Microsimulation and Tax Reform: Lessons from the Mirrlees Review

Recent Developments in Behavioural Microsimulation
ZEW Workshop

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Mircosimulation Evidence and Tax Design

- First, a little background to the *Mirrlees Review*
- Then a discussion on the role of evidence and microsimulation loosely organised under five headings:

1. Key margins of adjustment to tax reform
2. Measurement of effective tax rates
3. The importance of information and complexity
4. Evidence on the size of responses
5. Implications for tax design

An Analysis in Two Steps

- The first step (impact) is a positive analysis of household decisions. There are two dominant empirical approaches to the measurement of the impact of tax reform…
  - both prove useful:
  - 1. A 'quasi-experimental' evaluation of the impact of historic reforms /and randomised experiments
  - 2. A 'structural' estimation based on a general discrete choice model with (unobserved) heterogeneity
- The second step (optimality) is the normative analysis or optimal policy analysis
  - Examines how to best design benefits, in-work tax credits and earnings tax rates with (un)observed heterogeneity and unobserved earnings 'capacity'

A optimal tax design framework

- Assume earnings (and certain characteristics) are all that is observable to the tax authority
  - relax below to allow for 'partial' observability of hours

Social welfare, for individuals of type X, ε

$$W = \int_X \int_\varepsilon \Upsilon(U(c(h^*; T(w, h^*; X), h^*; X, \varepsilon))dF(\varepsilon)dG(X)$$

The tax structure $T(.)$ is chosen to maximise W, subject to:

$$\int_X \int_\varepsilon T(wh^*, h^*; X)dF(\varepsilon)dG(X) \geq \overline{T}(= -R)$$

for a given R.

- We solve for T(.) with structural estimation and simulation.

What is the Mirrlees Review?

- Review of tax design from first principles
  - For modern open economies in general and UK in particular
  - Reflect changes in the world, changes in our understanding and increased empirical knowledge
- Two volumes:
  - I. 'Dimensions of Tax Design': 13 chapters on specific areas co-authored by international experts and IFS researchers, along with 30 expert commentaries – free on the web and at OUP
  - I will draw on contributions by Brewer, Saez and Shephard, Adam and Browne, Banks and Diamond, Meghir and Phillips, Hoynes, Laroque and Moffitt.
  - II. 'Tax by Design': 20 chapters providing an integrated picture of tax design and reform, written by the editors

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Increased empirical knowledge: – some examples

- labour supply responses for individuals and families
  - at the intensive and extensive margins
  - by age and demographic structure
- taxable income elasticities
  - top of the income distribution using tax return information
- income uncertainty
  - persistence and magnitude of earnings shocks over the life-cycle
- ability to (micro-)simulate marginal and average rates
  - simulate reforms

The extensive – intensive distinction is important for a number of reasons:

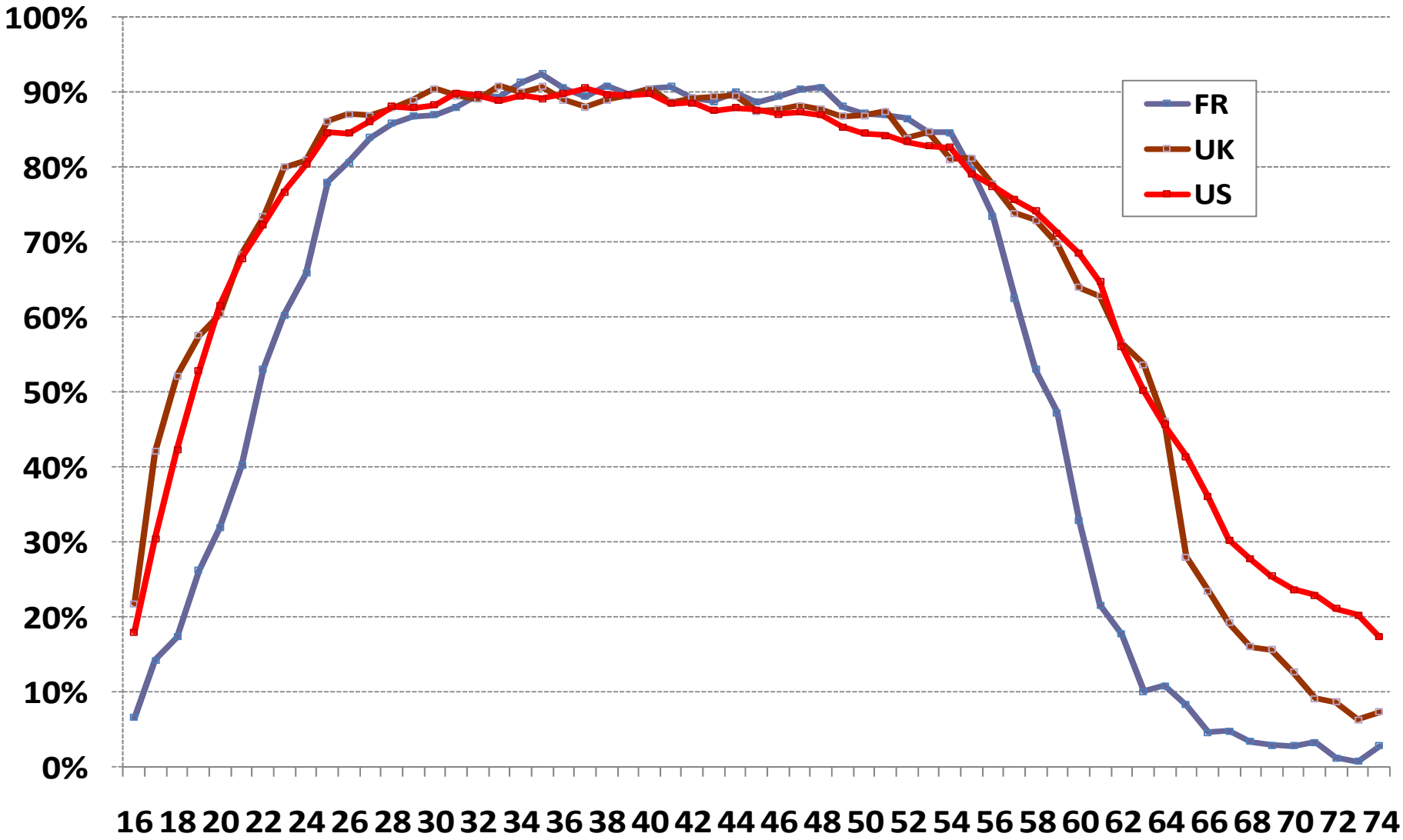
- Understanding responses to tax and welfare reform
  - Heckman, Wise, Prescott, Rogerson, .. all highlight the importance of extensive labour supply margin,
  - perhaps too much….
- The size of extensive and intensive responses are also key parameters in the recent literature on earnings tax design
  - used heavily in the Mirrlees Review.
- But the relative importance of the extensive margin is specific to particular groups
  - I'll examine a specific case of low earning families (from Blundell and Shephard, 2010) in more detail in what follows

The focus here is on earnings taxation

- Leading example of the mix of theory and evidence
- Key implications for tax design
- Earnings taxation, in particular, takes most of the strain in distributional adjustments of other parts of the reform package (VAT base broadening, for example)
  - I'll return to VAT reform at the end.

- So where are the key margins of response?
- Evidence suggests they are not all the extensive margin..
  - intensive and extensive margins both matter
  - they matter for tax policy evaluation and earnings tax design
  - and they matter in different ways by age and demographic groups
- Getting it right for men

Employment for men by age – FR, UK and US 2007



Blundell, Bozio and Laroque (2010)

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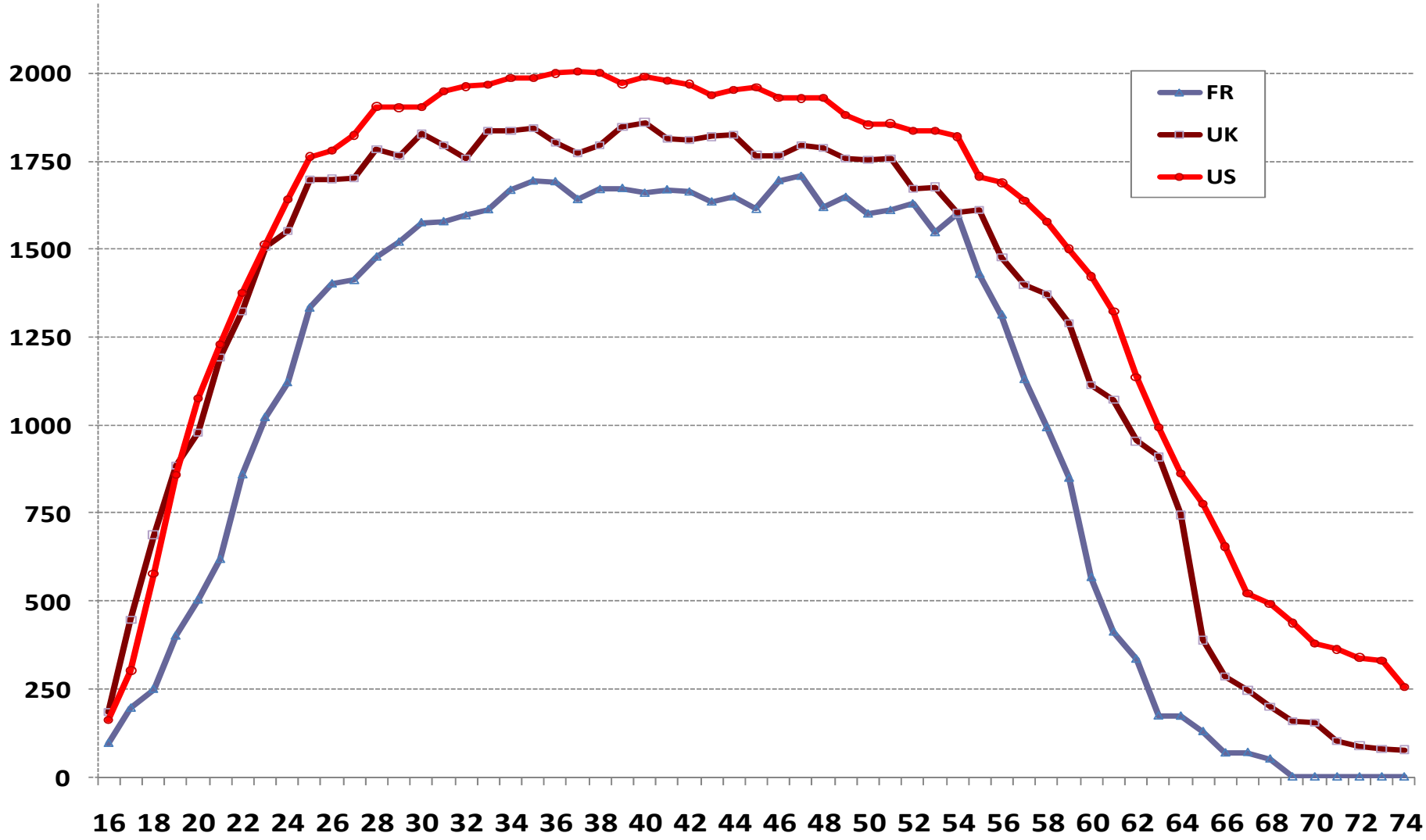
Total Hours for men by age – FR, UK and US 2007



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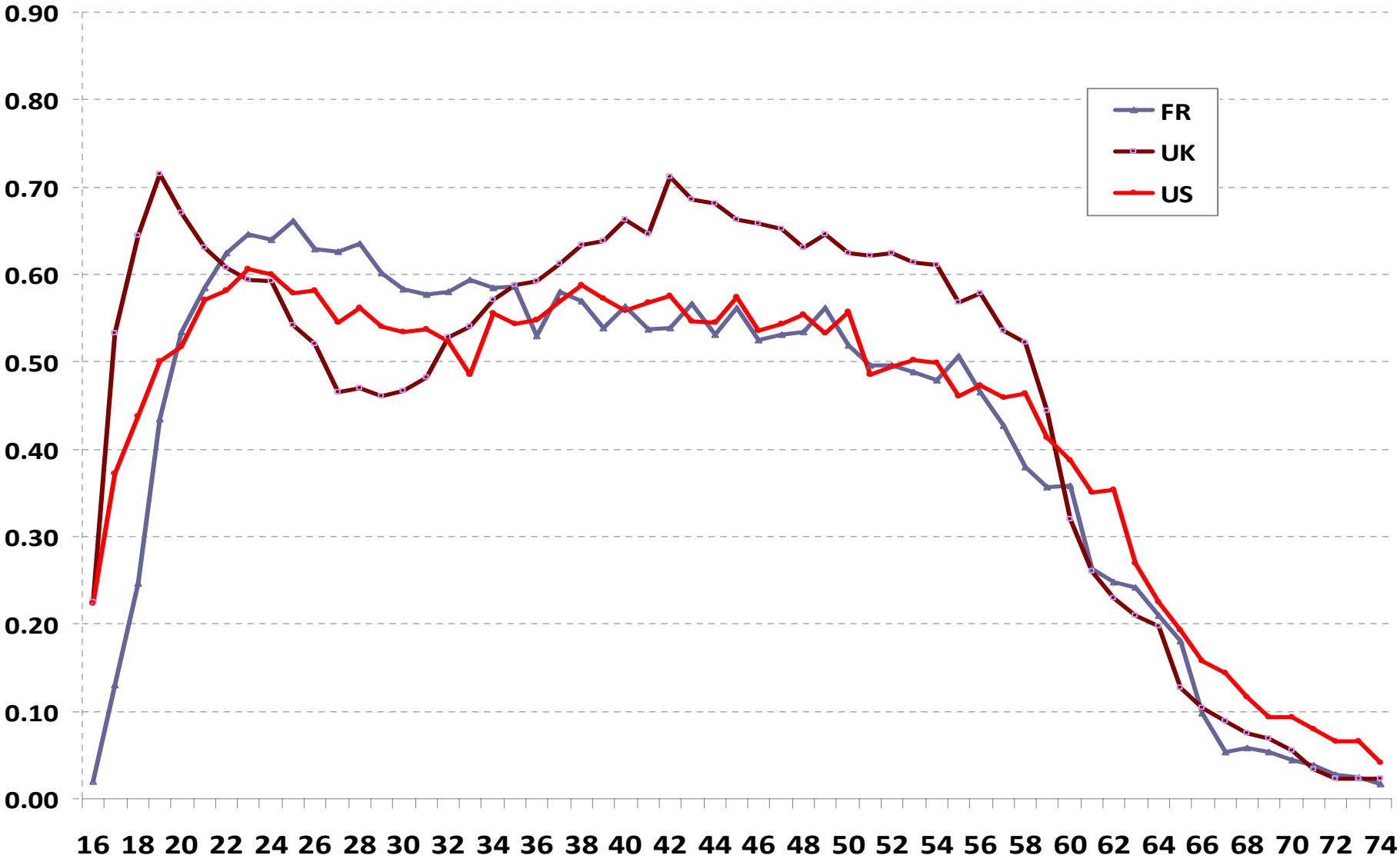
Key Margins of Adjustment

- and for women …..

