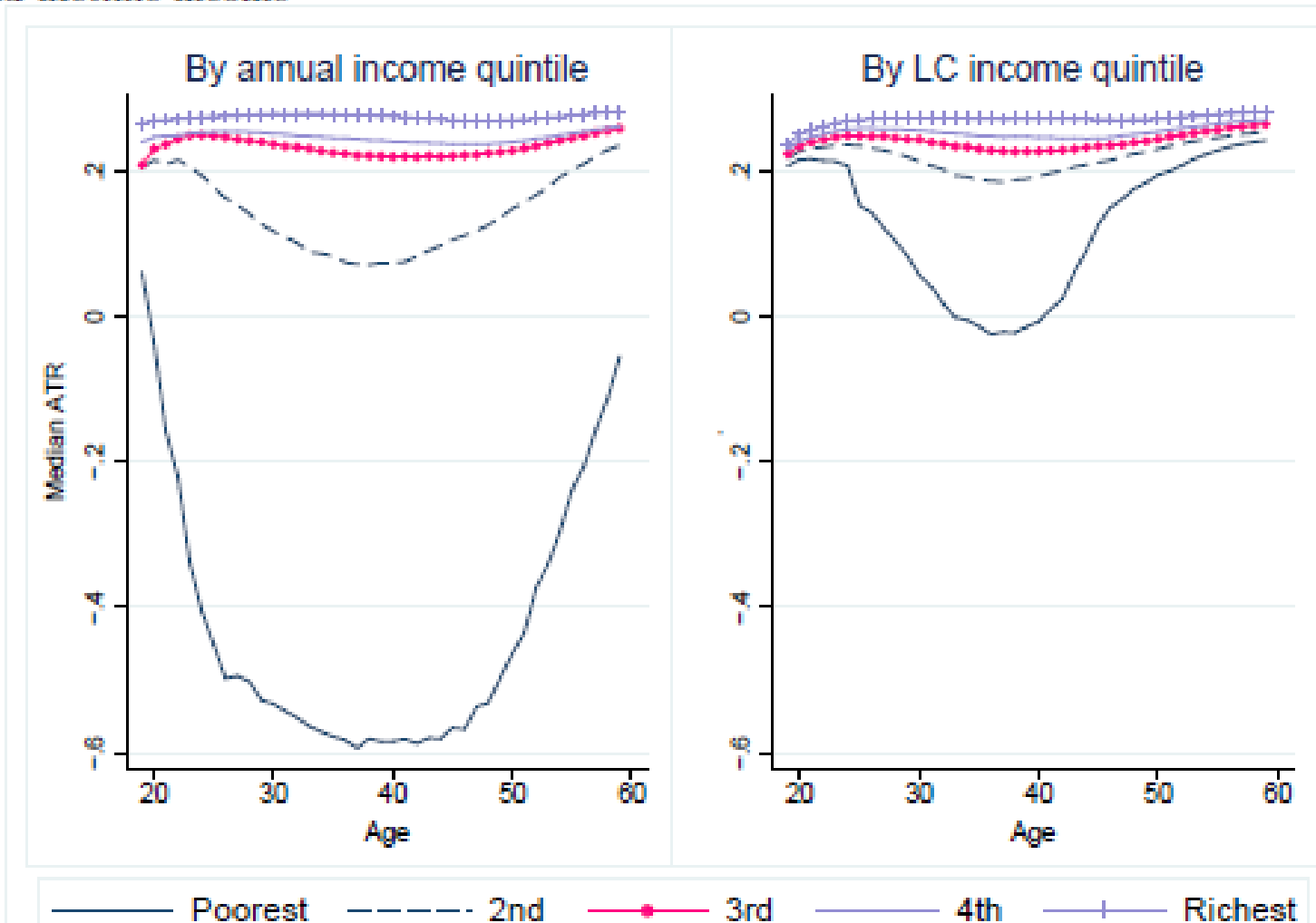
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Share of variation in lifetime income explained by each factor.

- So UK tax and benefit system is quite effective at preventing lone motherhood from leading to permanent inequalities
- Can also see this when look at redistribution and inequality over the lifecycle (i.e., by age)

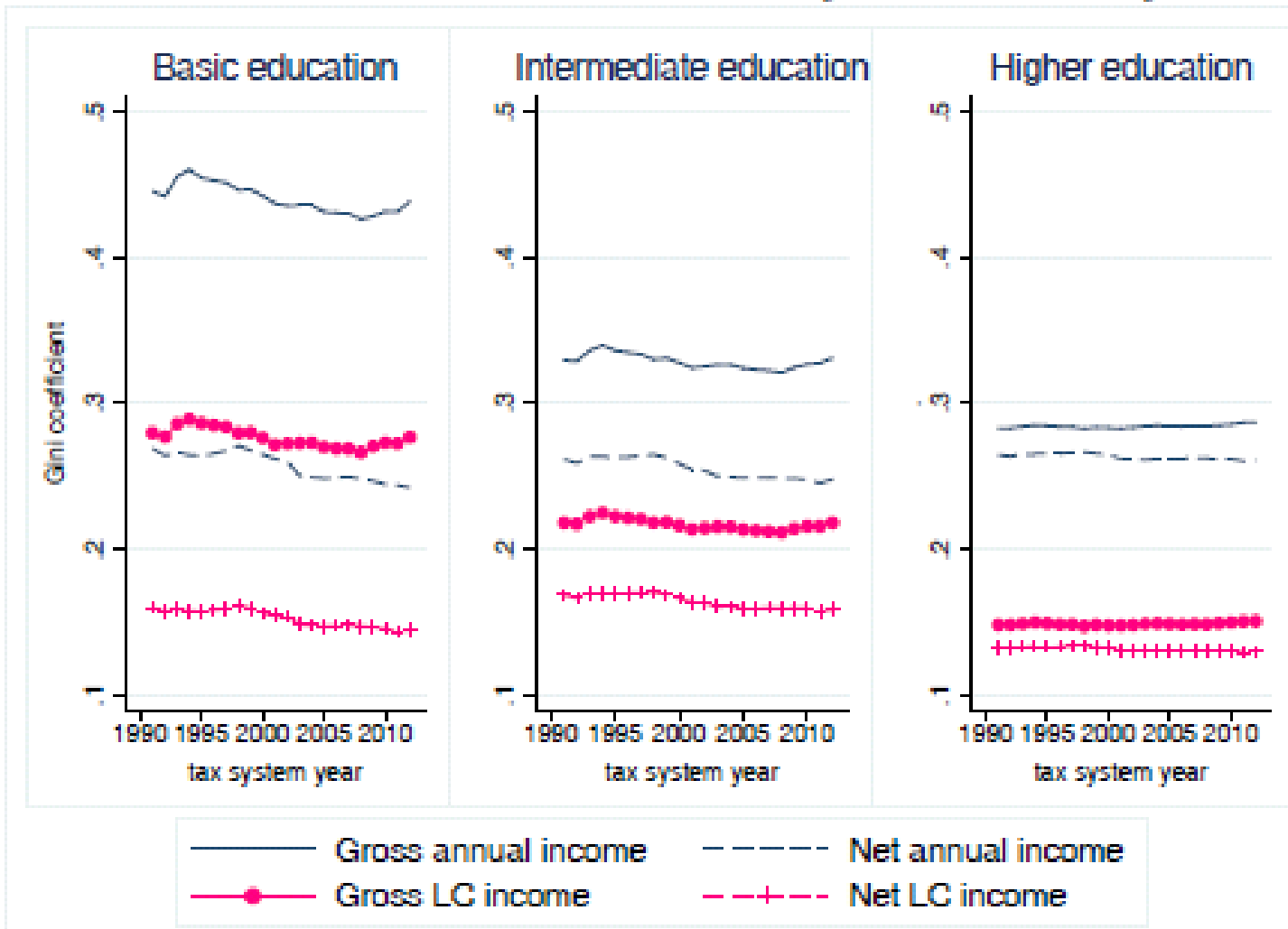
Redistribution over the lifecycle

Figure 8: Median Average Tax Rate over the life-cycle by quintile of the distributions of earned annual and lifetime income

