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A lifetime perspective on the incentive and distributional effects of the UK tax system

Mike Brewer, Monica Costa Dias and Jonathan Shaw

Richard Blundell, Monica Costa Dias, Costas Meghir and Jonathan Shaw

Preliminary – comments welcome

Motivation

- Welfare policies aim to redistribute at minimum efficiency cost
- Reforms typically justified by static arguments and evidence
- But annual inequality is very different to lifecycle inequality
  - Inequality exacerbated in annual snapshot
  - No distinction between inter- and intrapersonal redistribution
  - Difficult to disentangle variation from different sources: permanent individual differences, predictable lifecycle changes, decisions motivated by dynamic considerations, and transitory shocks
- Distortions mismeasured in a static framework
  - Labour supply and education choices partly driven by dynamic considerations

What we do

Today:

- How progressive is the UK tax and benefit system from annual and lifecycle perspectives?
- How has it changed over time?
- What are the implications for inequality and its sources?

Project also addresses:

- How does tax and benefit system affect work incentives over lifecycle?

Literature: redistribution and inequality

- Annual inequality higher than lifecycle inequality
- Annual inequality reduced more by tax and benefit system (Liebman, 2002, Bjorklund and Palme, 1997; Bengtsson et al, 2011)
- Much redistribution is across lifecycle rather than individuals (Bovenberg et al, 2008; O'Donoghue, 2001; Bartels, 2011)
- Retirement pensions possibly most important component of transfers across lifecycle (van de Ven, 2005)
- Majority (50-90%) of inequality due to initial conditions (Huggett et al, 2011; Storesletten et al, 2004; Keane and Wolpin, 1997)

How we do it

- Lifecycle model of female education, employment and saving choices
- Focus is on families containing a woman
- Female decisions sensitive to family circumstances and market conditions, including policy environment
- Careful modelling of employment, earnings and family composition
- Detailed model of UK tax and benefit system
  - Held fixed throughout life

What we leave out

- Retirement is simplified
  - Deterministic retirement age and end of life
  - Retirement excluded from analysis of tax and benefit system
- Taxes and benefits
  - Taxation of capital
  - Indirect taxation
  - Disability
- Endogenous male behavioural responses

Model: overview of female lifecycle

Life in four stages:

1. Initial conditions
   - Wealth and ability
2. Education (up to 18/21)
   - Secondary, A-levels or university (determines type of human capital)
3. Working life (18/21-59)
   - Labour supply {0hrs, 20hrs, 40hrs} and consumption
   - Partnering and childbearing
4. Retirement (60-69)
   - Consumption only

Model: dynamics of female earnings

- Wage equation

s=schooling
i=individual
a=age

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

Log wage — Market wage rate — Experience — Productivity

- Experience accumulation

$$e_{ia+1} = e_{ia}(1 - \delta_s) + \delta_{sPT} 1[l_{ia} = 20] + \delta_{sFT} 1[l_{ia} = 40]$$

Depreciation rate — PT accumulation rate — FT accumulation rate

Model: dynamics of family income

- (Exogenous) family formation dynamics
  - Children
    - At most 1 child
    - Arrival probability depends on female age, education and presence of partner
    - Departure with certainty when child reaches age 18
  - Partners
    - Characterised by education, employment status and wage
    - Arrival probability for male with given education depends on female age and education
    - Departure probability depends on female age, presence of child and male education

Model: dynamics of family income

- Male wage equation and selection into employment

$$w^{m}_{s^m ia} = \ln W^{m}_{s^m} + \alpha^{m}_{s^m} \ln(a - 18) + v^{m}_{s^m ia}$$

Log wage — Market wage rate — Age — Productivity

$$v^{m}_{s^m ia} = \rho^{m} v^{m}_{s^m ia-1} + u^{m}_{s^m ia}$$

$$u^{m}_{s^m ia} \sim N(0, \sigma^{2}_{us^m})$$ Ongoing couples

$$v^{m}_{s^m ia} \sim N(0, \sigma^{2}_{vs^m})$$ New couples

- Detailed model of tax and benefit system (FORTAX)
  - Mostly 2006 tax and benefit system
  - Taxes: income tax, NI, council tax
  - Benefits: child benefit, maternity grant, tax credits, income support, housing benefit, council tax benefit, free school meals

Model: decision-making environment

- Risk averse individuals faced with uncertainty
  - Own productivity (health)
  - Family dynamics: partnering/separation, child bearing
  - Partner employment and income
- No insurance market
  - Only implicit insurance through human capital, savings and public policy
- Credit constraints
  - So public policy may facilitate transfers across lifecycle
- Decisions taken to maximise expected lifetime utility