Female Employment by age – US, FR and UK 1977



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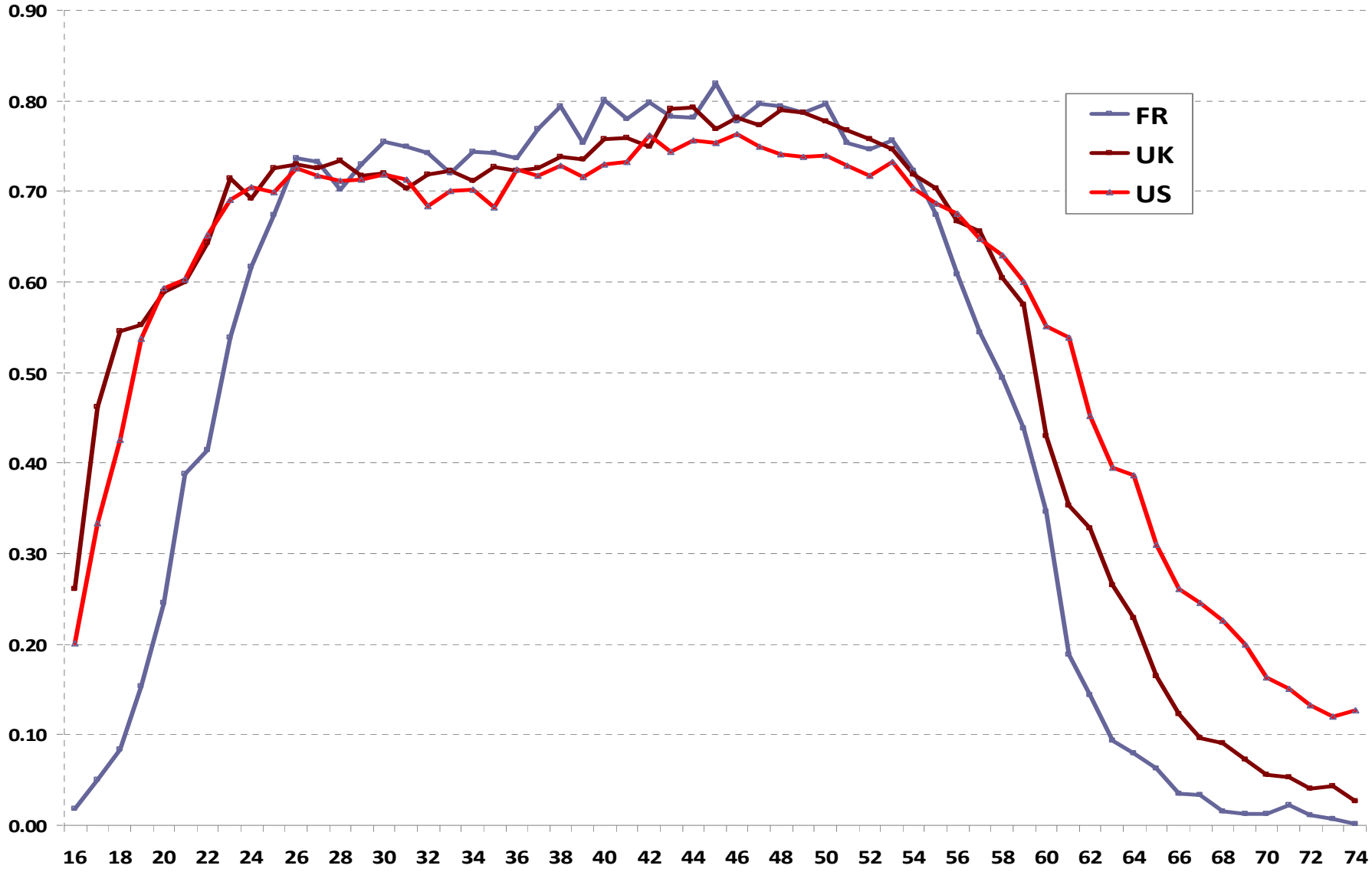

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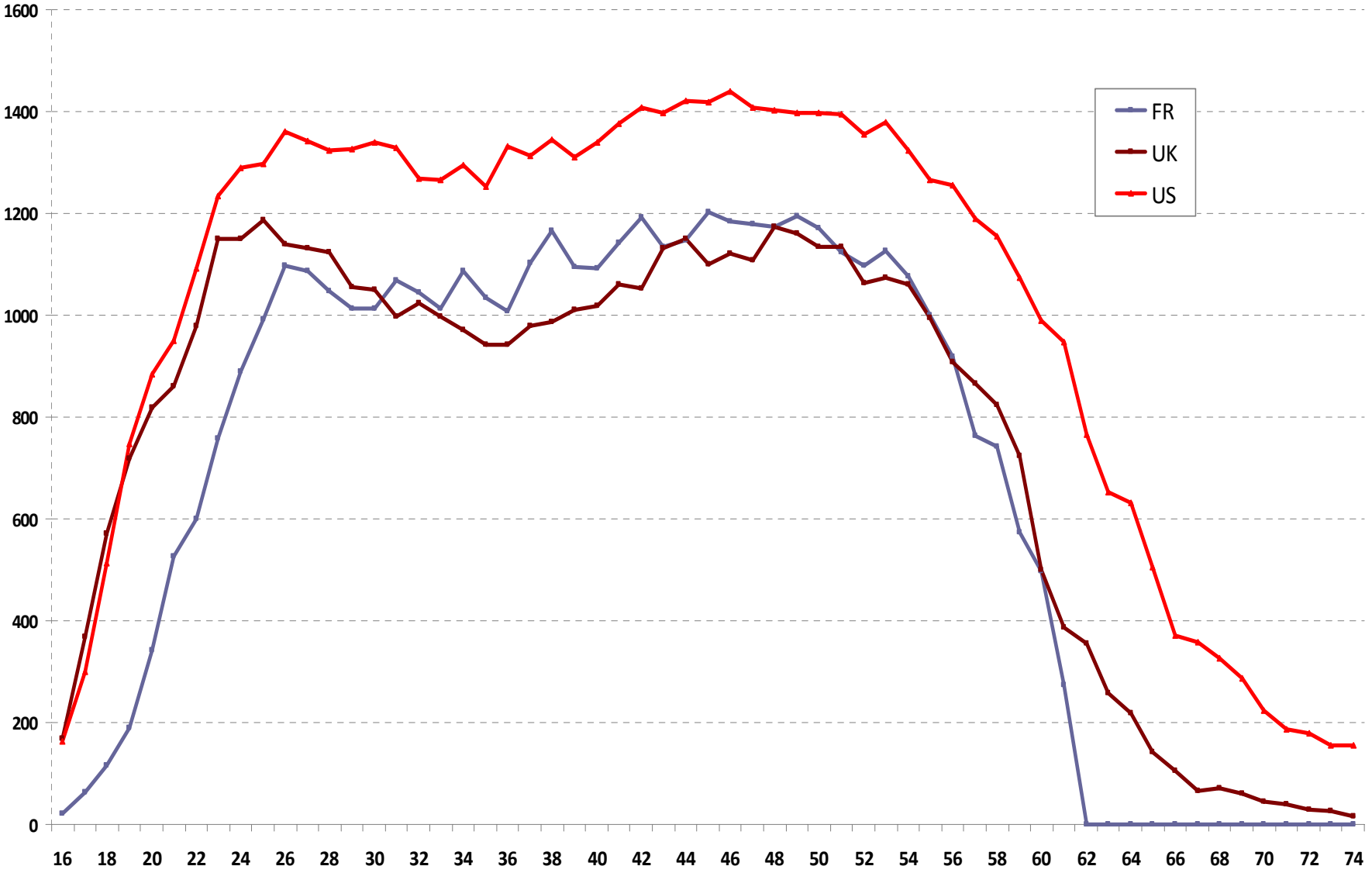
Female Total Hours by age – US, FR and UK 2007



Blundell, Bozio and Laroque (2010)

Bounds on Intensive and Extensive Responses (1977-2007)

	Year	Men 16-29	Women 16-29	Men 30-54	Women 30-54	Men 55-74	Women 55-74
FR	I-P, I-L	[-37,-28]	[-23, -19]	[-59, -56]	[-49, -35]	[-11, -8]	[-10, -9]
	E-L, E-P	[-54, -45]	[-19, -16]	[-27, -23]	[71, 85]	[-28, -25]	[6, 7]
	Δ	-82	-38	-82	36	-36	-3
UK	I-P, I-L	[-42, -36]	[-26, -23]	[-48, -45]	[-3, -2]	[-22, -19]	[-8, -6]
	E-L, E-P	[-35, -29]	[14, 17]	[-25, -22]	[41, 41]	[-23, -20]	[15, 17]
	Δ	-71	-9	-70	39	-42	10
US	I-P, I-L	[-6, -6]	[1, 1]	[-5, -5]	[14, 19]	[3, 3]	[3, 5]
	E-L, E-P	[-13, -13]	[21, 21]	[-14, -14]	[72, 77]	[3, 3]	[33, 35]
	Δ	-19	22	-19	90	6	38

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Blundell, Bozio and Laroque (2010)

Why is this distinction important for tax design?

- Some key lessons from recent tax design theory (Saez (2002, Laroque (2005), ..)
- A ‘large’ extensive elasticity at low earnings can ‘turn around’ the impact of declining social weights
  - implying a higher optimal transfer to low earning workers than to those out of work
  - a role for earned income tax credits
- But how do individuals perceive the tax rates on earnings implicit in the tax credit and benefit system - salience?
  - are individuals more likely to ‘take-up’ if generosity increases? – marginal rates become endogenous…
- Importance of margins other than labour supply/hours
  - use of taxable income elasticities to guide choice of top tax rates
- Importance of dynamics and frictions

Focus here on tax rates on lower incomes

Main concerns with current welfare/benefit systems

- Participation tax rates at the bottom remain very high in UK and elsewhere
- Marginal tax rates are well over 80% for some low income working families because of phasing-out of means-tested benefits and tax credits
  - Working Families Tax Credit + Housing Benefit in UK
  - and interactions with the income tax system
  - for example, we can examine a typical budget constraint for a single mother in the UK…

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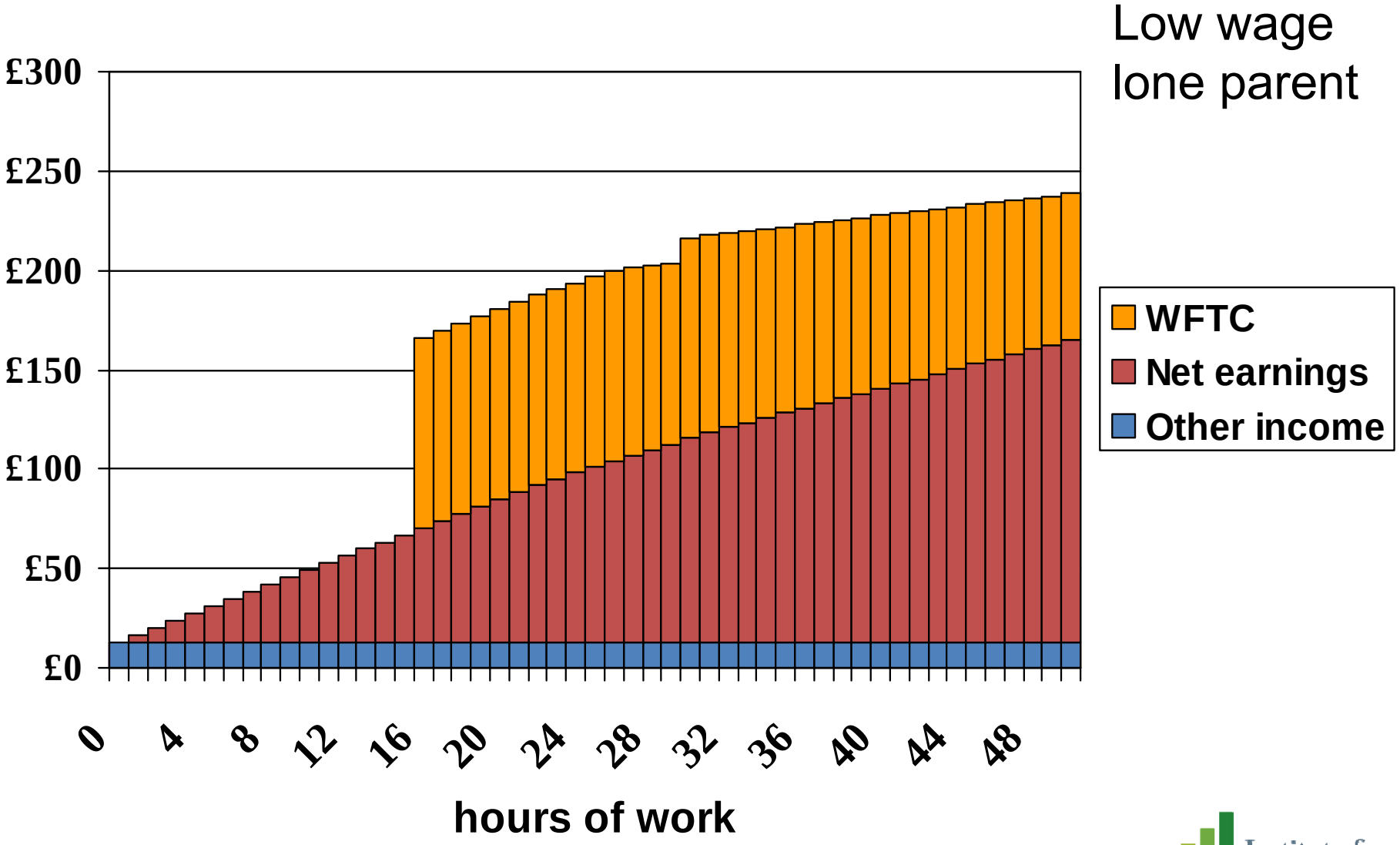
The interaction of WFTC with other benefits in the UK