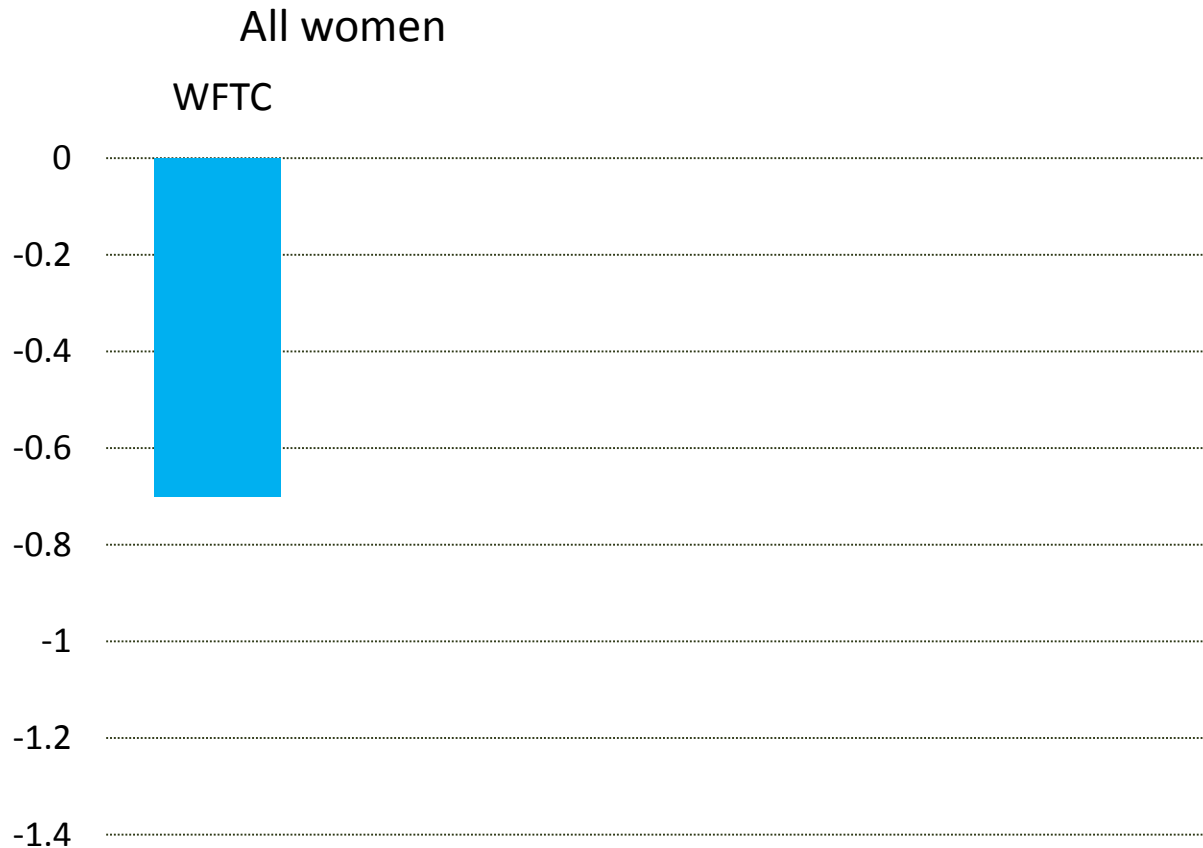


Recent tax changes have made the UK more equal

Figure 10: Gini coefficients for annual and lifetime income by tax and benefits system and education

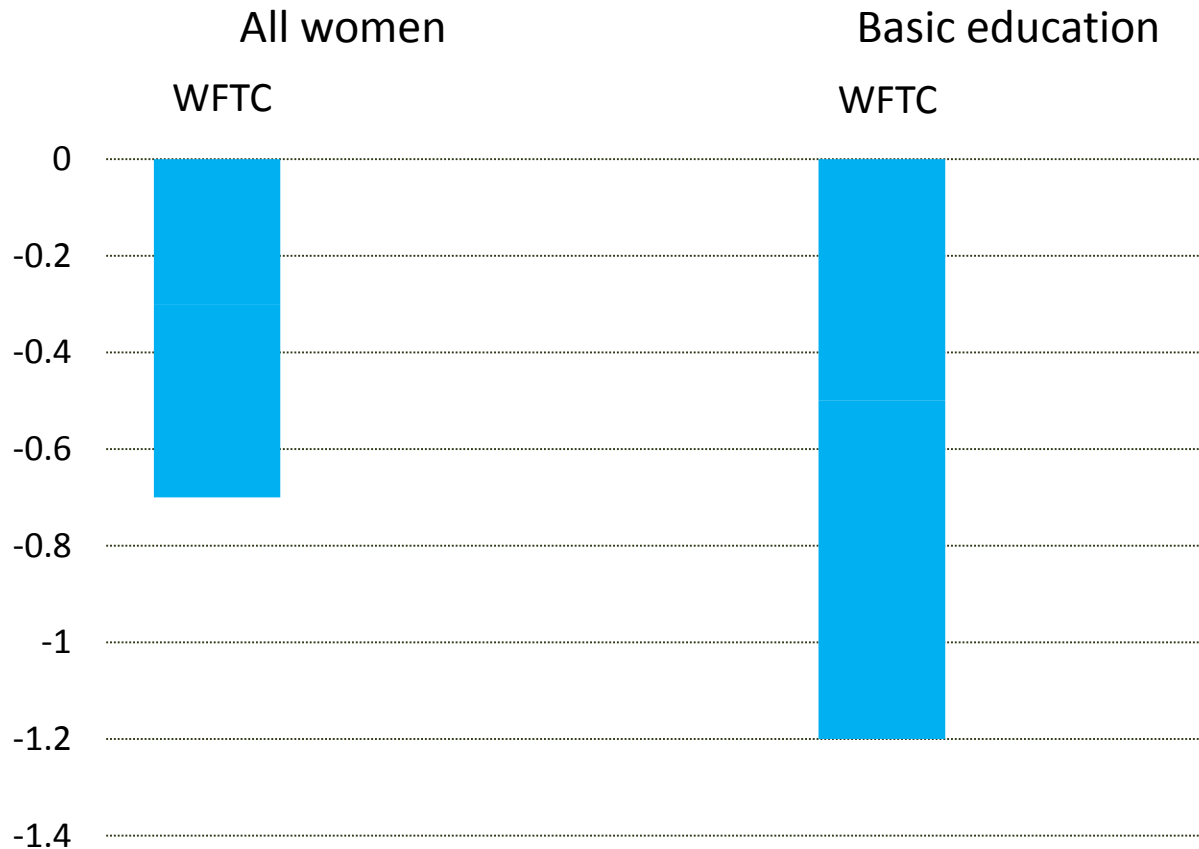


...mostly because in-work benefits for low income families with children reduce lifetime inequality