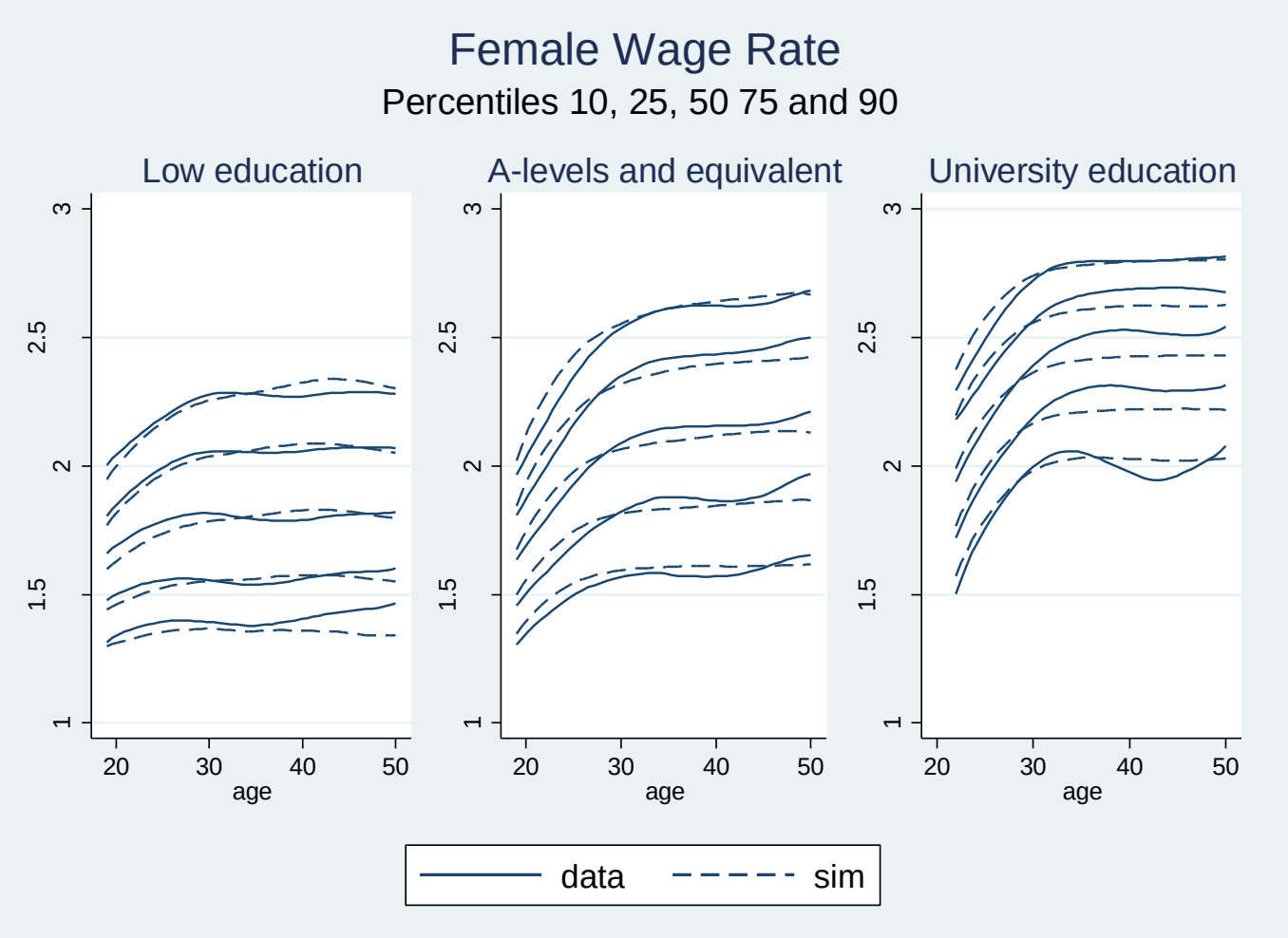
$$V_a(X_{ia}) = \max_{\{c,l\}a,\ldots,A} E\left\{\sum_{b=a}^{A} \beta^{b-a} U(c_{ib}, l_{ib}; X_{ib}) \mid X_{ia}\right\}$$

Value — State variables — Utility function — Consumption — Labour supply

Model: data and estimation

- All results below are based on data simulated by the model
  - Lifecycles simulated for lots of imaginary individuals given initial conditions
  - Simulating an individual involves:
    - Drawing exogenous shocks (e.g. for productivity, family composition, ability)
    - Using the model to determine the choices the individual will make at each age
- What guarantees that the simulated data mimics patterns in the real data?
  - Model designed to be able to capture key features of real data
  - Parameters chosen to make simulated data look as like real data as possible
- Real data: BHPS unbalanced panel of 5,300 females over 16 waves, 1991–2006
  - 12% in all 16 waves, 56% in six waves or fewer; 17% observed starting working life
- Estimation by method of simulated moments (MSM)
  - Calculate moments of real data
  - Calculate same moments of simulated data
  - Use minimisation routine to minimise distance between real and simulated moments