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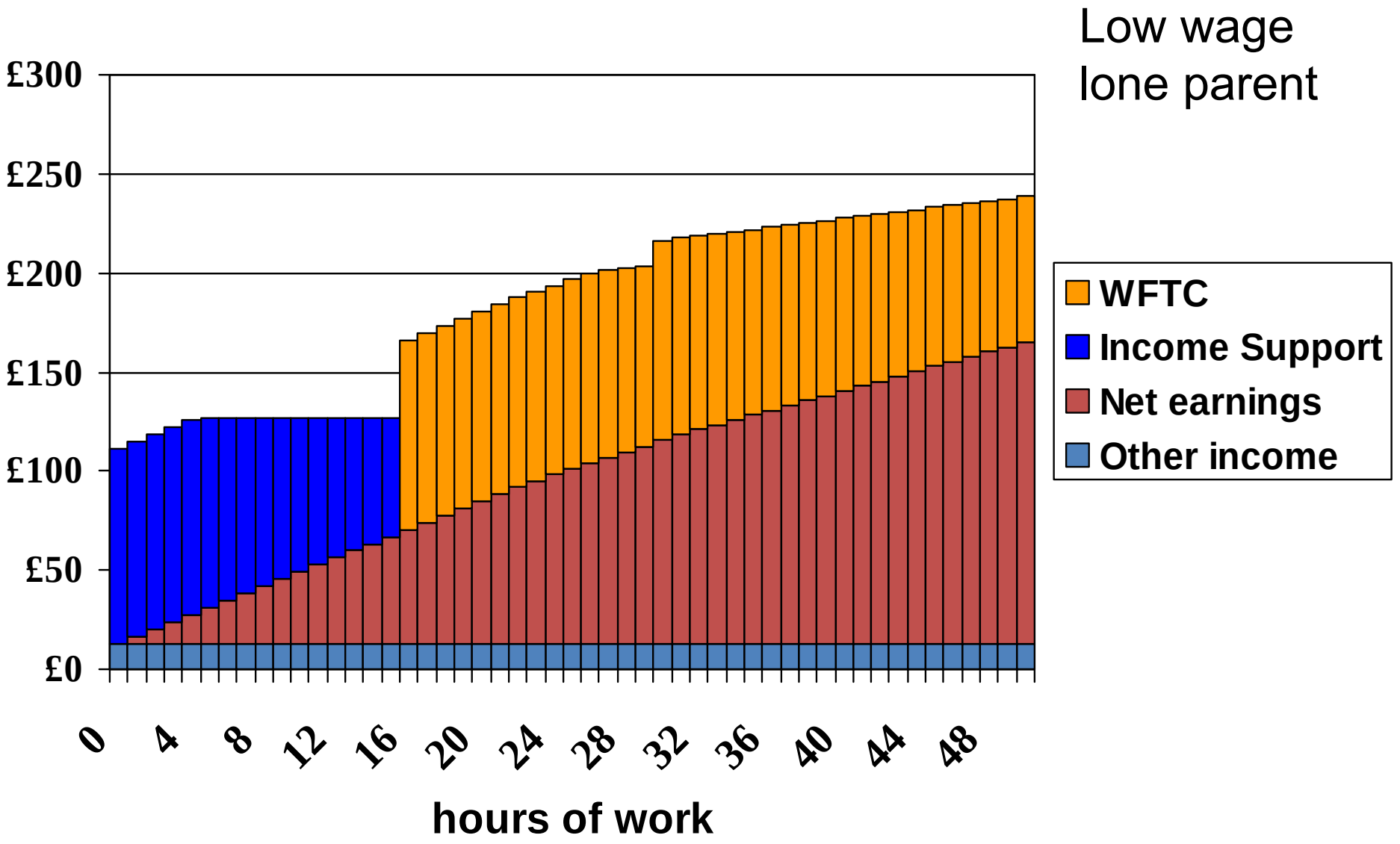

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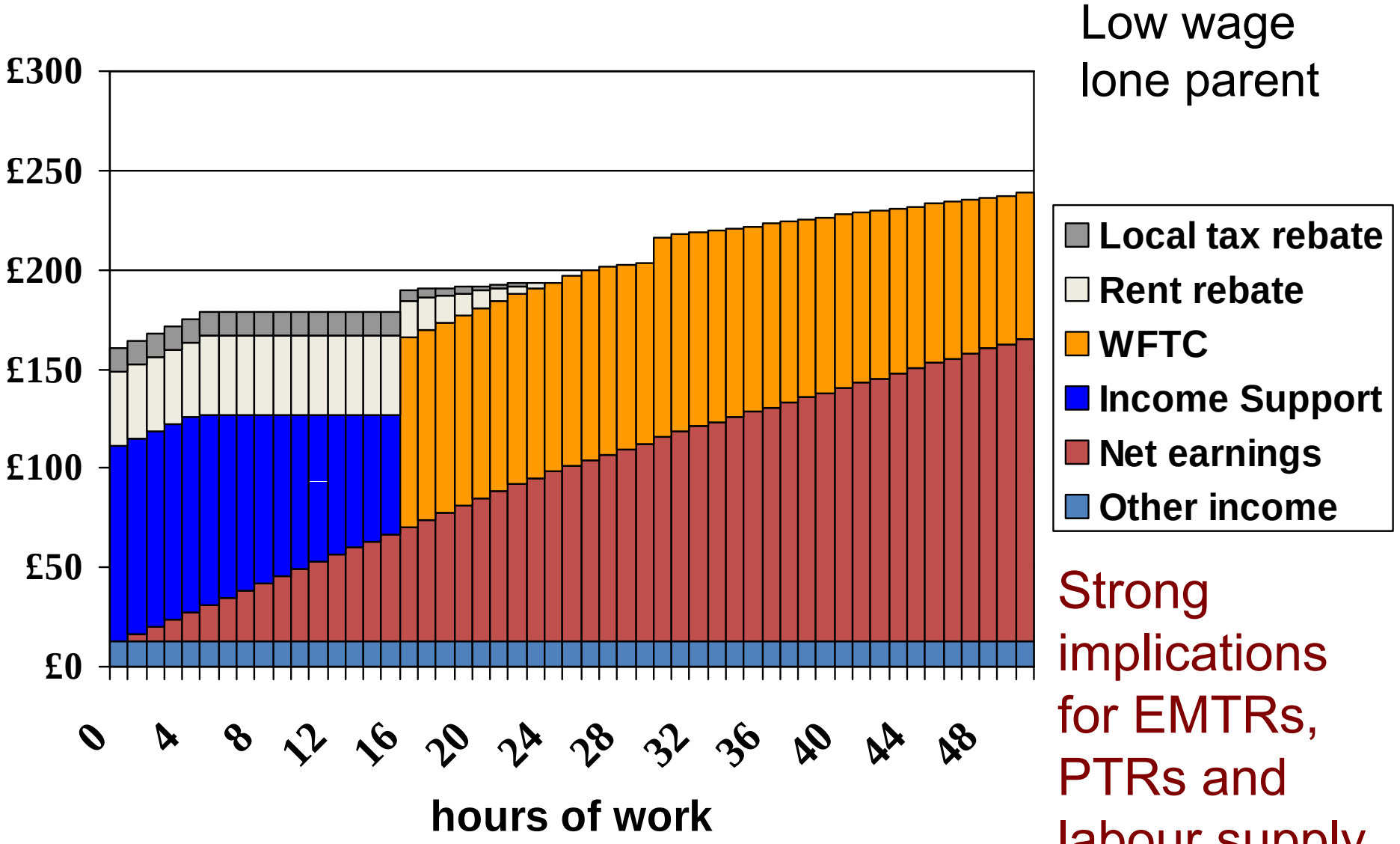
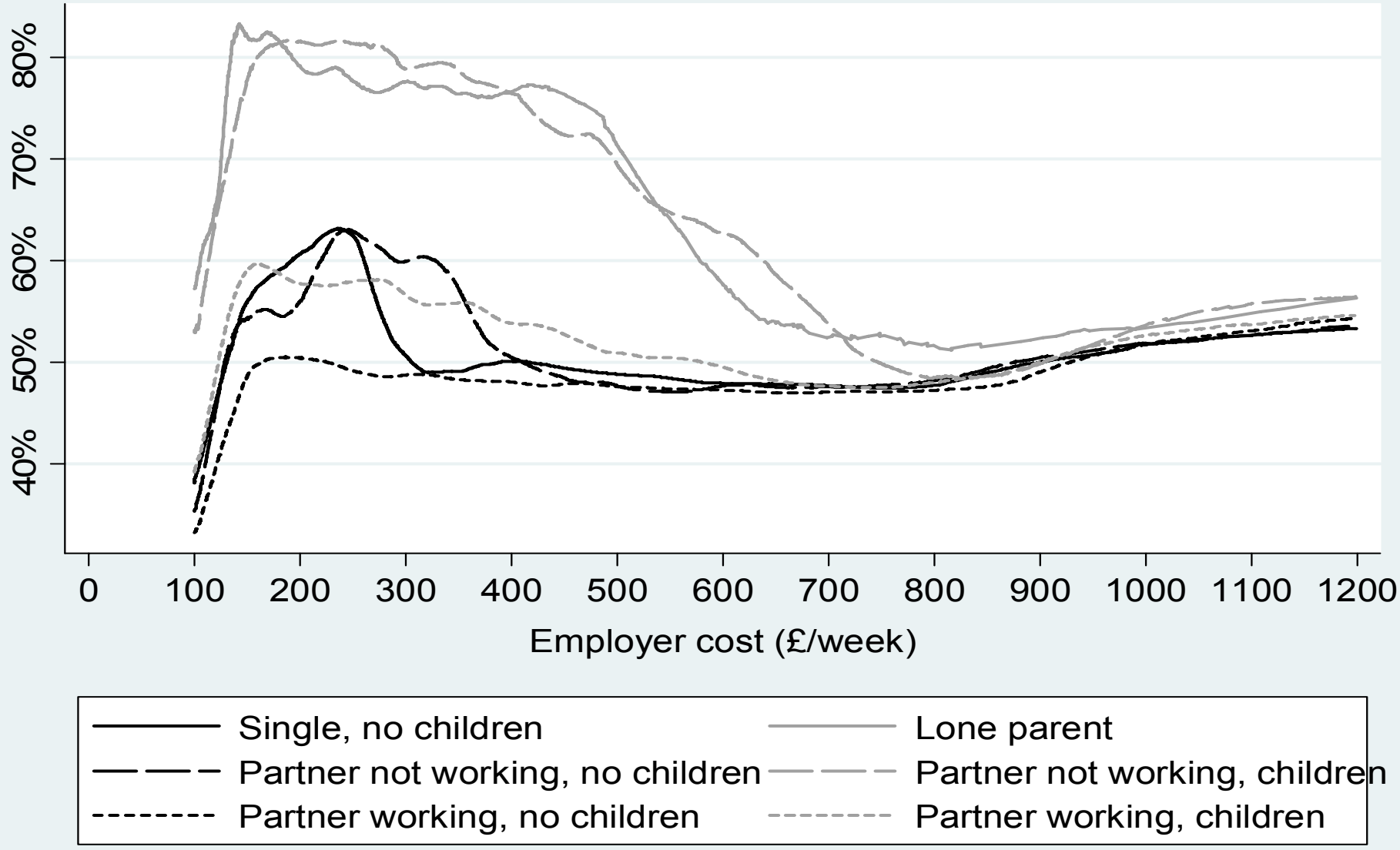