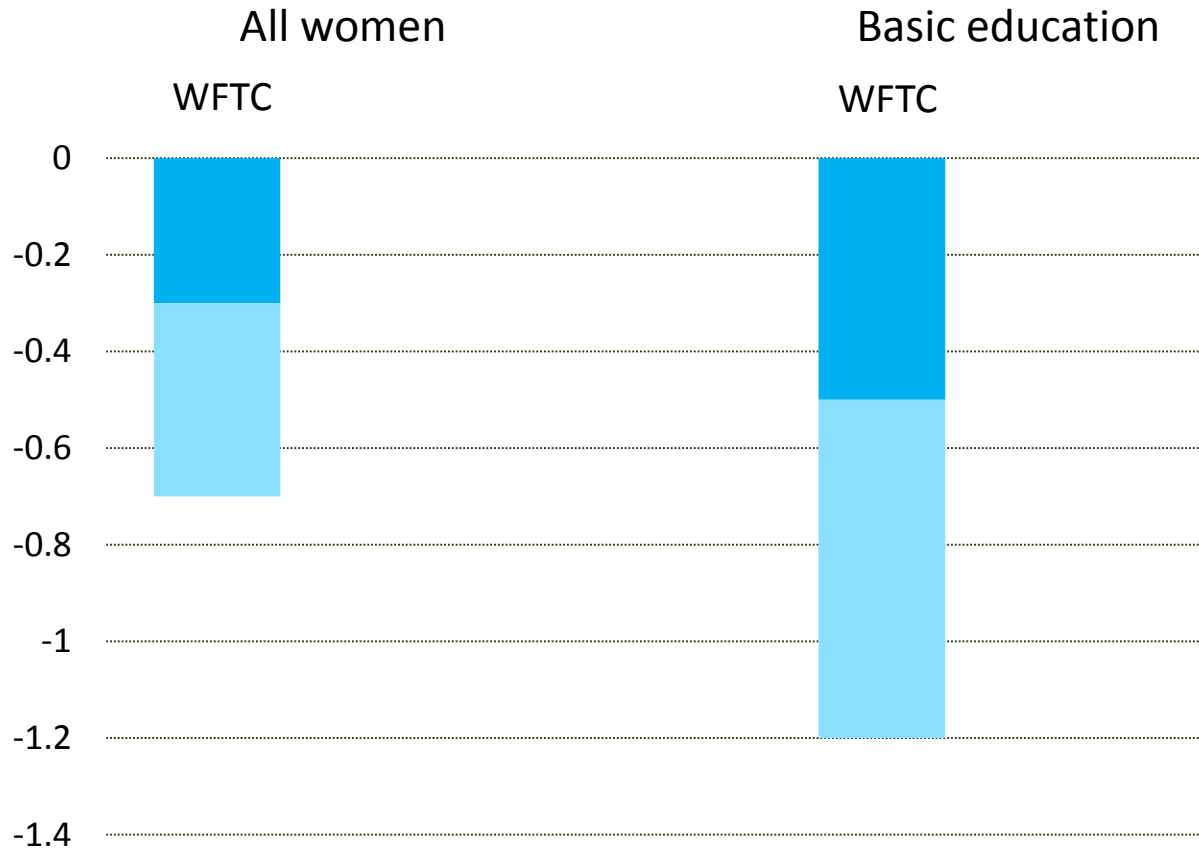
Effects on Gini coefficient: 2002 version of WFTC and IS versus pre-WFTC 1999 tax and benefits system

...particularly for women with basic education...



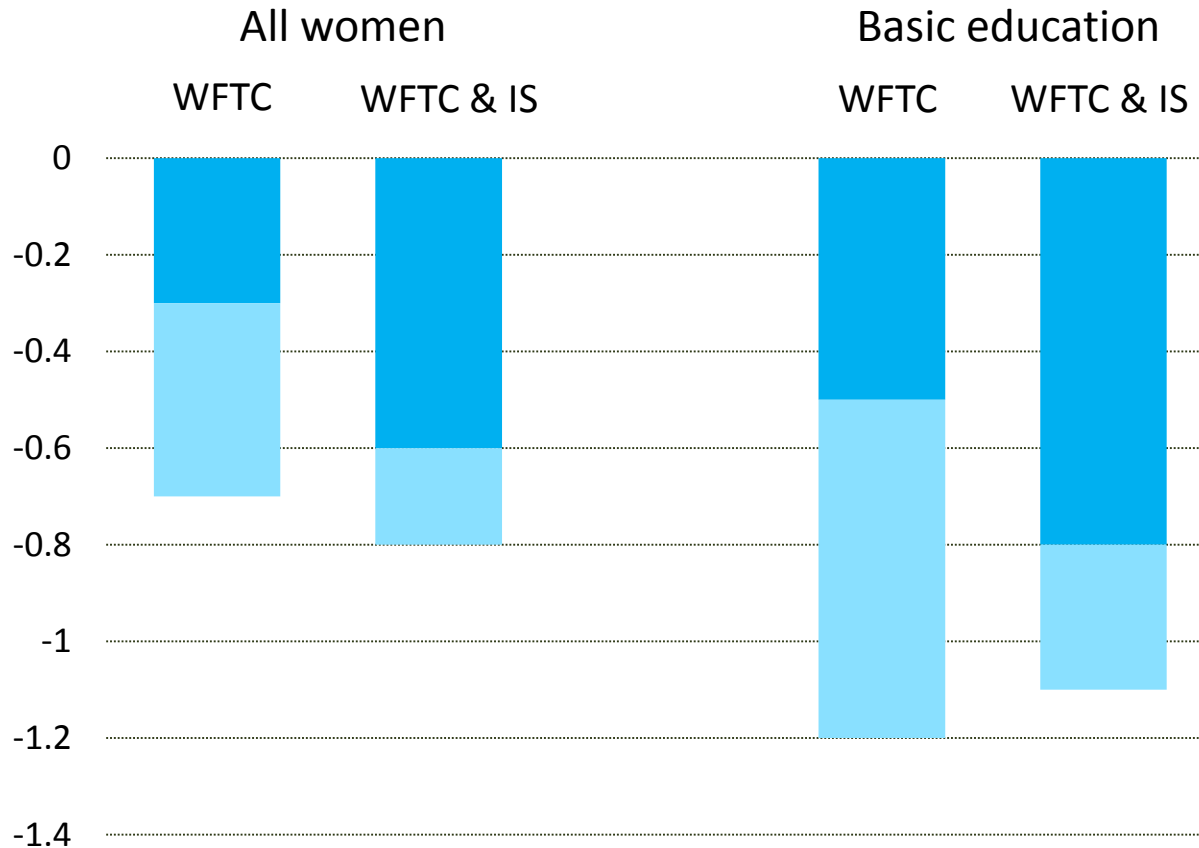
Effects on Gini coefficient: 2002 version of WFTC and IS versus pre-WFTC 1999 tax and benefits system

...and this largely driven by its impact on moving women into work...