Model fit (1): Female wage rates



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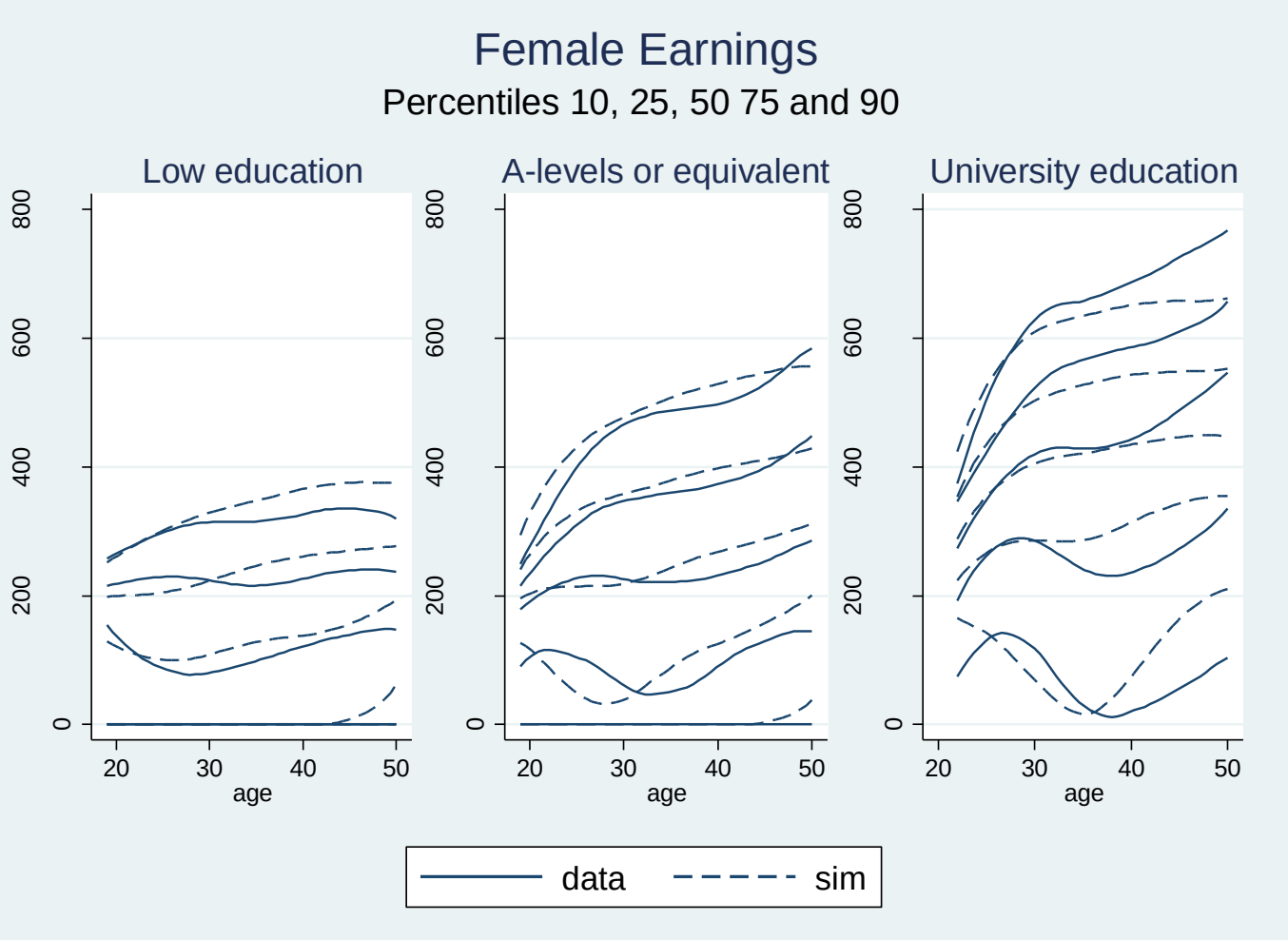
Model fit (2): Female earnings