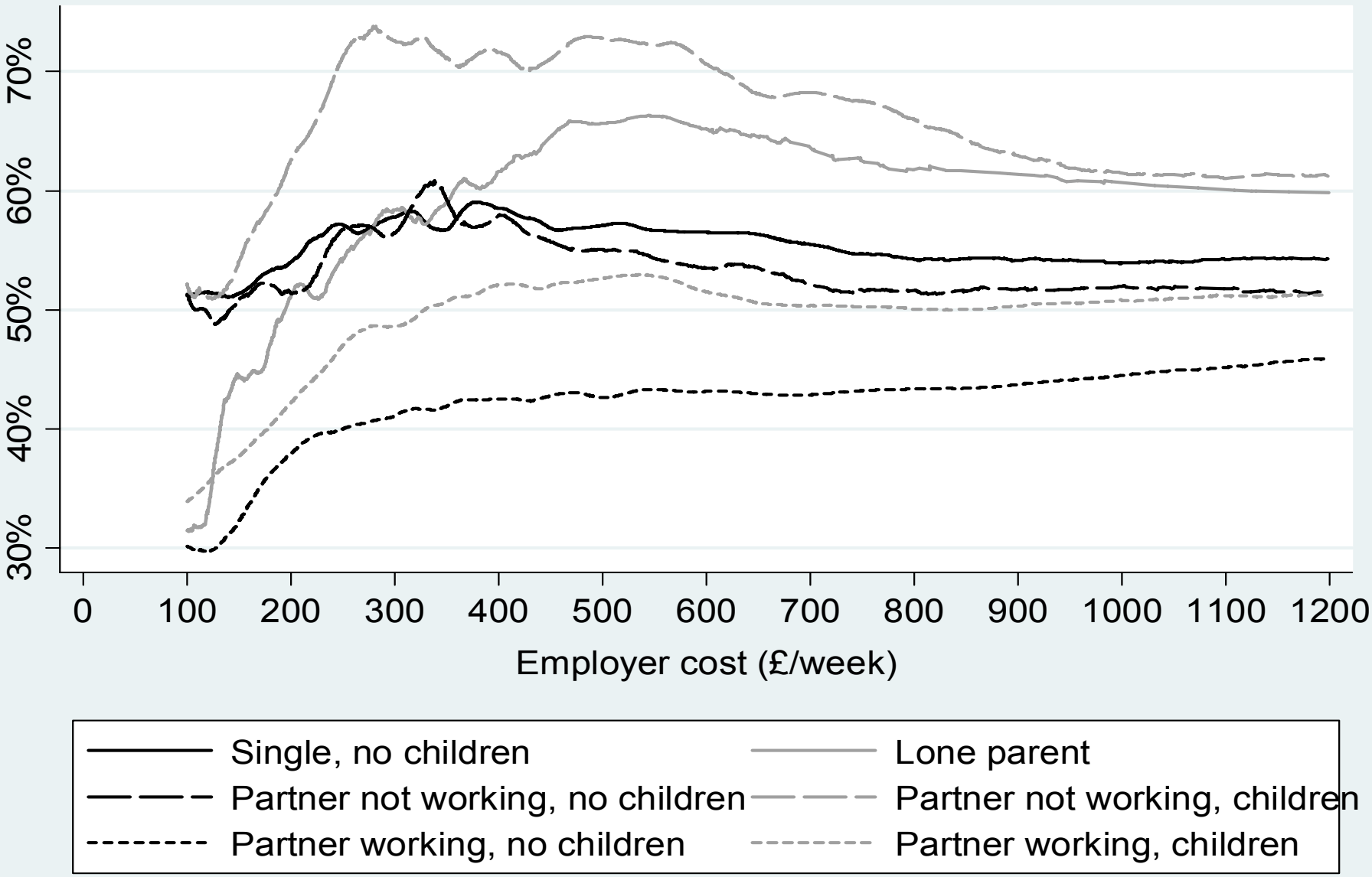
Strong implications for EMTRs, PTRs and labour supply

Average EMTRs across the earnings distribution for different family types



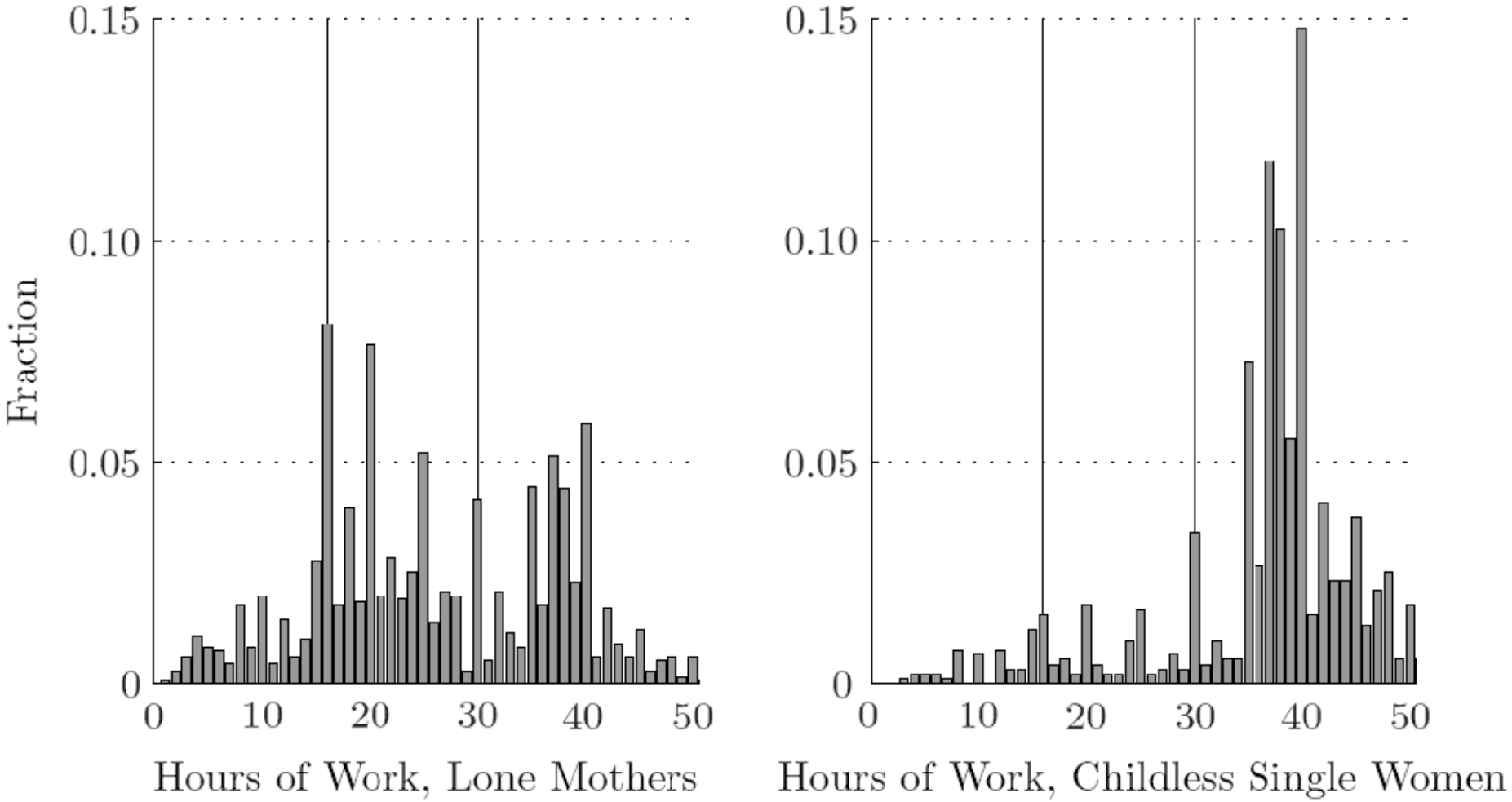
Source: Chpt 4, Tax by Design, Mirrlees

Average PTRs for different family types



Can the reforms explain weekly hours worked?

Single Women (aged 18-45) - 2002



Blundell and Shephard (2009)

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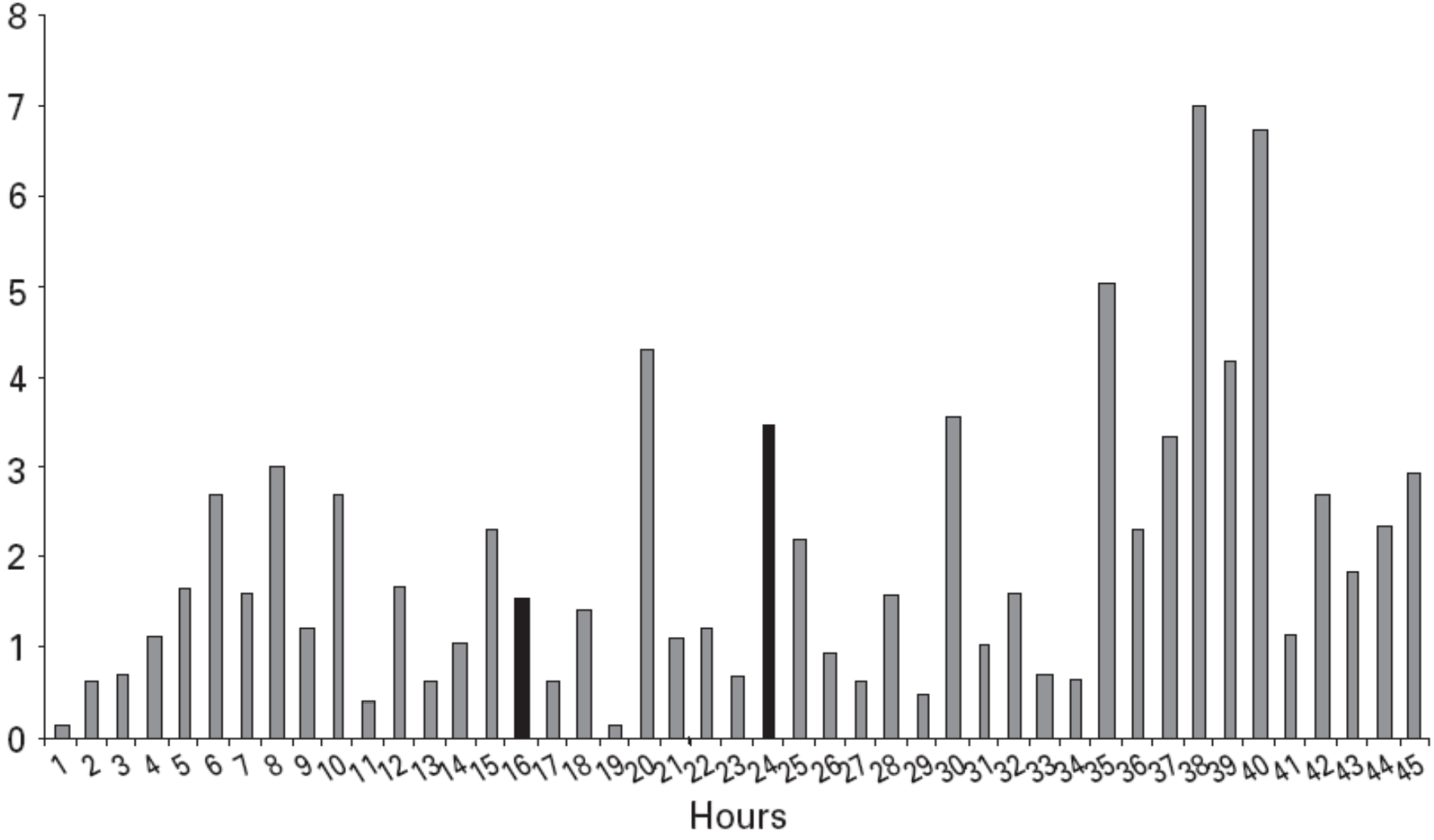
Hours' distribution for lone parents, before WFTC



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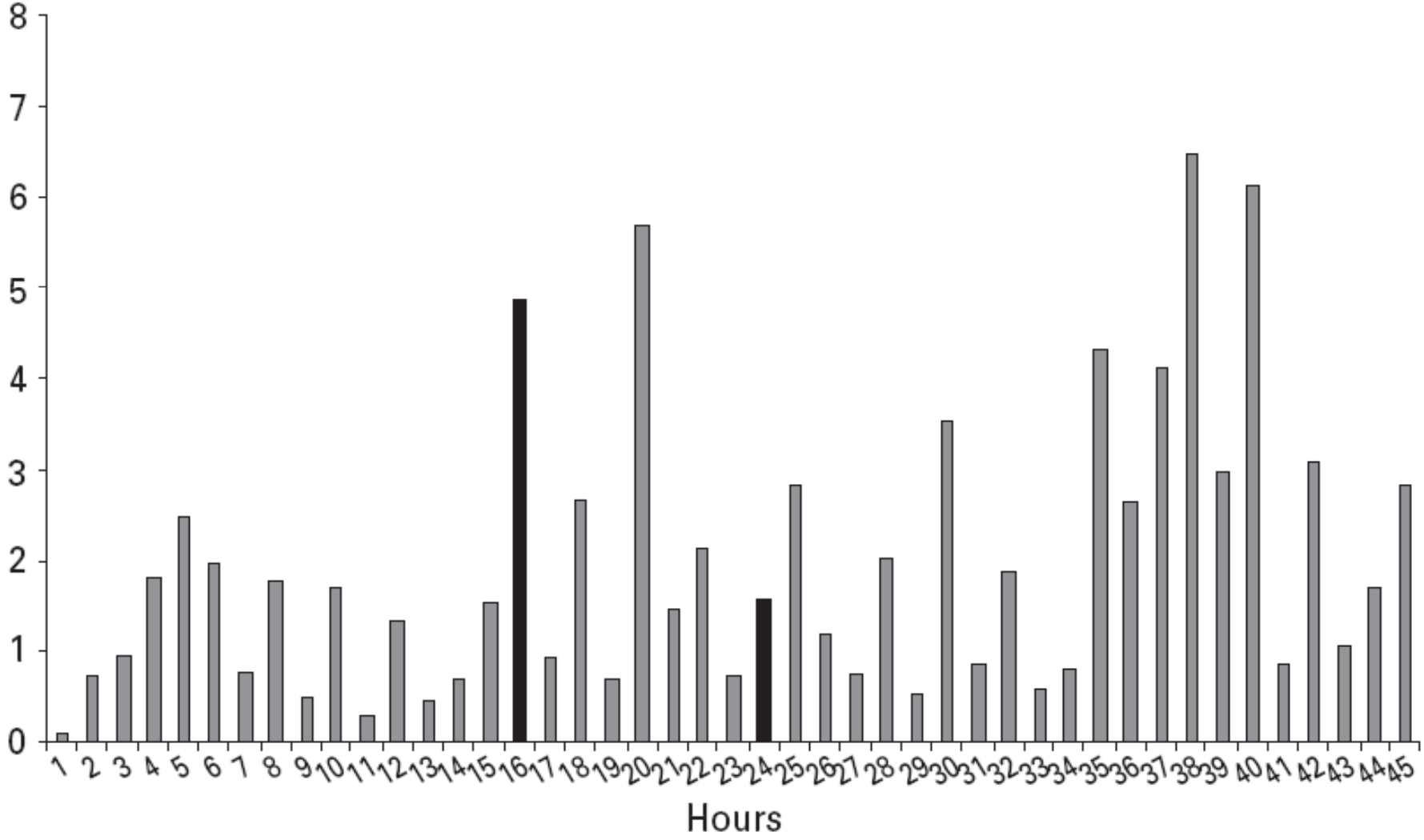