Effects on Gini coefficient: 2002 version of WFTC and IS versus pre-WFTC 1999 tax and benefits system

...but welfare increases (“IS”) for families with kids dulled employment responses



Effects on Gini coefficient: 2002 version of WFTC and IS versus pre-WFTC 1999 tax and benefits system

Recap

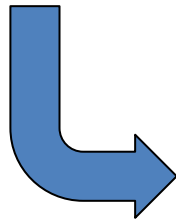
- Lifetime vs annual measures
 - Lifetime inequality is lower than annual inequality
 - UK tax and benefit system is less progressive on lifetime basis than annual basis
 - Periods of zero earnings contribute a lot to inequality, but are well compensated-for by UK tax and benefit system
- Inequality and redistribution over the lifecycle
 - UK tax and benefits particularly good at reducing inequalities at bottom during main child-rearing ages, especially its support for lone mothers
 - Redistribution to parents with low earnings is well targeted at reducing lifetime inequalities
 - Encouraging low-earning lone mothers to work is especially effective at reducing lifetime inequalities

- Work incentives and the tax and benefit system

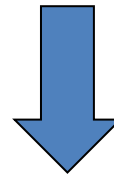
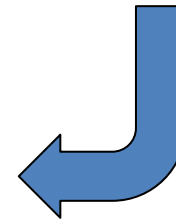
Work incentives: the story in one slide

Work incentives vary lots
by family circumstances

Family
circumstances vary
lots across life



Work incentives vary
lots across life



Static measure of work incentives
will be misleading

Forward-looking measure gives a
different impression of incentives
for lone parents

Usual measures of work incentives

- Marginal effective tax rate (METR):

The fraction of a small rise in earnings that is lost to extra taxes and lower benefits

$$METR \equiv 1 - \frac{y_{h+1} - y_h}{e_{h+1} - e_h}$$

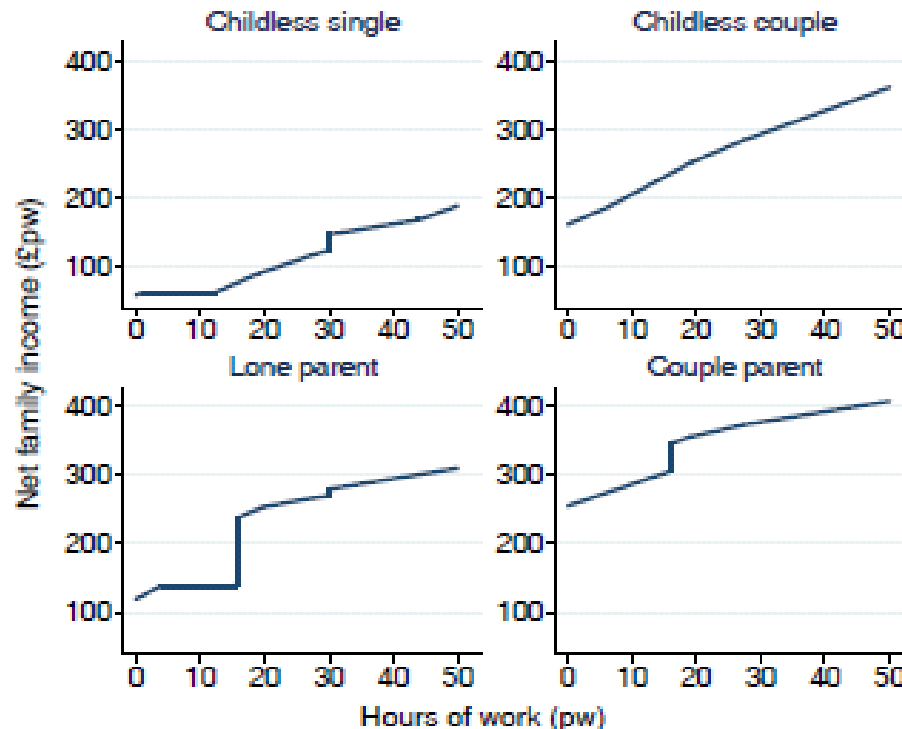
- Participation tax rate (PTR):

When moving into work, the fraction of the rise in earnings that is lost to extra taxes and lower benefits

$$PTR \equiv 1 - \frac{y_h - y_0}{e_h - e_0}$$

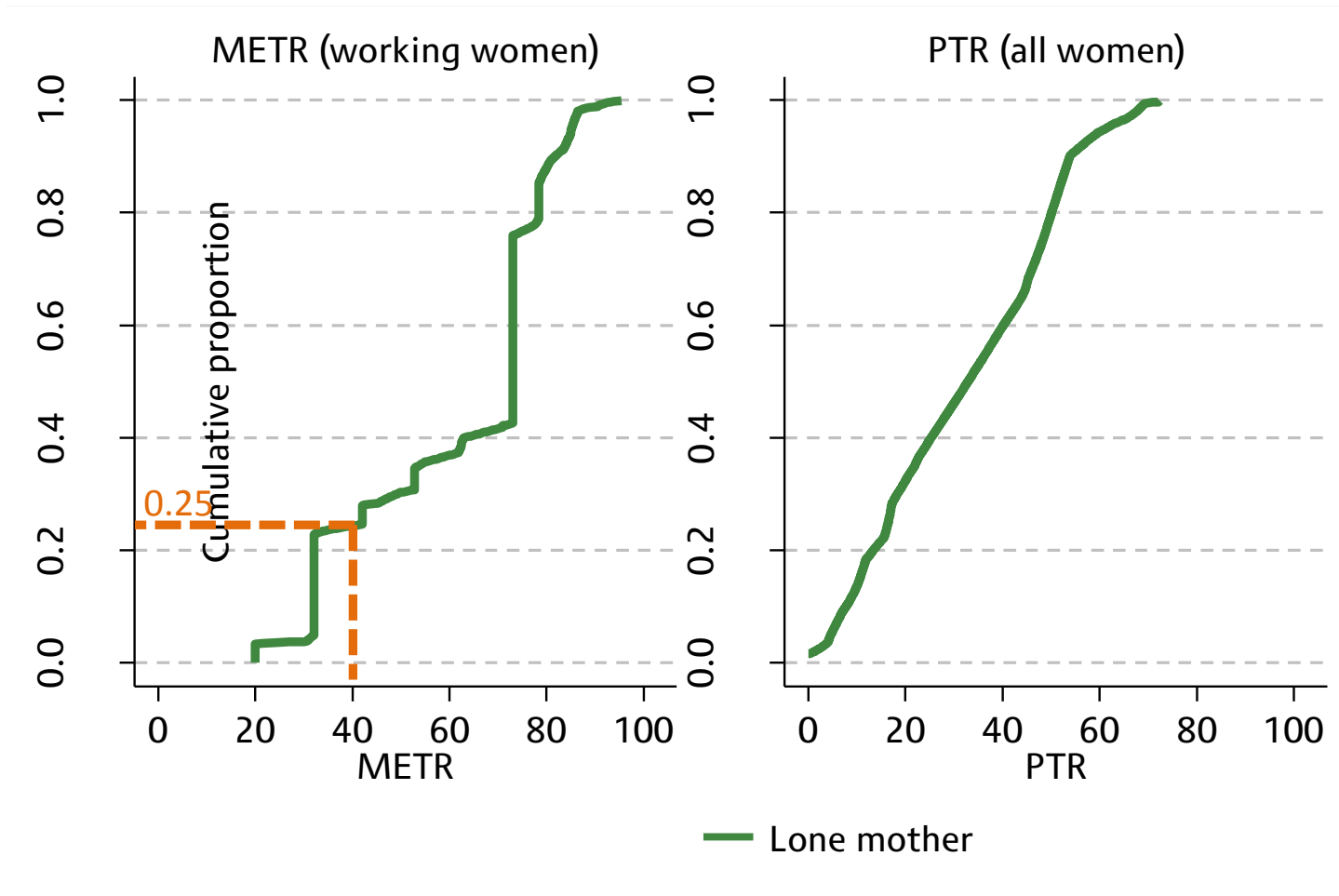
UK budget constraints for low wage women

Figure 1: Budget constraints by family type and female working hours: UK 2006 tax and benefits system