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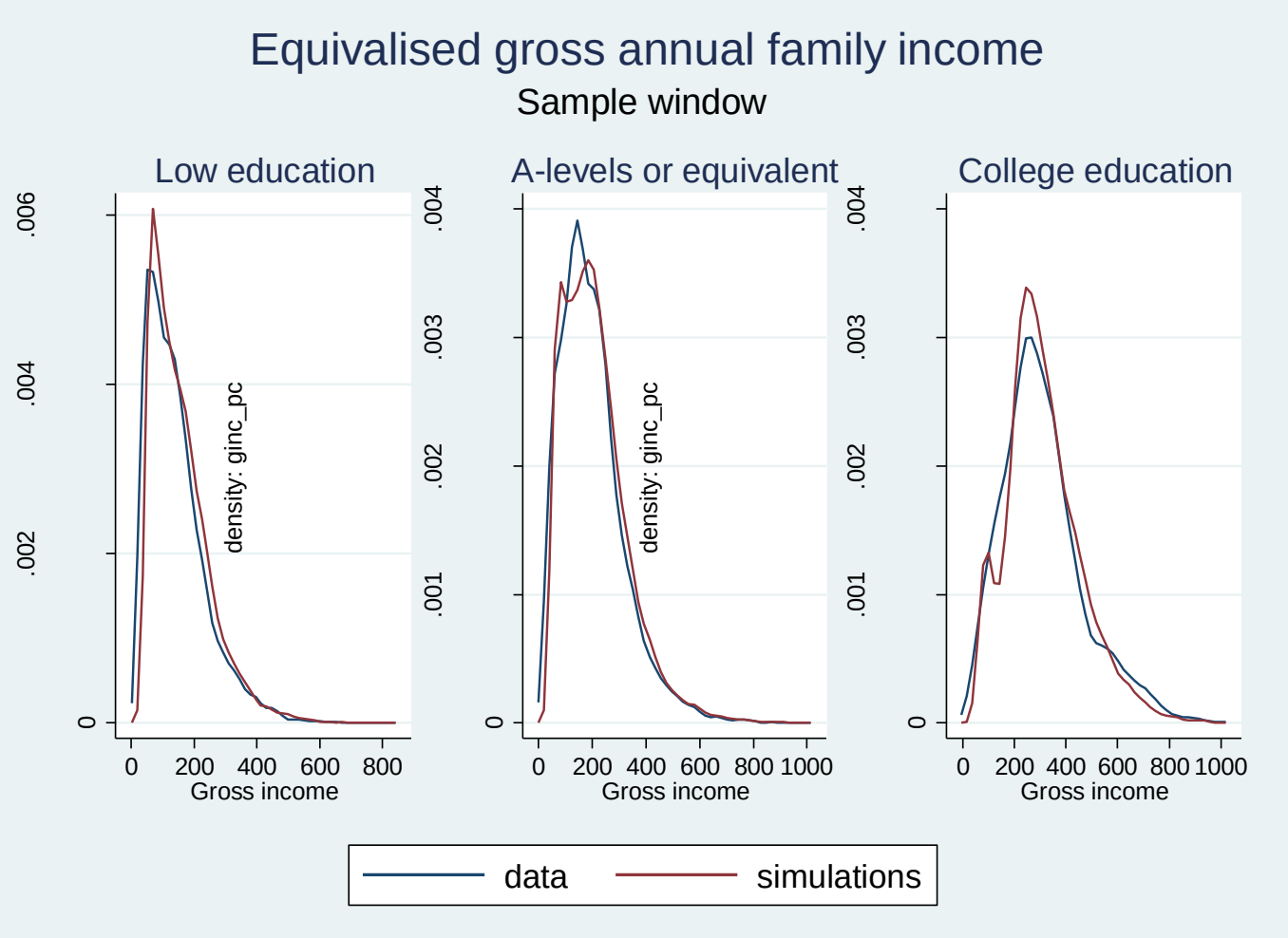
Model fit (3): Gross income distributions



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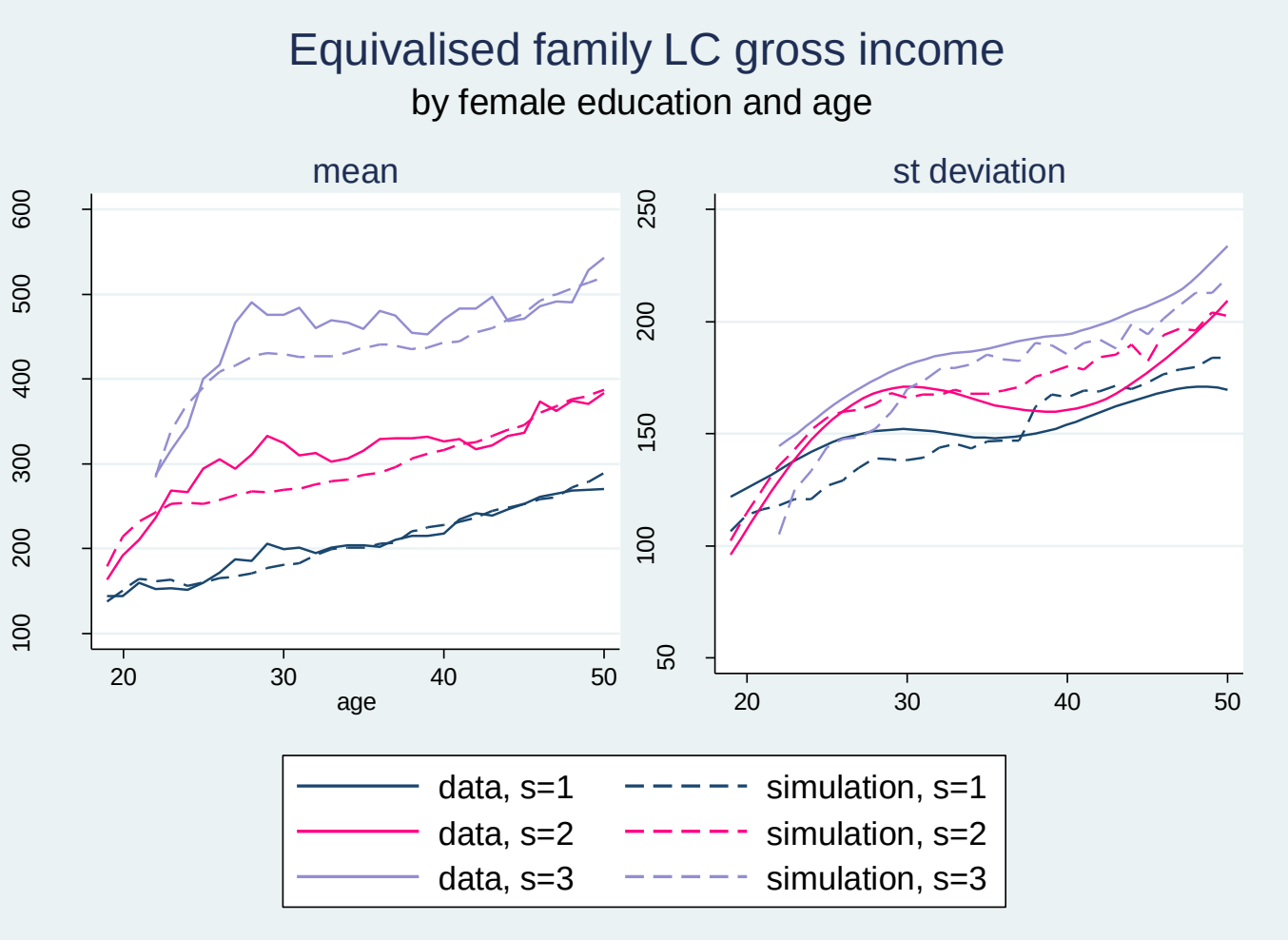
Model fit (4): gross income across the lifecycle