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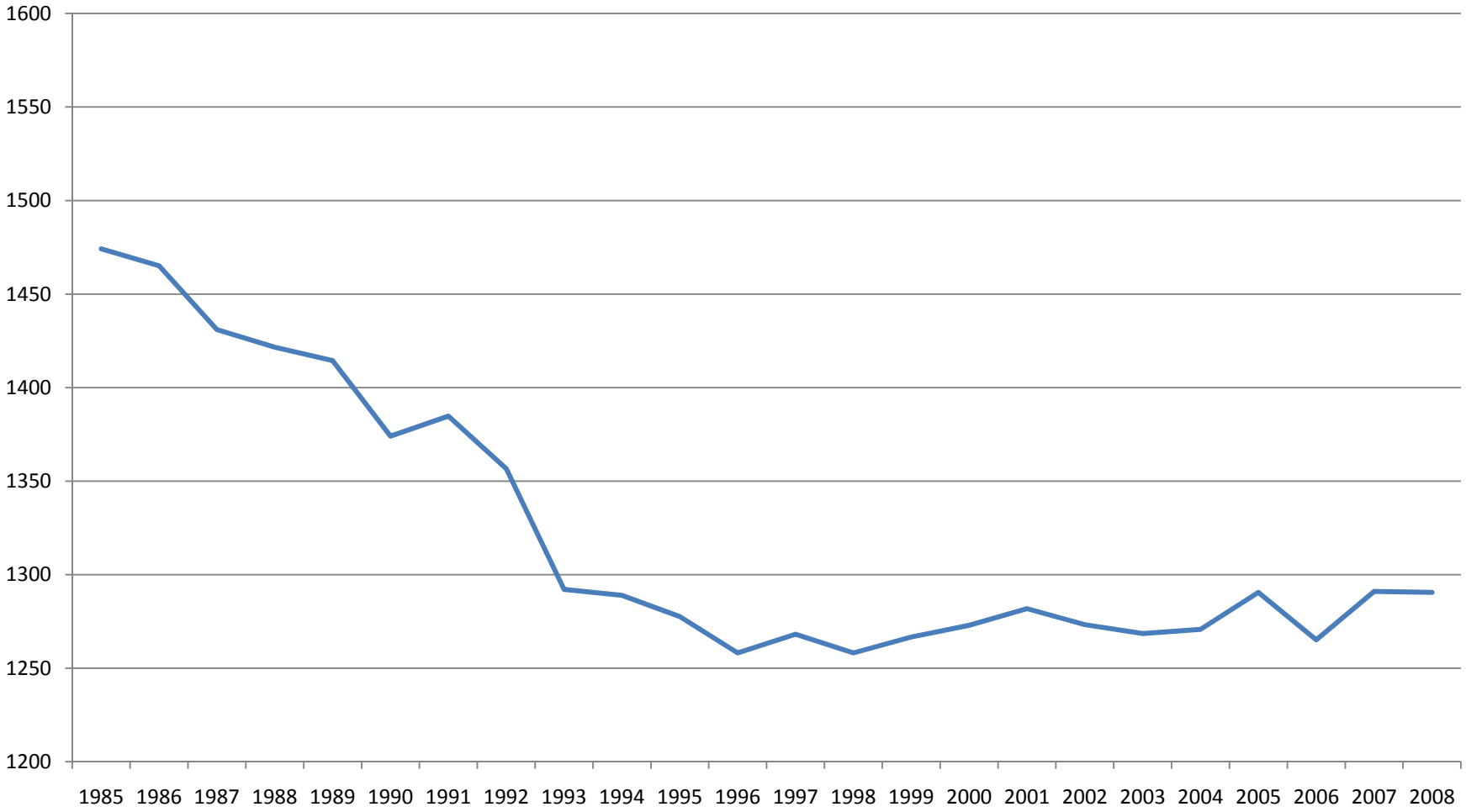
Hours trend for low ed lone parents in UK



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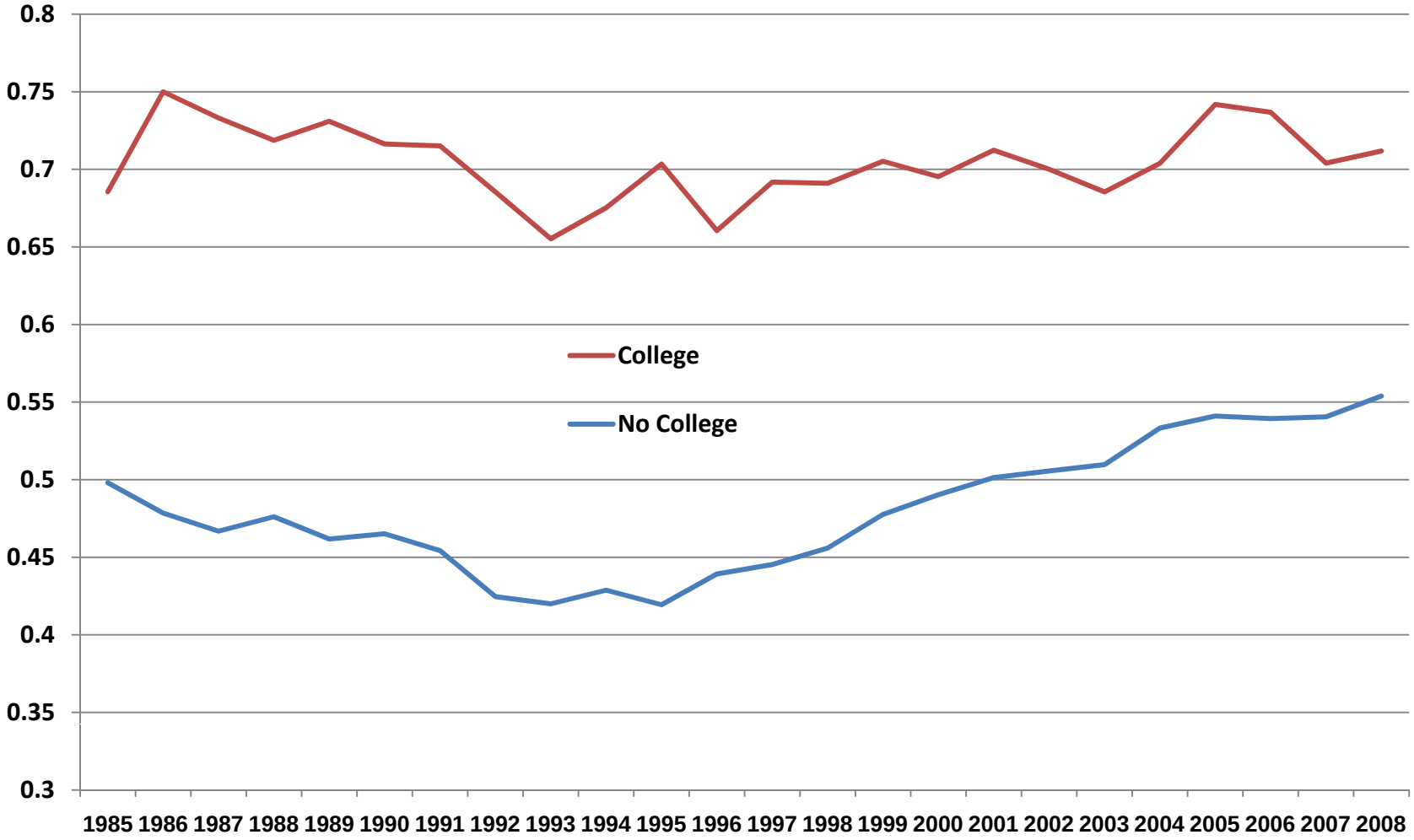
Employment trends for lone parents in UK



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WFTC Reform: Quasi-experimental Evaluation
Matched Difference-in-Differences

Average Impact on % Employment Rate of Single Mothers

Single Mothers	Marginal Effect	Standard Error	Sample Size
Family Resources Survey	4.5	*1.55*	25,163
Labour Force Survey	4.7	*0.55*	233,208

Data: FRS, 45,000 adults per year, Spring 1996 – Spring 2002.

Base employment level: 45% in Spring 1998.

Matching Covariates: age, education, region, ethnicity,..

Can use this quasi-experimental evidence to (partially) validate the structural simulation model

Key features of the structural simulation model

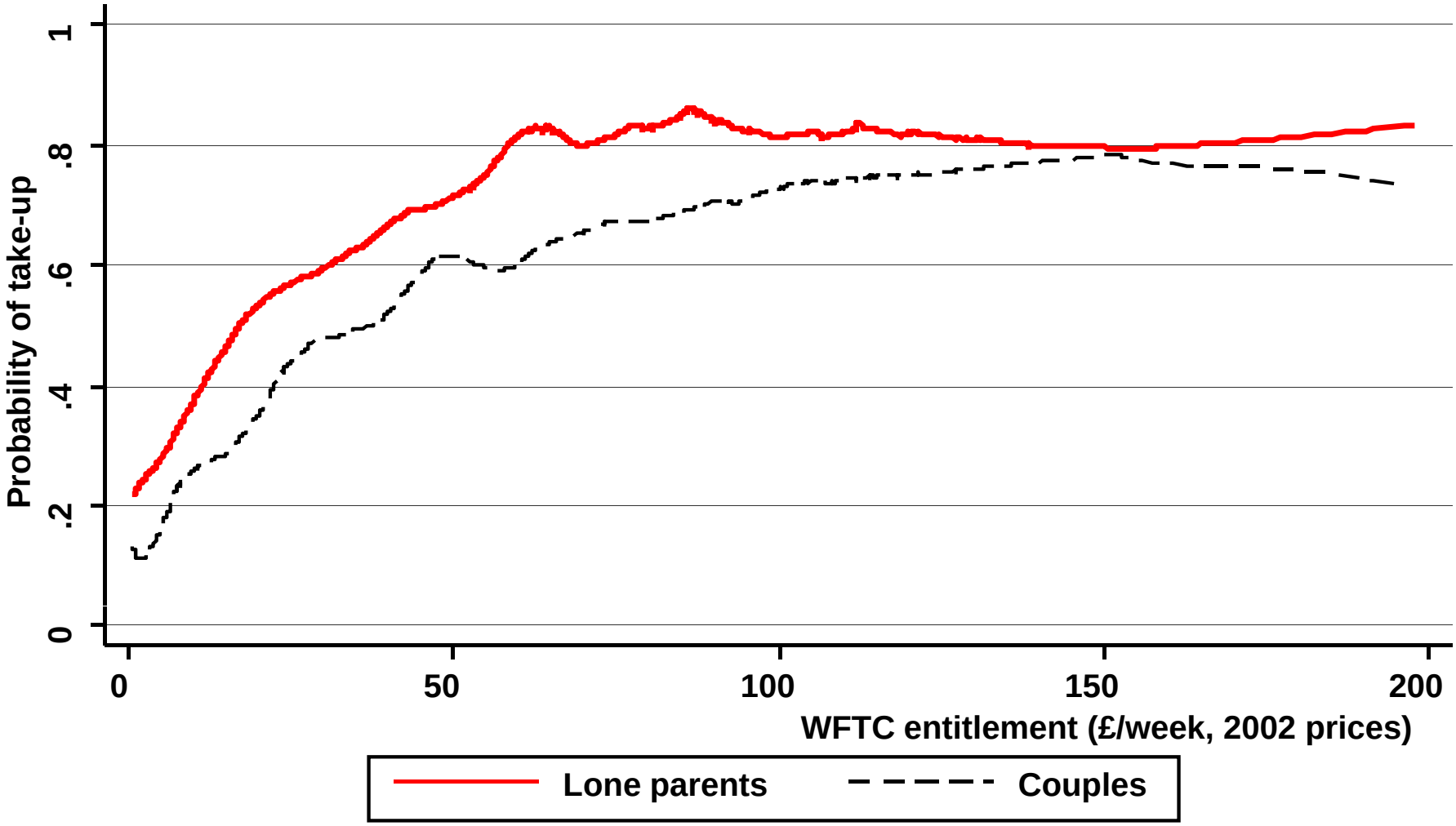
Preferences $U(c_h, h, P; X, \varepsilon)$

typically approximated by shape constrained sieves

- Structural model allows for
  - unobserved work-related fixed costs
  - childcare costs
  - observed and unobserved heterogeneity
  - programme participation ‘take-up’ costs
- See Blundell and Shephard (2010)

Importance of take-up and information/hassle costs

Variation in take-up probability with entitlement to WFTC



Preference Specifications

Preferences:

$$U_P(c,h,P;X,\varepsilon)=\alpha_y(X,\varepsilon)\frac{c^{\theta_y(X)}-1}{\theta_y(X)}$$

$$+\alpha_l(X,\varepsilon)\frac{(1-h/H)^{\theta_l(X)}-1}{\theta_l(X)}-P\cdot\eta(X,\varepsilon)$$

where $\alpha_j=\exp[X_j\beta_j+\varepsilon_j]$

where the 'cost' of receiving in-work support is given by

$$\eta(X,\varepsilon)=X_\eta\beta_\eta+\varepsilon_\eta$$

Also allow higher order polynomial and interaction terms.