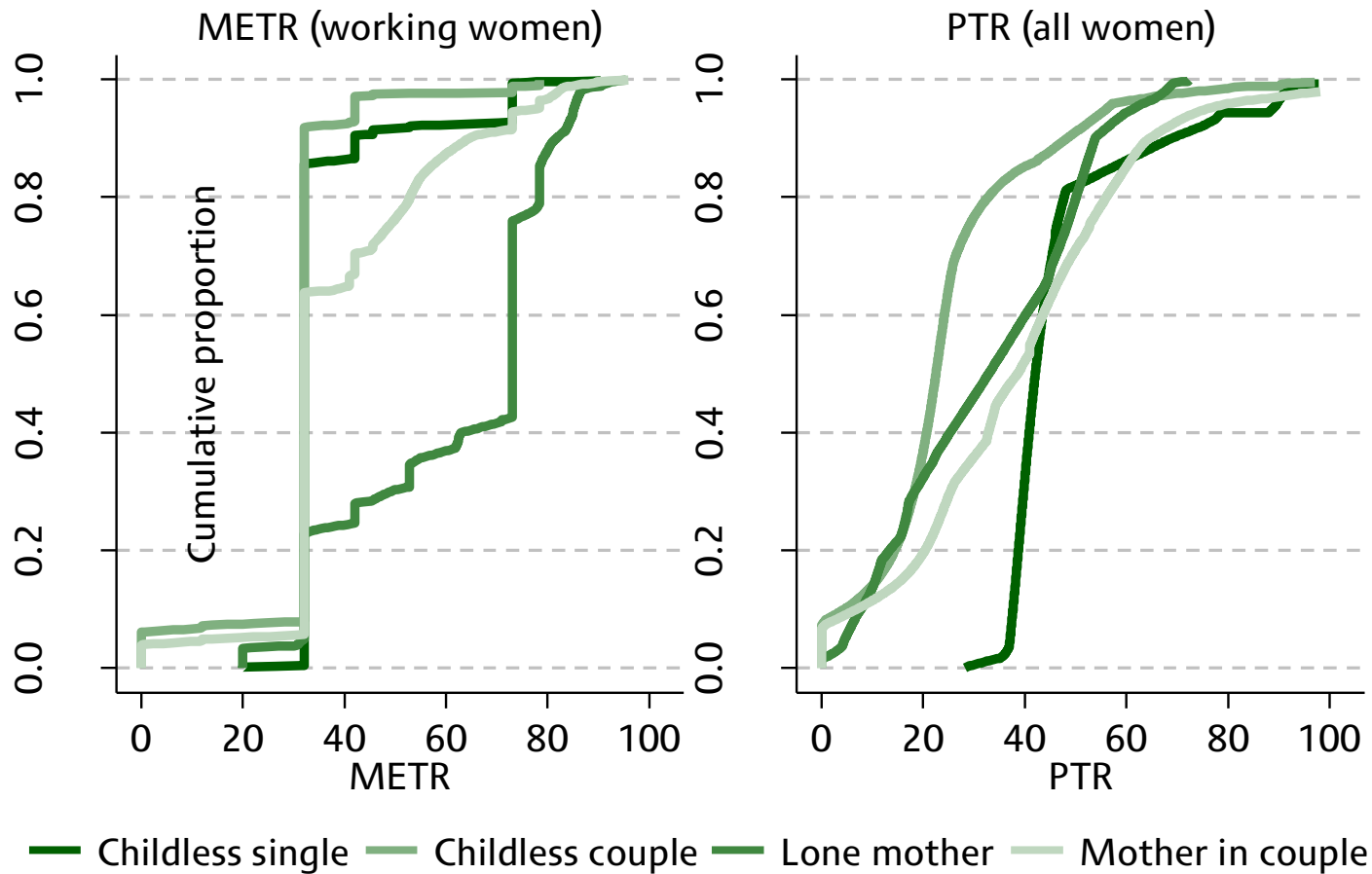


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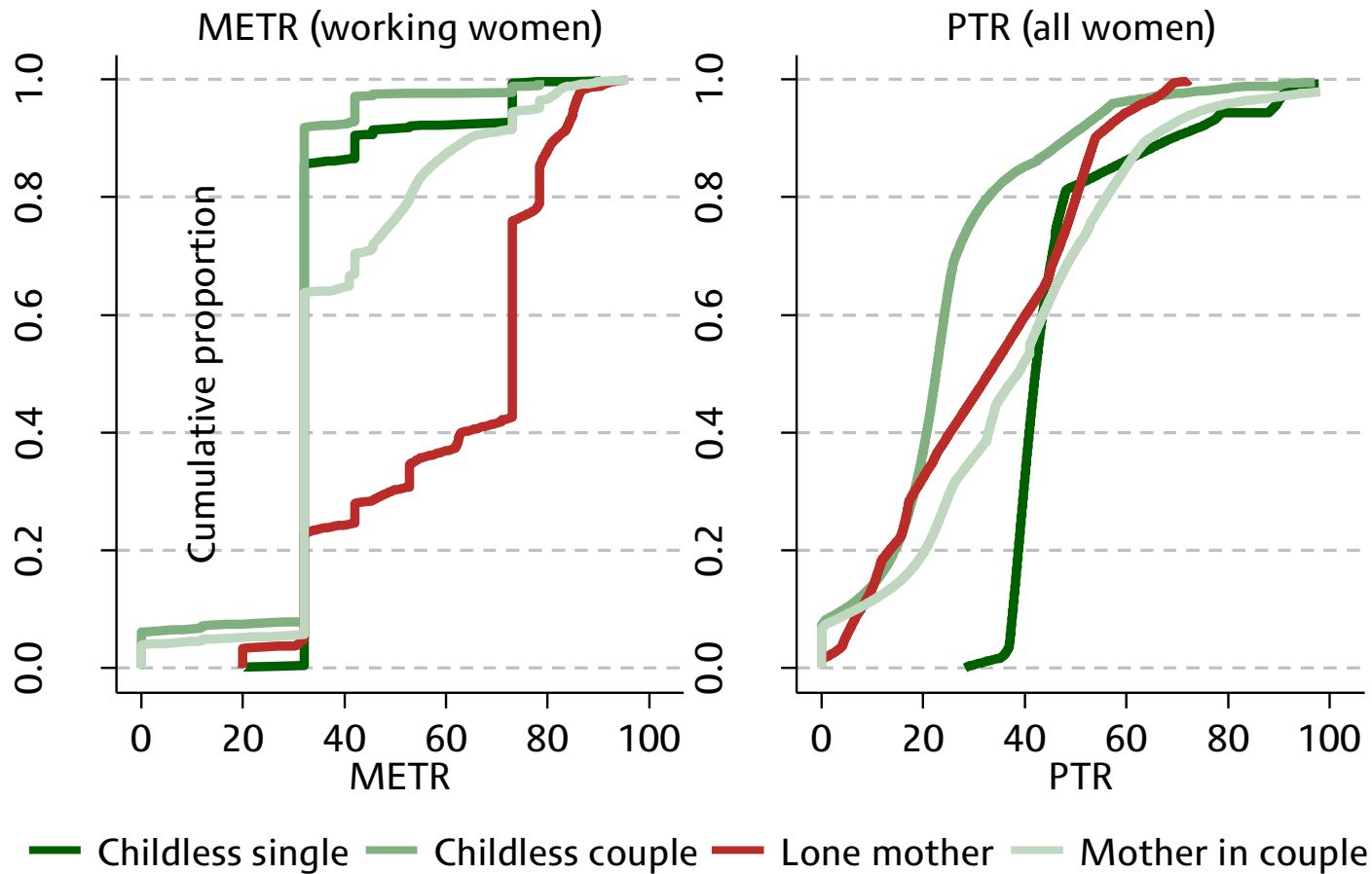
Work incentives vary by family circumstances