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Model fit (5): gross income mobility

Transitions for equivalised gross family income; consecutive years

Real data	Quintile 1	2	3	4	Quintile 5
Quintile 1	0.801	0.165	0.025	0.007	0.002
2	0.109	0.650	0.196	0.039	0.006
3	0.023	0.127	0.627	0.200	0.023
4	0.005	0.028	0.141	0.644	0.182
Quintile 5	0.002	0.006	0.021	0.108	0.863

Simulated data	Quintile 1	2	3	4	Quintile 5
Quintile 1	0.801	0.157	0.037	0.004	0.000
2	0.118	0.688	0.161	0.027	0.005
3	0.039	0.124	0.619	0.207	0.010
4	0.015	0.029	0.152	0.637	0.166
Quintile 5	0.002	0.012	0.015	0.132	0.840

Definitions: income, average tax rate (ATR) and progressivity

- Gross earnings is earnings from employment
- Equivalised using modified OECD equivalence scale
- Average tax rate:

$$ATR = \frac{N}{E} = \frac{T - B}{E}$$

E = equivalised gross family earnings

N = equivalised taxes net of benefits

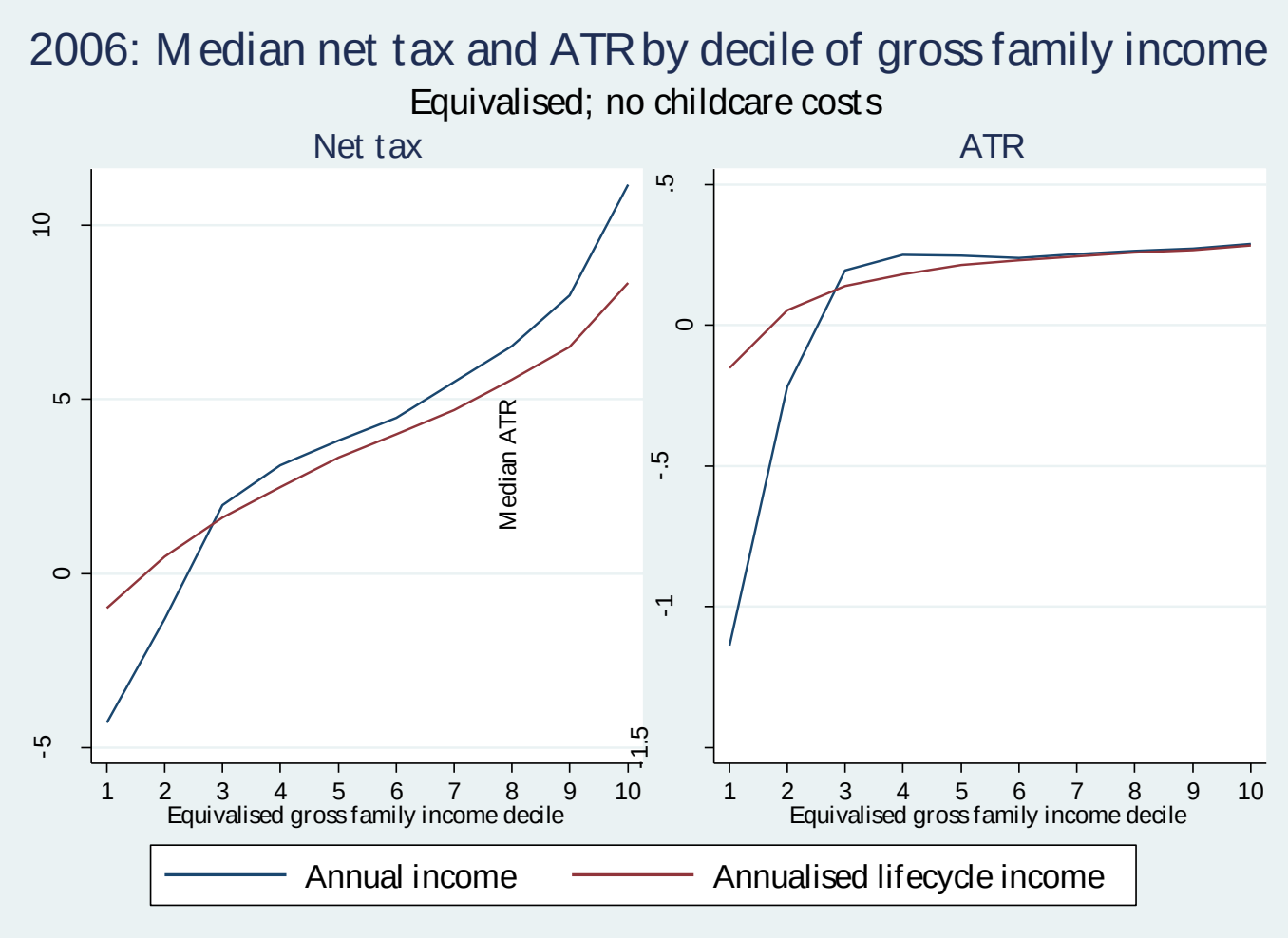
T = equivalised family tax liability

B = equivalised family benefit entitlements

- Progressivity = ATR increases with equivalised gross family earnings
- Cross-section dataset: randomly selected one age for each family

Q1: How progressive is the UK tax and benefit system from annual and lifecycle perspectives?

Median net tax and ATR by gross income decile
2006 tax system



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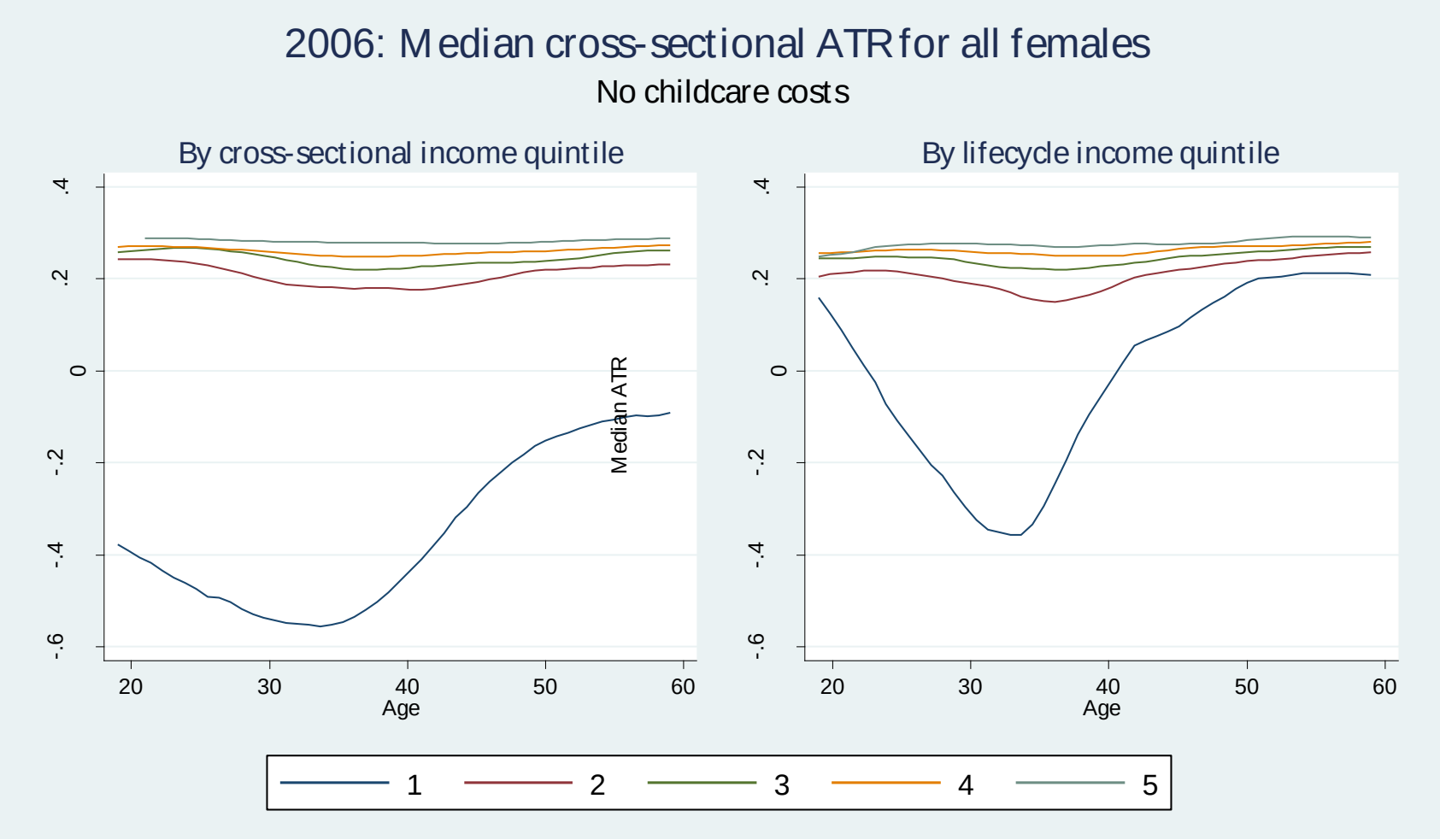
Median cross-sectional ATR by age and quintile