Childcare costs

Assume stochastic relationship between total hours of childcare and maternal hours of work

$$\alpha_c(h, X, \varepsilon) = 1[h > 0].1[\varepsilon_c < -\beta_c h].(\beta_c h + \varepsilon_c)$$

Fixed costs of work

$$f = \alpha_f(X, \varepsilon)1[h > 0]$$

Consumption at given hours and programme participation

$$c(h, P; T, X, \varepsilon) = wh - T(wh, h, P; X) - p_c(X, \varepsilon)h_c - f$$

Programme participation (Take-up) model

We denote $P^*(h) \in \{0, E(h; X, \varepsilon)\}$

as the optimal choice of programme participation for given hours h, where $E(h; X, \varepsilon) = 1$ if the individual is eligible at hours h.

Assuming eligibility, $P^*(h) = 1$ if and only if

$$U(c(h, P=1; T, X, \varepsilon), h, P=1; X, \varepsilon)$$
$$\geq U(c(h, P=0; T, X, \varepsilon), h, P=0; X, \varepsilon)$$

The optimal choice of hours $h^* \in \mathrm{H}$ maximises

$$U(c(h, P^*(h); T, X, \varepsilon), h, P^*(h); X, \varepsilon, \varepsilon_h)$$

Estimation

- 1995-1999: pre-reform estimation data (ex-ante)
- 2001-2003: ‘post-reform’ validation sample
- Use complete sample for ex-ante analysis of 2004 and more recent reform proposals
- Sample restricted to lone mothers aged 18-45
- Jointly estimate wages, take-up, childcare and preferences by simulated maximum likelihood:
  - Incorporate detailed/accurate model of tax and transfer system

Structural Model Elasticities – low education lone parents

(a) Youngest Child Aged 5-10

Weekly Earnings	*Density*	*Extensive*	*Intensive*
0	0.4327		
50	0.1575	0.280 (.020)	0.085 (.009)
150	0.1655	0.321 (.009)	0.219 (.025)
250	0.1298	0.152 (.005)	0.194 (.020)
350	0.028	0.058 (.003)	0.132 (.010)
Employment elasticity		0.820 (.042)	

Blundell and Shephard (2010)

Structural Model Elasticities – low education lone parents

(b) Youngest Child Aged 11-18

Weekly Earnings	*Density*	*Extensive*	*Intensive*
0	0.3966		
50	0.1240	0.164 (.018)	0.130 (.016)
150	0.1453	0.193 (.008)	0.387 (.042)
250	0.1723	0.107 (.004)	0.340 (.035)
350	0.1618	0.045 (.002)	0.170 (.015)
Employment elasticity		0.720 (.036)	

Blundell and Shephard (2010)

Structural Model Elasticities – low education lone parents

(c) Youngest Child Aged 0-4

Weekly Earnings	*Density*	*Extensive*	*Intensive*
0	0.5942		
50	0.1694	0.168 (.017)	0.025 (.003)
150	0.0984	0.128 (.012)	0.077 (.012)
250	0.0767	0.043 (.004)	0.066 (.010)
350	0.0613	0.016 (.002)	0.035 (.005)
Participation elasticity		0.536 (.047)	

- Differences in intensive and extensive margins by age and demographics have strong implications for the design of the tax schedule... Non-monotonic in age of youngest child
- But do we believe the structural model estimates?

Structural Simulation of the WFTC Reform:

WFTC Tax Credit Reform

	All	y-child 0 to 2	y-child 3 to 4	y-child 5 to 10	y-child 11 to 18
Change in employment rate:	6.95	3.09	7.56	7.54	4.96
	0.74	*0.59*	*0.91*	*0.85*	*0.68*
Average change in hours:	1.79	0.71	2.09	2.35	1.65
	0.2	*0.14*	*0.23*	*0.34*	*0.2*

Notes: Simulated on FRS data; Standard errors in italics.

– relatively 'large' impact

Blundell and Shephard (2010)

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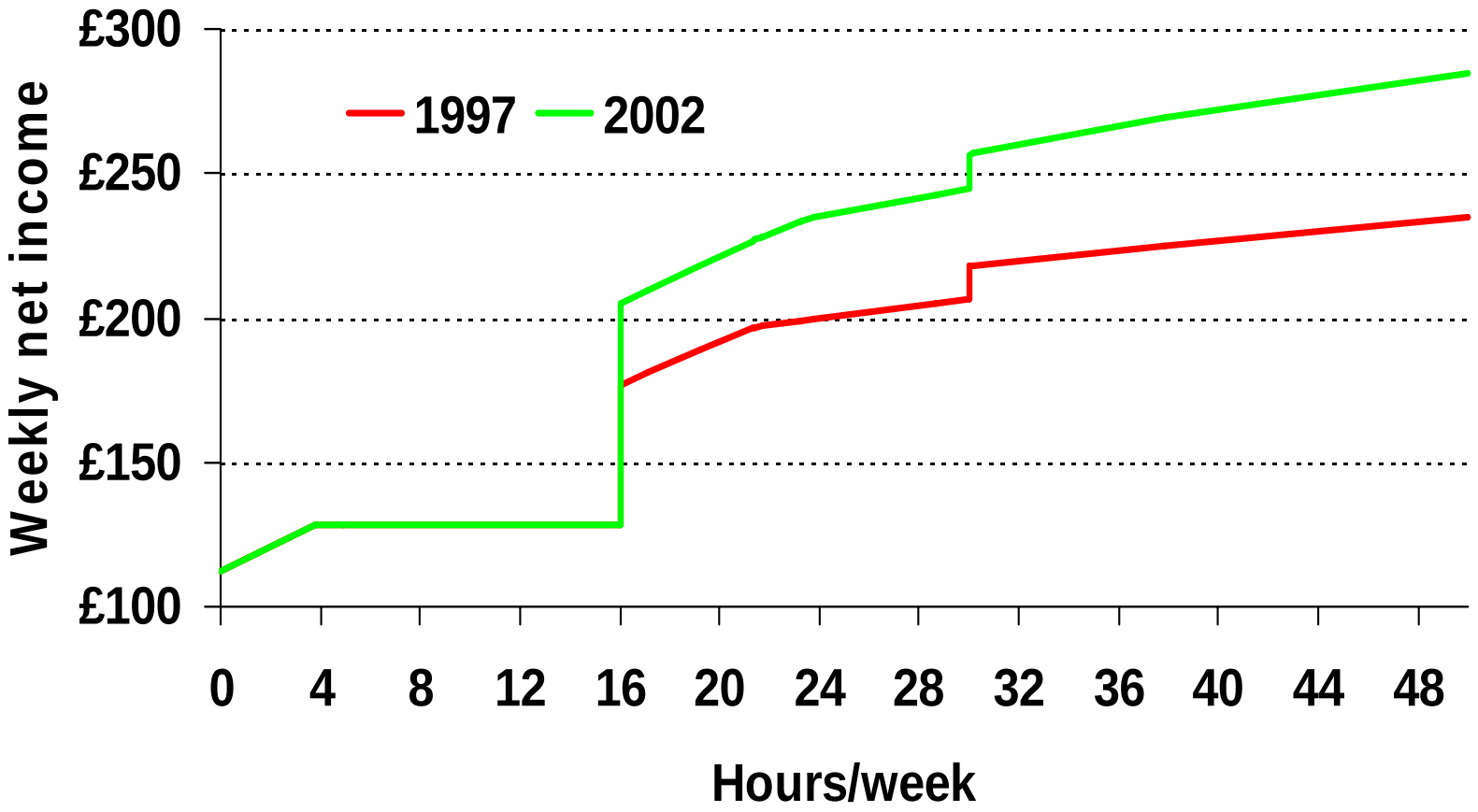
Impact of WFTC reform on lone parent, 2 children



- ***Notes:*** **Two children under 5. Assumes hourly wage of £4.10, no housing costs or council tax liability and no childcare costs.**

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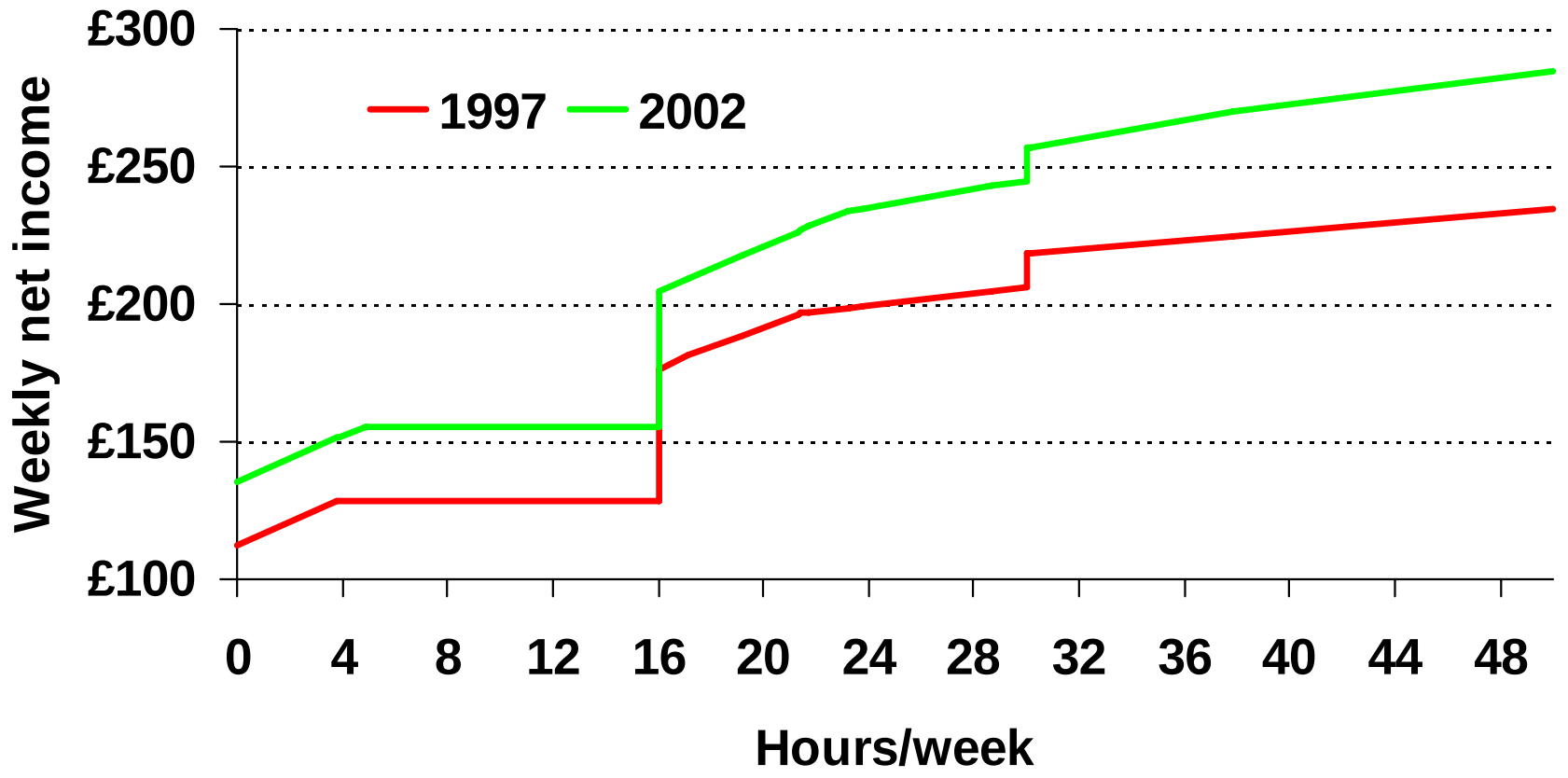
Impact of WFTC and IS reforms on lone parent, 2 children



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Structural Simulation of the WFTC Reform:

Impact of all Reforms (WFTC and IS)

	All	y-child 0 to 2	y-child 3 to 4	y-child 5 to 10	y-child 11 to 18
Change in employment rate:	4.89	0.65	5.53	6.83	4.03
	0.84	*0.6*	*0.99*	*0.94*	*0.71*
Average change in hours:	1.02	0.01	1.15	1.41	1.24
	0.23	*0.21*	*0.28*	*0.28*	*0.22*

- shows the importance of getting the effective tax rates right especially when comparing with quasi-experiments.
- compare with experiment or quasi-experiment.

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Evaluation of the 'ex-ante' structural model

- The diff-in-diff impact parameter can be identified from the structural evaluation model
- *Simulated* diff-in-diff parameter
- The structural model then defines the average impact of the policy on the treated as:

$$\alpha_{SEM}(X) = \Pr[h > 0 \mid X, D = 1] - \Pr[h > 0 X, D = 0]$$

- Compare *simulated diff-in-diff moment* with *diff-in-diff*

$$\alpha_{SEM}^{DD} = \int_X \int_X \int_\varepsilon f(X, \varepsilon, D = 1) dF_\varepsilon^{T=1,t=1} dF_X - \int_X \int_\varepsilon f(X, \varepsilon, D = 0) dF_\varepsilon^{T=1,t=0} dF_X$$

$$- \left[\int_\varepsilon f(X, \varepsilon, D = 0) dF_\varepsilon^{T=0,t=1} dF_X - \int_X \int_\varepsilon f(X, \varepsilon, D = 0) dF_\varepsilon^{T=0,t=0} dF_X \right]$$

Evaluation of the ex-ante model

- The *simulated* diff-in-diff parameter from the structural evaluation model is precise and does not differ significantly from the diff-in-diff estimate
- Compare *simulated diff-in-diff moment* with *diff-in-diff*
  - .21 (.73), chi-square p-value .57
- Consider additional moments
  - education: low education: 0.33 (.41)
  - youngest child interaction
    - Youngest child aged < 5: .59 (. 51)
    - Youngest child aged 5-10: .31 (.35)

A optimal tax design framework

- Assume earnings (and certain characteristics) are all that is observable to the tax authority
  - relax below to allow for 'partial' observability of hours

Social welfare, for individuals of type X, ε

$$W = \int_X \int_\varepsilon \Upsilon(U(c(h^*; T(w, h^*; X), h^*; X, \varepsilon))dF(\varepsilon)dG(X)$$

The tax structure $T(.)$ is chosen to maximise W, subject to:

$$\int_X \int_\varepsilon T(wh^*, h^*; X)dF(\varepsilon)dG(X) \geq \overline{T}(= -R)$$

for a given R.