Work incentives vary by family circumstances

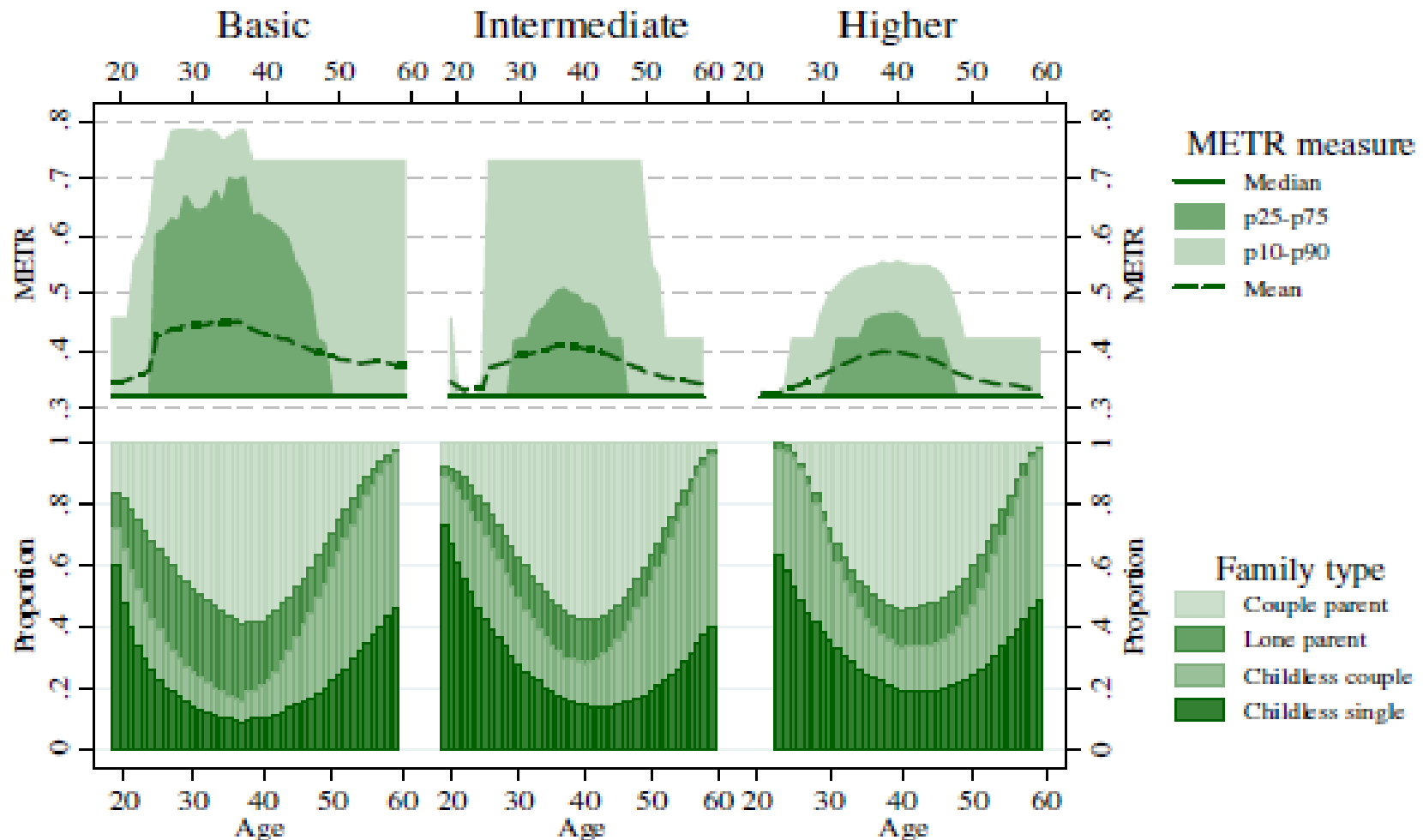


Work incentives vary by family circumstances



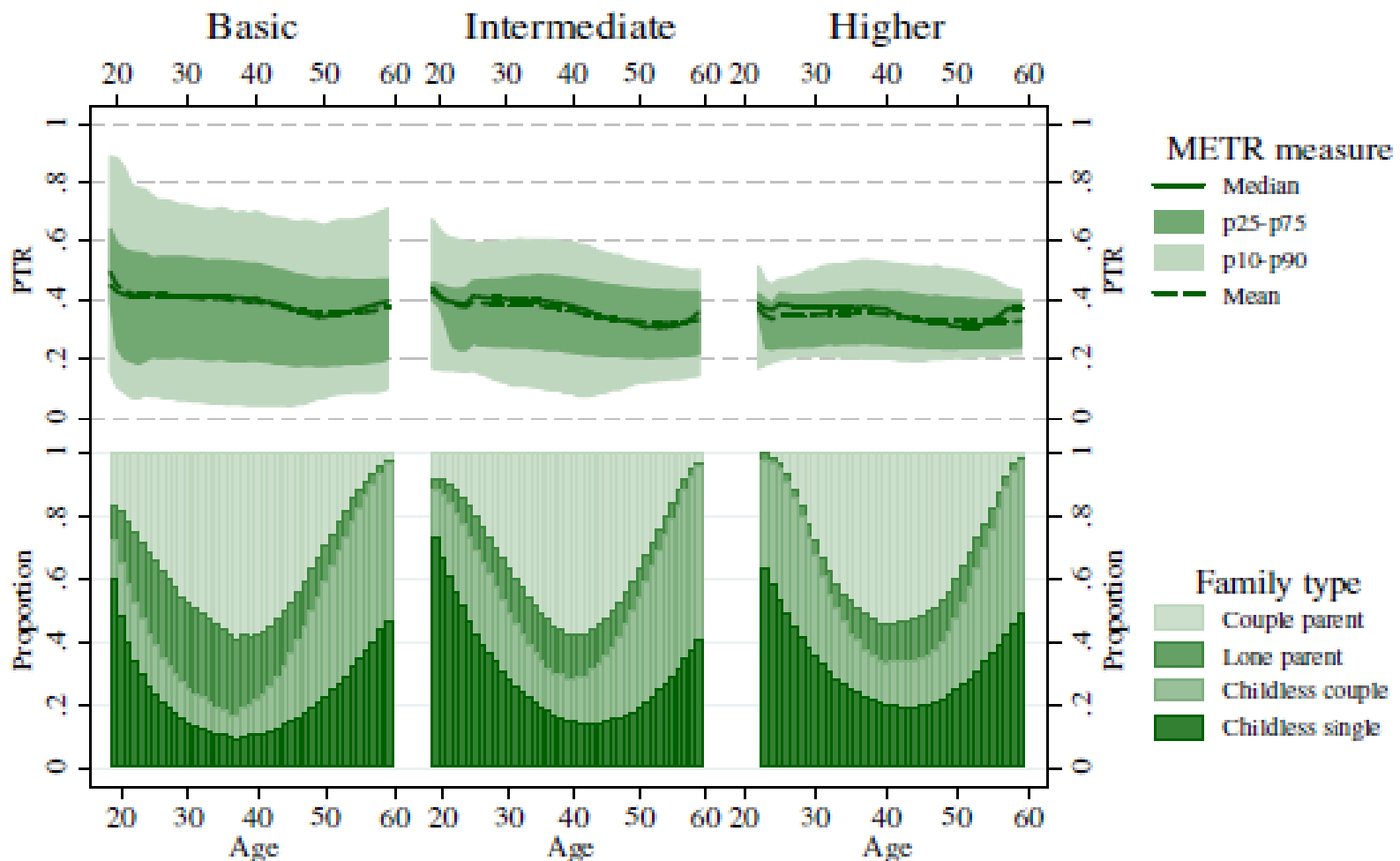
Changing family circumstances mean work incentives vary across life (1)...

Figure 4.6. Distribution of METRs and family types for working women across the lifecycle: by education



Changing family circumstances mean work incentives vary across life (2)...