2006 tax system



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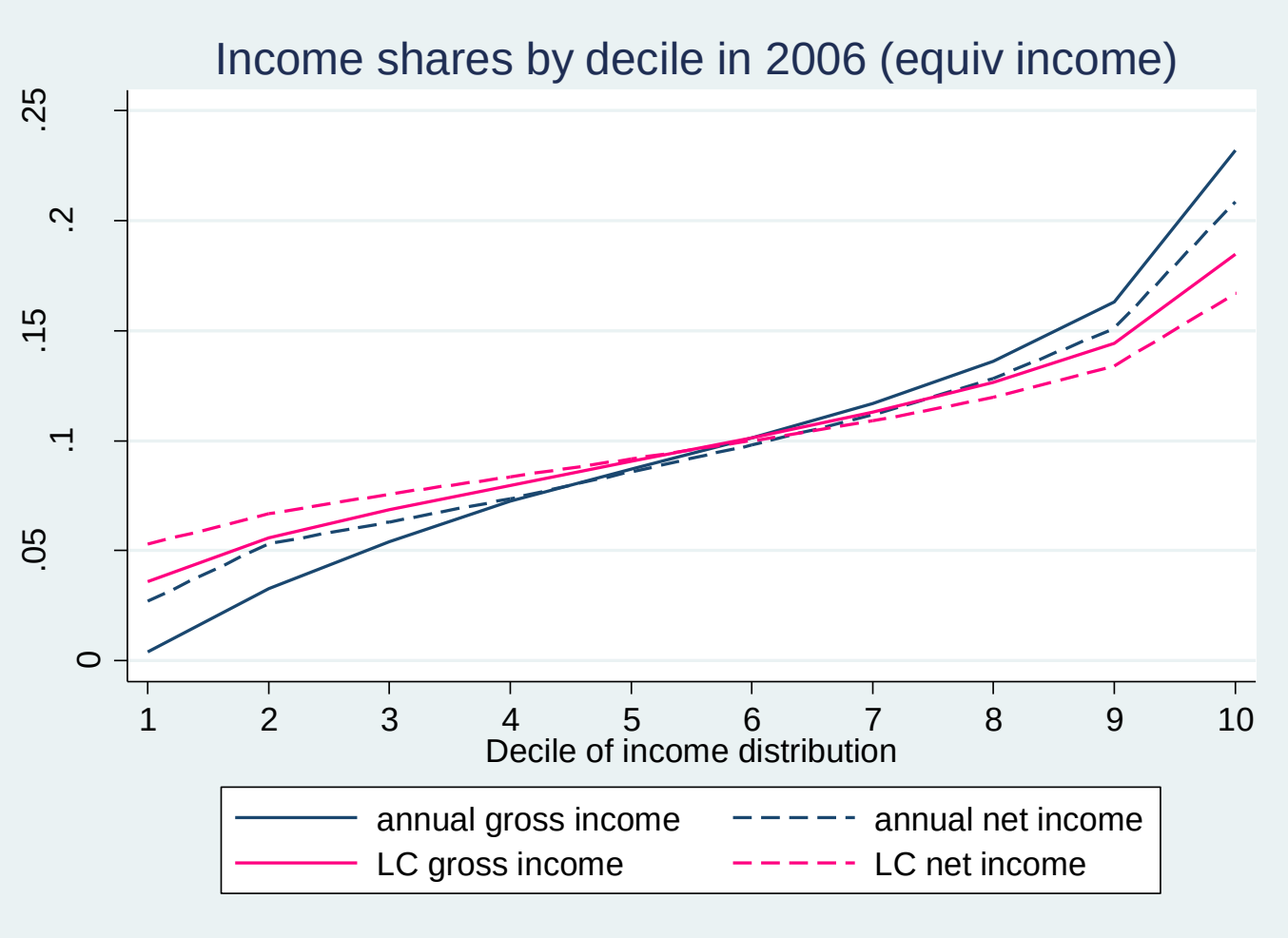
Income shares by decile
2006 tax system