- We solve for T(.) with structural estimation and simulation.

Control preference for equality by transformation function:

$$\Upsilon(U \mid \theta) = \frac{1}{\theta}\left\{(\exp U)^{\theta} - 1\right\}$$

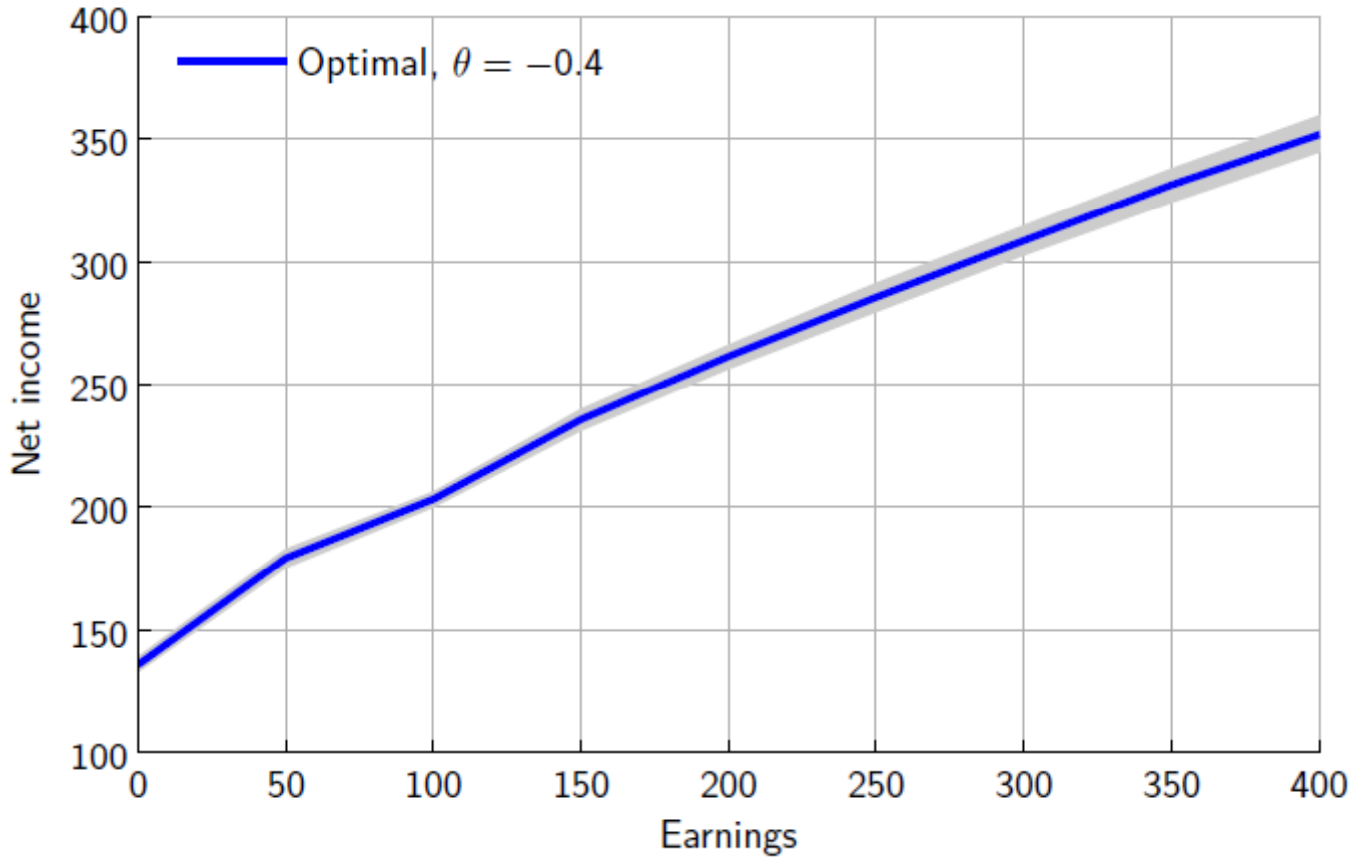
when θ is negative, the function favors the equality of utilities. θ is the coefficient of (absolute) inequality aversion.

Proposition: If $\theta < 0$ then analytical solution to integral over (Type I extreme-value) j state specific errors

$$\frac{1}{\theta}\left[\Gamma(1-\theta)\cdot\left(\sum_{h\in \mathrm{H}} \exp u(c(h;T,X,\varepsilon)\right)^{\theta} - 1\right]$$

Objective: robust policies for fairly general social welfare weights, document the weights in each case (Table 7 BS, 2010)

Implied Optimal Schedule



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March 2002 prices

Blundell and Shephard (2010)

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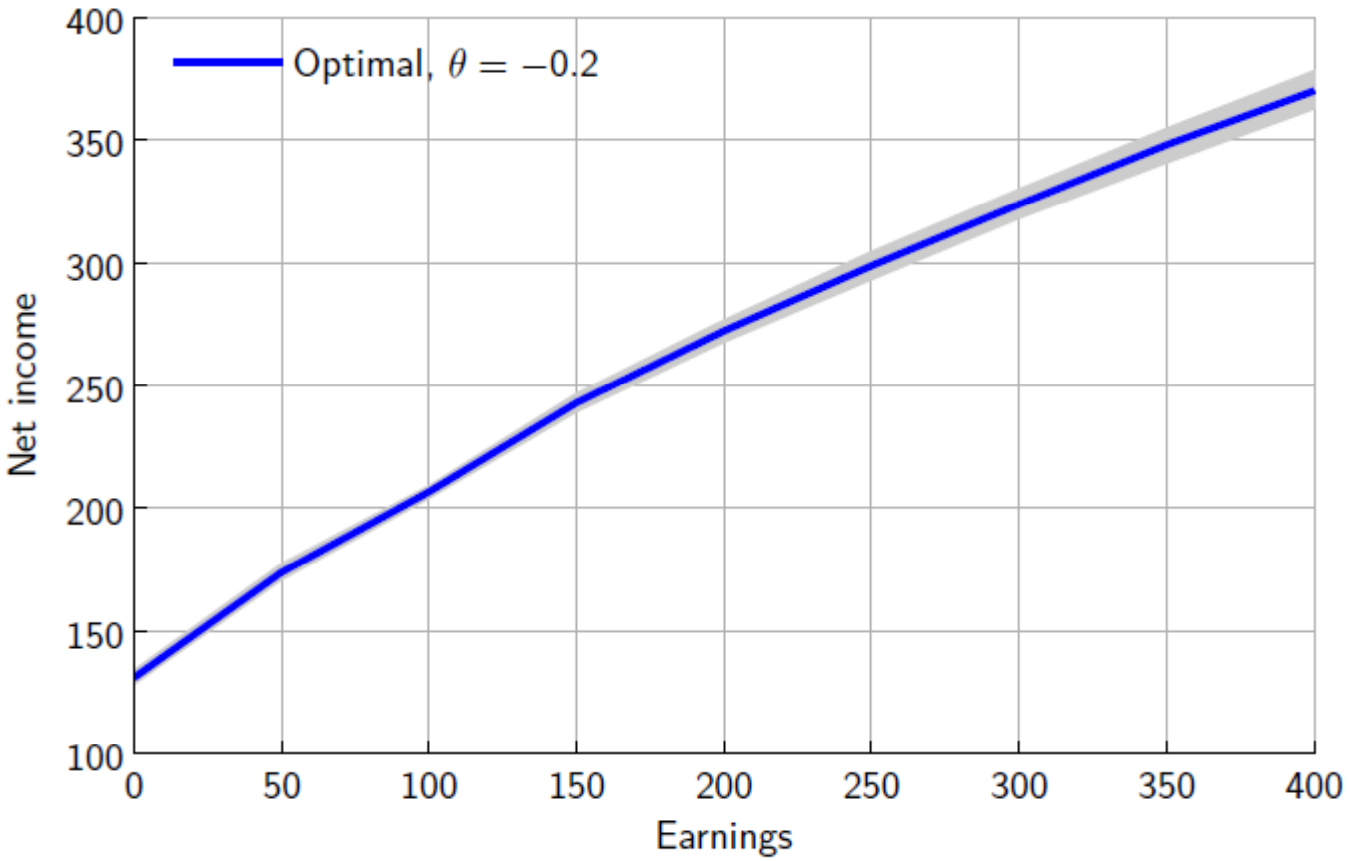

March 2002 prices

Blundell and Shephard (2010)

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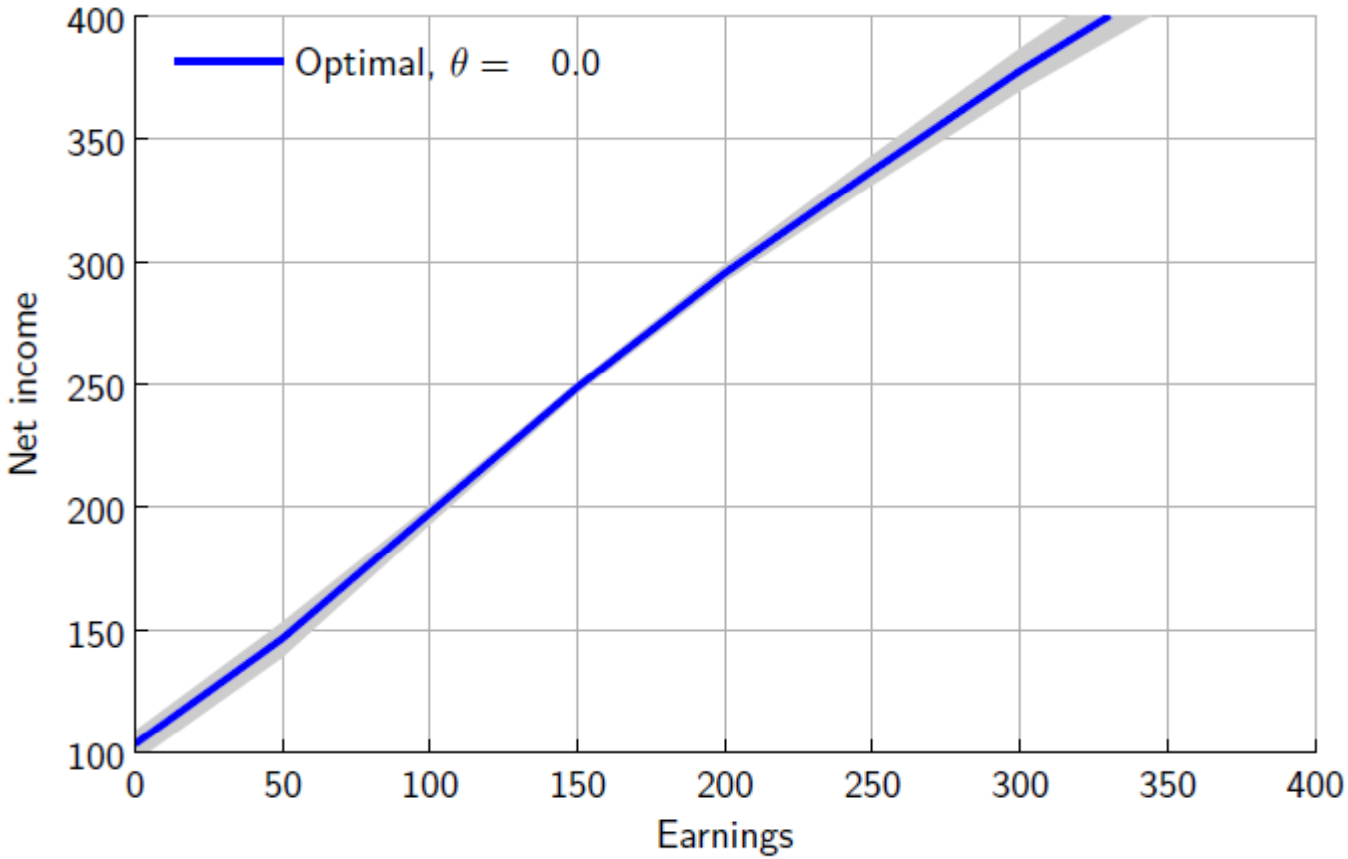
Implied Optimal Schedule