Figure 4.7. Distribution of PTRs and family types for all women across the lifecycle: by education



But individuals are not permanently stuck with weak (or strong) work incentives (1)

Table 4.15. 5-year transition matrix for PTR bands at different ages

	Age 25-29							Age 35-39					
	≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share		≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share
≤0.2	0.52	0.22	0.18	0.05	0.03	0.179	≤0.2	0.61	0.22	0.11	0.03	0.03	0.198
0.2-0.4	0.12	0.55	0.27	0.05	0.01	0.317	0.2-0.4	0.14	0.61	0.20	0.04	0.01	0.336
0.4-0.6	0.10	0.26	0.55	0.06	0.02	0.387	0.4-0.6	0.08	0.27	0.57	0.07	0.01	0.350
0.6-0.8	0.09	0.14	0.33	0.38	0.07	0.073	0.6-0.8	0.09	0.17	0.36	0.33	0.05	0.083
>0.8	0.19	0.10	0.15	0.14	0.42	0.044	>0.8	0.21	0.11	0.20	0.13	0.35	0.034
	Age 45-49												
	≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share							
≤0.2	0.65	0.21	0.10	0.02	0.02	0.226							
0.2-0.4	0.13	0.68	0.16	0.02	0.01	0.392							
0.4-0.6	0.06	0.30	0.60	0.04	0.01	0.299							
0.6-0.8	0.09	0.18	0.30	0.40	0.03	0.060							
>0.8	0.18	0.10	0.12	0.24	0.35	0.024							

Notes: Authors' calculations based on simulated data.

But individuals are not permanently stuck with weak (or strong) work incentives (2)

Table 4.16. 5-year transition matrix for METR bands at different ages (for individuals employed in both years)

	Age 25-29							Age 35-39						
	≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share		≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share	
≤0.2	0.456	0.383	0.035	0.125	0.000	0.026		≤0.2	0.426	0.495	0.016	0.063	0.000	0.033
0.2-0.4	0.021	0.801	0.108	0.056	0.014	0.738		0.2-0.4	0.024	0.848	0.072	0.049	0.008	0.602
0.4-0.6	0.013	0.244	0.539	0.151	0.054	0.101		0.4-0.6	0.016	0.328	0.503	0.120	0.034	0.188
0.6-0.8	0.046	0.400	0.127	0.370	0.057	0.104		0.6-0.8	0.021	0.462	0.104	0.380	0.034	0.140
>0.8	0.004	0.149	0.235	0.338	0.275	0.032		>0.8	0.007	0.278	0.177	0.355	0.184	0.037
	Age 45-49													
	≤0.2	0.2-0.4	0.4-0.6	0.6-0.8	>0.8	Share								
≤0.2	0.366	0.547	0.024	0.060	0.002	0.041								
0.2-0.4	0.016	0.895	0.047	0.041	0.002	0.707								
0.4-0.6	0.022	0.584	0.313	0.074	0.007	0.114								
0.6-0.8	0.013	0.568	0.048	0.361	0.010	0.120								
>0.8	0.017	0.362	0.052	0.447	0.122	0.019								

Notes: Conditional on working in both years under consideration. Authors' calculations based on simulated data.

But individuals are not permanently stuck with weak (or strong) work incentives (3)

- Within-between decomposition of variance of PTR and METR across population shows about two-thirds is “within”
- Main reason for these large lifecycle changes is changes in family type
 - Fields-style decomposition suggests female working patterns “explain” only 14% of METR, rising to 31% if include partner
 - or 13% rising to 40% for PTRs

So?

If the distortions inherent in tax system change over lifecycle, and if working now has implications for future choices, then static measures of financial work incentives (“extra tax paid now / additional earnings now”) likely to be misleading

Example: working now provides

1. higher (taxed) earnings now
 2. higher (taxed) hourly wage in future
- If I think I won't work in future, or if my future earnings will be highly taxed, then I won't value (2) much
 - Conversely, even if I am highly taxed now, I might still work if I am young, or if my tax rate likely to fall

Usual measures of work incentives

- Marginal effective tax rate (METR):

The fraction of a small rise in earnings that is lost to extra taxes and lower benefits

$$METR \equiv 1 - \frac{y_{h+1} - y_h}{e_{h+1} - e_h}$$

- Participation tax rate (PTR):

When moving into work, the fraction of the rise in earnings that is lost to extra taxes and lower benefits

$$PTR \equiv 1 - \frac{y_h - y_0}{e_h - e_0}$$

A forward-looking measure

- Forward-looking participation tax rate (FLPTR):

When moving into work today, the fraction of the rise in current and future earnings that is lost to extra taxes and lower benefits

$$FLPTR_a \equiv 1 - \frac{Y_{h_a=h} - Y_{h_a=0}}{E_{h_a=h} - E_{h_a=0}}$$

$$\tilde{Y}_{h_a=0} \equiv \sum_{s=0}^{A-a} \beta^s y_{a+s|h_a=0}$$

- FLPTR can be written as a weighted average of today's PTR and future METRs and PTRs

$$FLPTR_a = \alpha_a PTR_a + \sum_{s=1}^{A-a} \alpha_{a+s} TR_{a+s}$$

$$\alpha_{a+s} \equiv \frac{\beta^s (e_{a+s|h_a=h} - e_{a+s|h_a=0})}{\sum_{t=0}^{A-a} \beta^t (e_{a+t|h_a=h} - e_{a+t|h_a=0})}$$

$$TR_{a+s} \equiv 1 - \frac{y_{a+s|h_a=h} - y_{a+s|h_a=0}}{e_{a+s|h_a=h} - e_{a+s|h_a=0}}$$

$$FLPTR_a = \alpha_a PTR_a + \sum_{s=1}^{A-a} \alpha_{a+s} TR_{a+s}$$

$$\alpha_{a+s} \equiv \frac{\beta^s (e_{a+s|h_a=h} - e_{a+s|h_a=0})}{\sum_{t=0}^{A-a} \beta^t (e_{a+t|h_a=h} - e_{a+t|h_a=0})}$$