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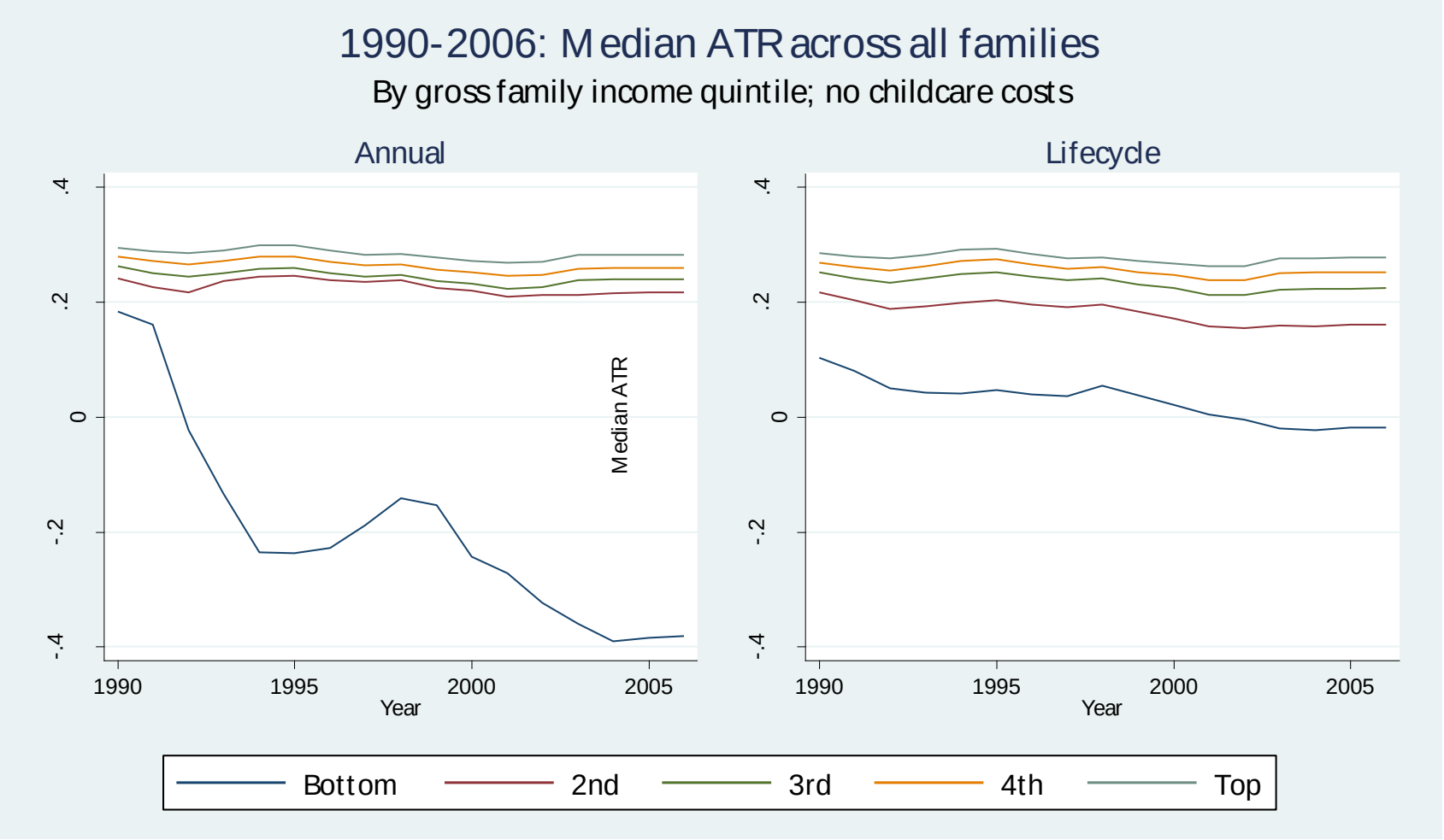
Q2: How has progressivity changes over time?

Change in median ATR by income quintile, 1990–2006



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Change in quintile income shares, 1991–2006

	Annual gross	Annual net	Lifecycle gross	Lifecycle net
Quintile 1	+0.2%	+1.4%	-0.0%	+0.6%
2	-0.9%	-0.3%	-0.2%	+0.1%
3	+0.0%	-0.3%	-0.1%	-0.0%
4	+0.2%	-0.2%	+0.0%	-0.2%
Quintile 5	+0.5%	-0.6%	+0.3%	-0.5%

Q3: What are the implications for inequality and its sources?

Variance decomposition for annual income: within vs between groups

	Within	Between	Total
Female earnings	0.445	0.555	1
Equivalised gross family income	0.563	0.437	1
Equivalised net family income	0.577	0.423	1
% reduction in variance	60.1	62.3	61.1

Within = variation in annual income (i.e. transitory)

Between = variation in lifecycle income (i.e. permanent)

Change in annual income variance: 1991–2006

	Within	Between	Total
Equivalised gross family income	-0.9%	+0.3%	-0.4%
Equivalised net family income	-8.0%	-6.5%	-6.7%

Variance decomposition for lifecycle income

2006	Initial conditions	Education	Family	Residual	Total
Female earnings	0.314	0.244	0.020	0.419	1
Equivalised gross family income	0.169	0.234	0.055	0.538	1
Equivalised net family income	0.174	0.216	0.035	0.571	1
% reduction in variance	62.1	65.9	76.0	60.8	63.1
1991			**Family**		
Equivalised gross family income			0.051		
Equivalised net family income			0.047		
% reduction in variance			63.0		

Conclusions

- Tax and benefit system broadly progressive, but not clearly more so from cross-sectional rather than lifecycle perspective
- We are less pessimistic than other papers about ability of tax and benefit system to affect lifecycle outcomes
- Reforms since 1990 have:
  - Favoured bottom of distribution
  - Affected within (annual) and between (lifecycle) inequality fairly evenly
- Sources of lifecycle inequality:
  - Initial conditions and education account for over half of variability in lifecycle earnings
  - Education important: selection in partnering and odds of separation