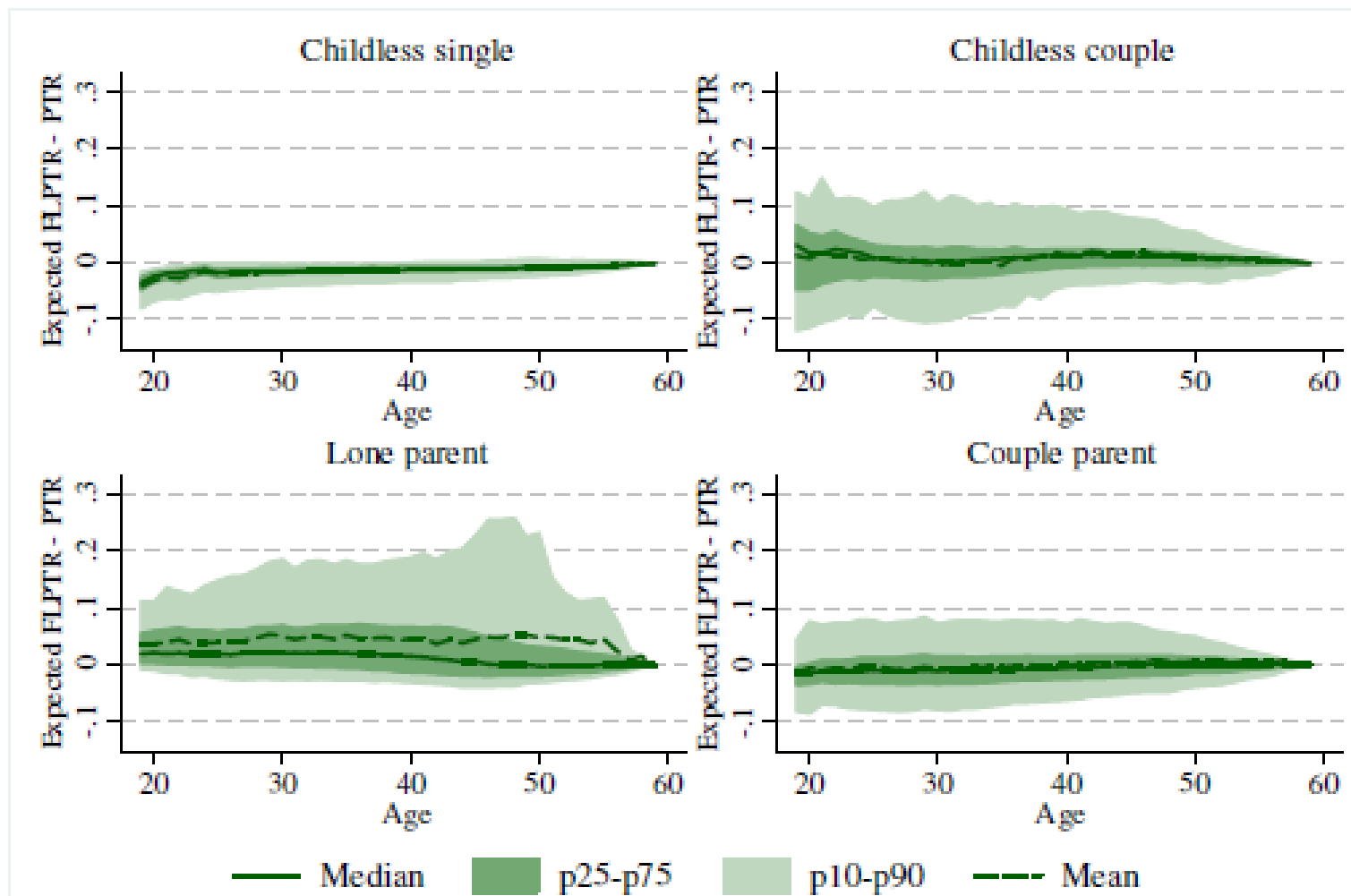
$$TR_{a+s} \equiv 1 - \frac{y_{a+s|h_a=h} - y_{a+s|h_a=0}}{e_{a+s|h_a=h} - e_{a+s|h_a=0}}$$

1. Hold future labour supply constant at optimal labour supply choices given did not work in period a
 - This will capture extent to which future wage gains are taxed
2. Re-compute future optimal labour supply choices given did work in period a
 - But making an individual work now can reduce lifetime earnings if current PTR low, or income effect strong
3. Re-compute future optimal labour supply choices, holding wealth constant
4. In periods a to T , let individual *always work* or *always not work*

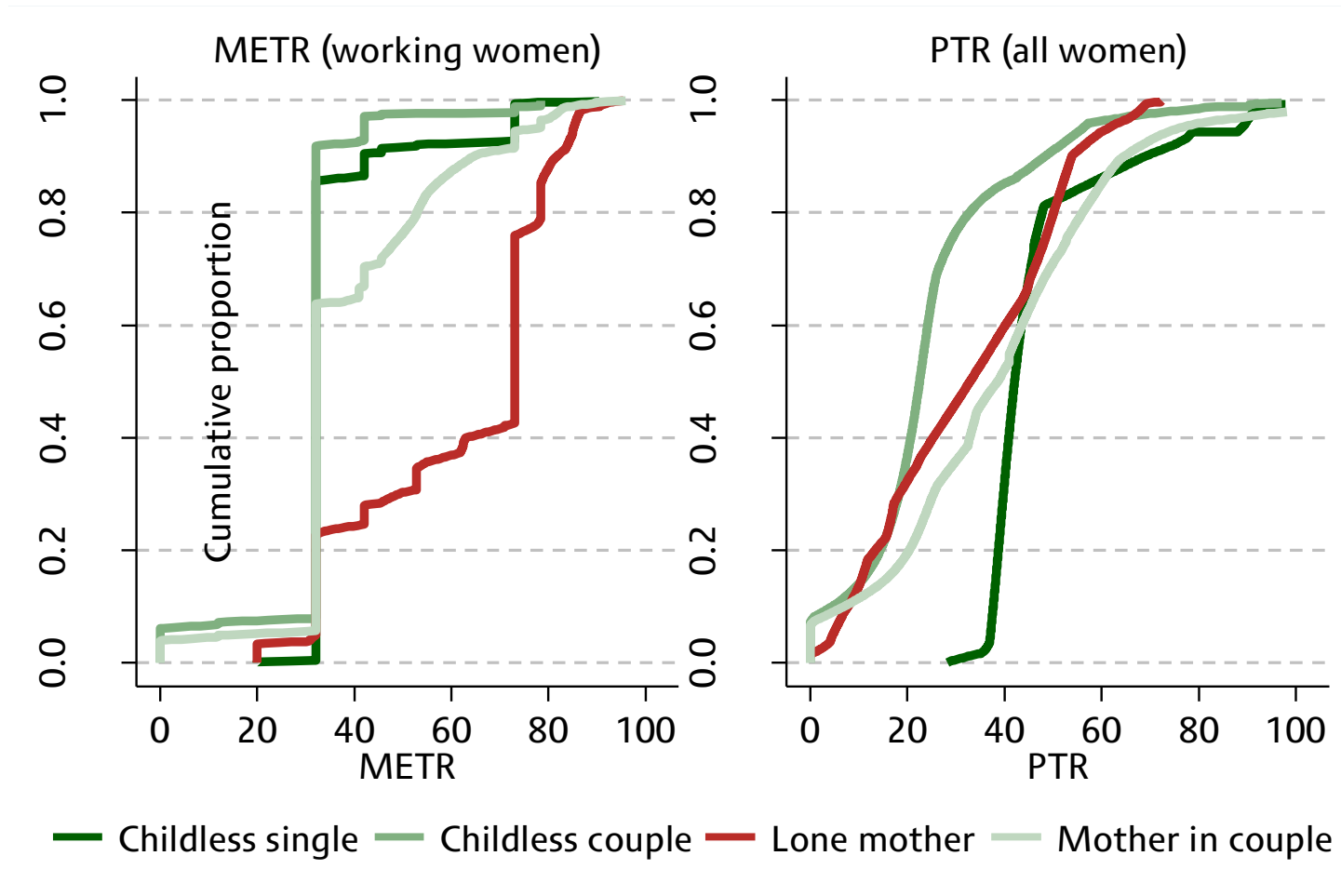
We have full results for (2) (and, in paper, some for (1))

Taking forward looking view makes biggest differences for lone mothers...

Figure 5.4. Distribution of difference between expected FLPTR and PTR, by age and family type



...largely because of patterns in static work incentives



Recap

- Changes in family circumstances mean extent to which tax system distorts work choices changes a lot over lifecycle
- This means a static view of work incentives is misleading when there are dynamic effects to labour supply choices
- This is especially true for lone parents, who face strong incentives to work when lone parents, but for whom additional earnings are highly taxed

Overall summary

- We used a dynamic, structural model, that replicates behaviour of real women, to analyse impact of UK tax and benefit system on inequality and work incentives over the lifetime and across the lifecycle
 - UK tax and benefit system redistributes a lot to low-wage or non-working parents, but this is well-targeted on the lifetime poor, and also (by encouraging work) helps reduce inequalities in gross lifetime earnings
 - Changes in family type mean that the way the tax system disincentives work varies a lot within and between individuals (holding earnings constant)
 - Lone mothers face higher effective tax rates on working than static measures suggest