March 2002 prices

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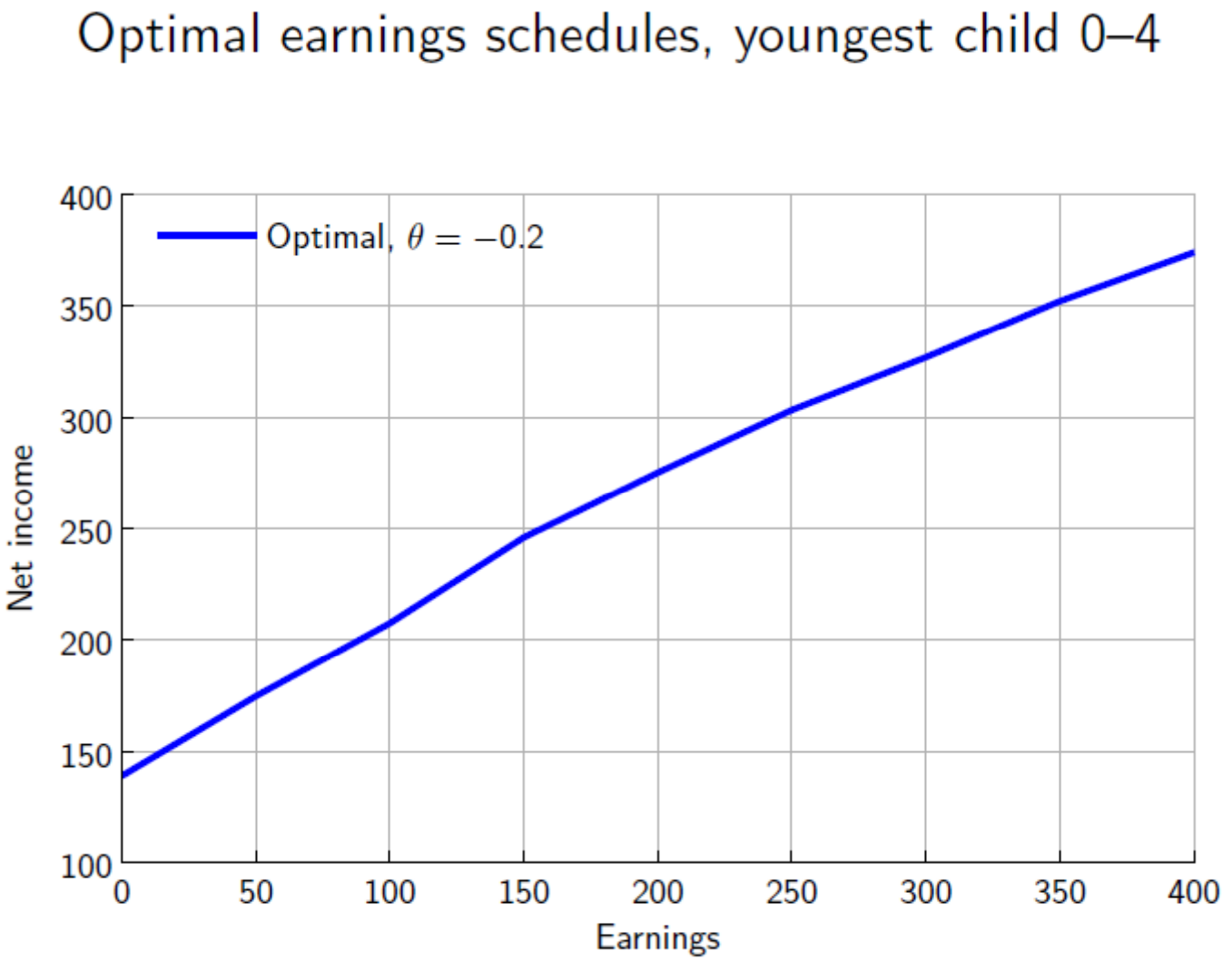
Implied Optimal Schedule



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Blundell and Shephard (2010)

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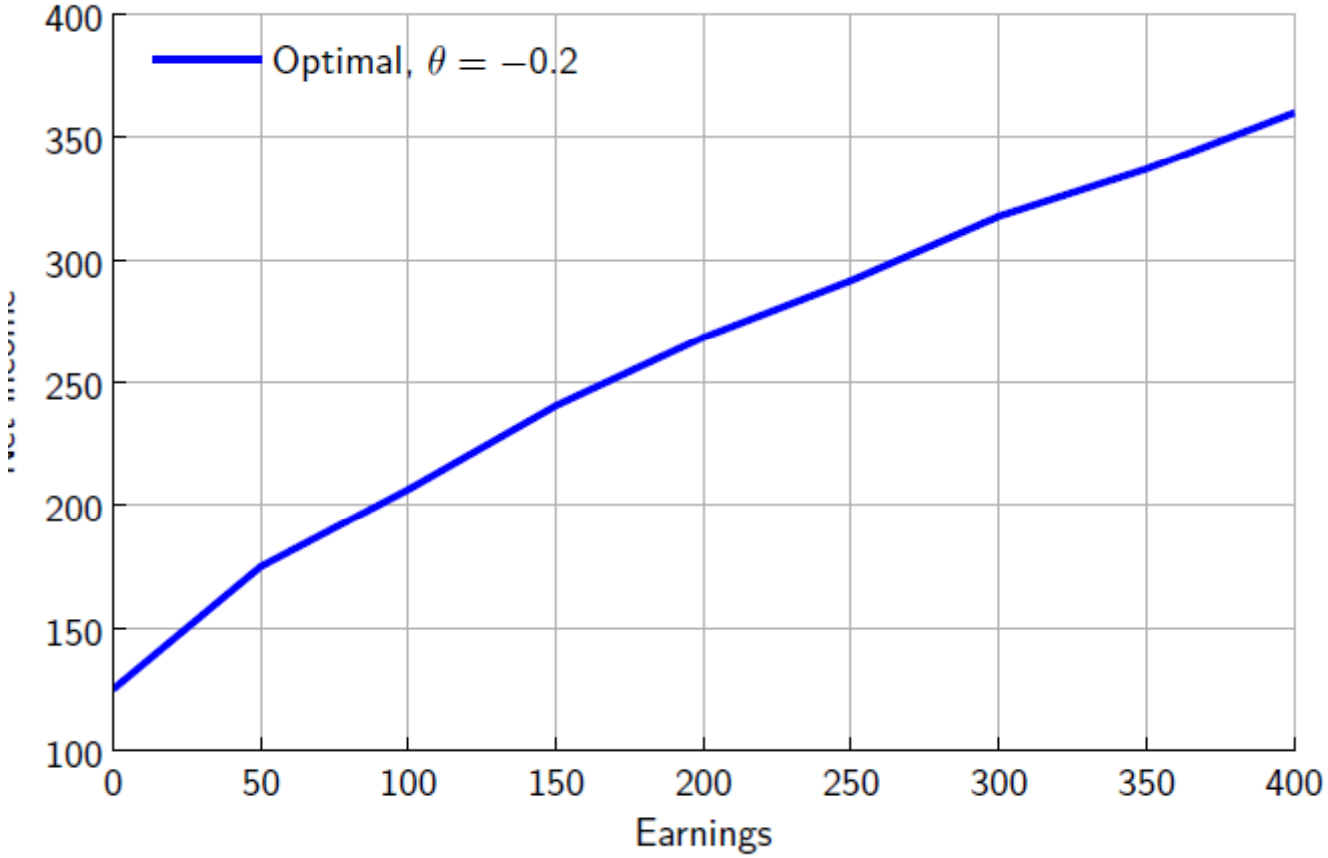
Implied Optimal Schedule

Optimal earnings schedules, youngest child 5–10



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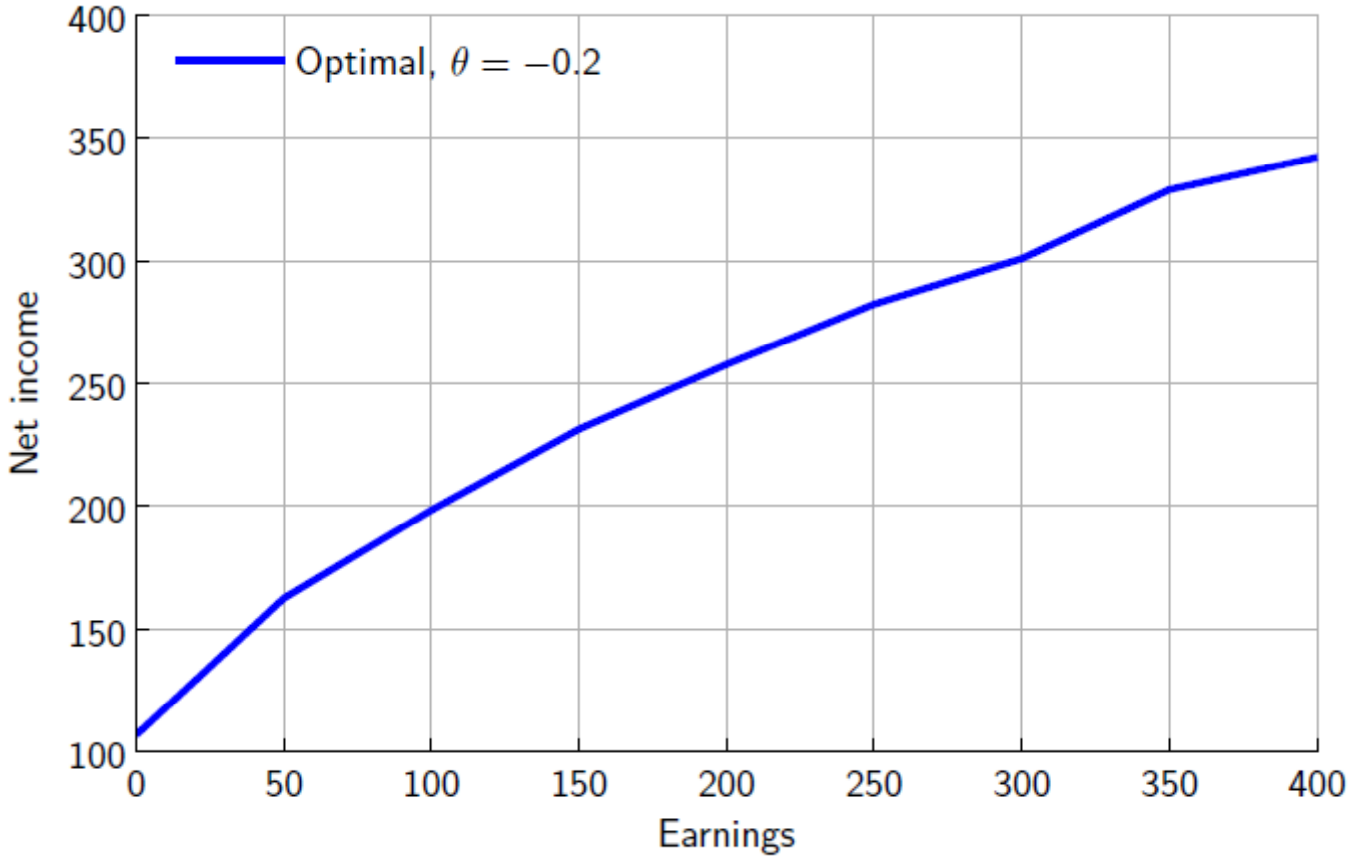
Optimal earnings schedules, youngest child 11–18



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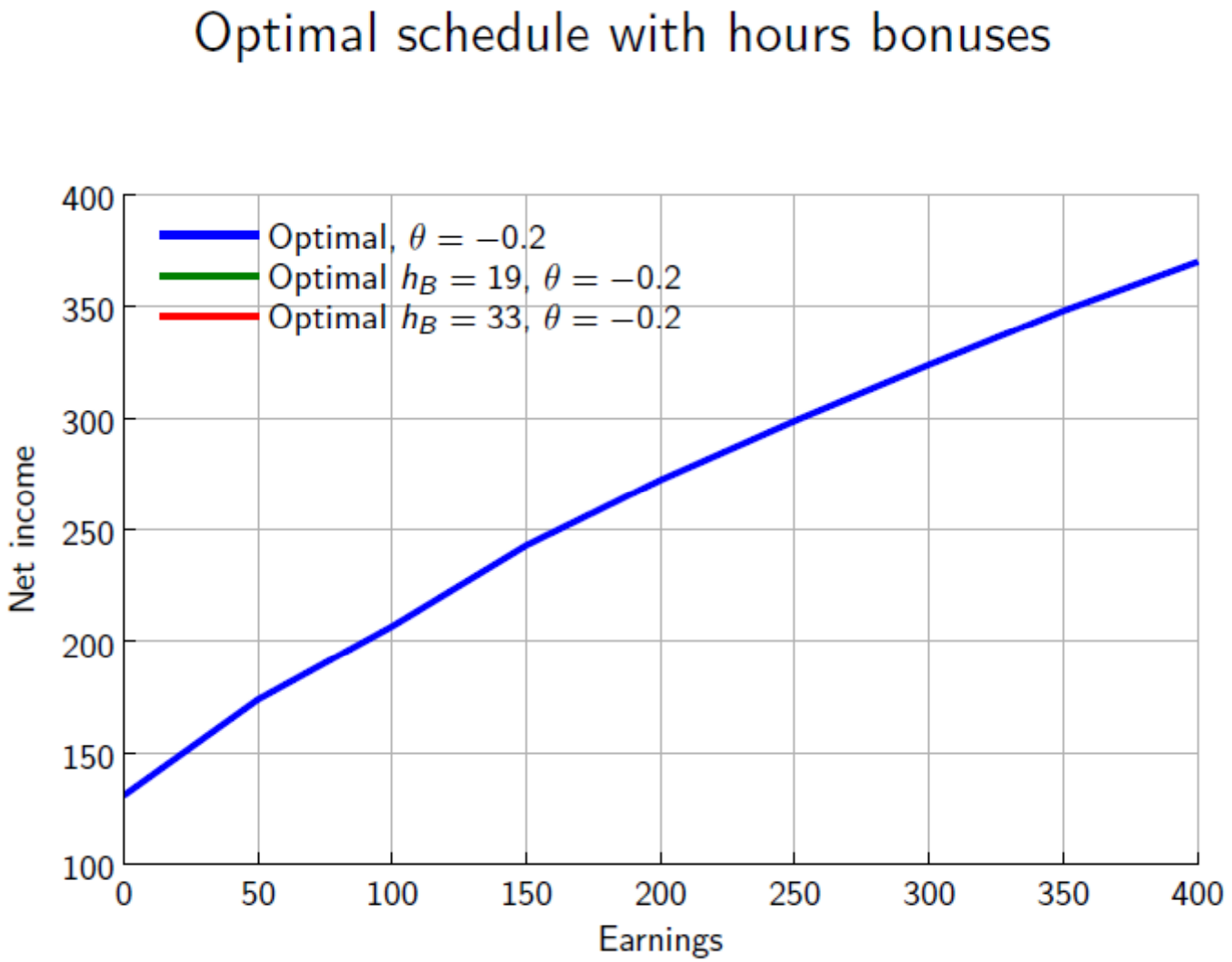

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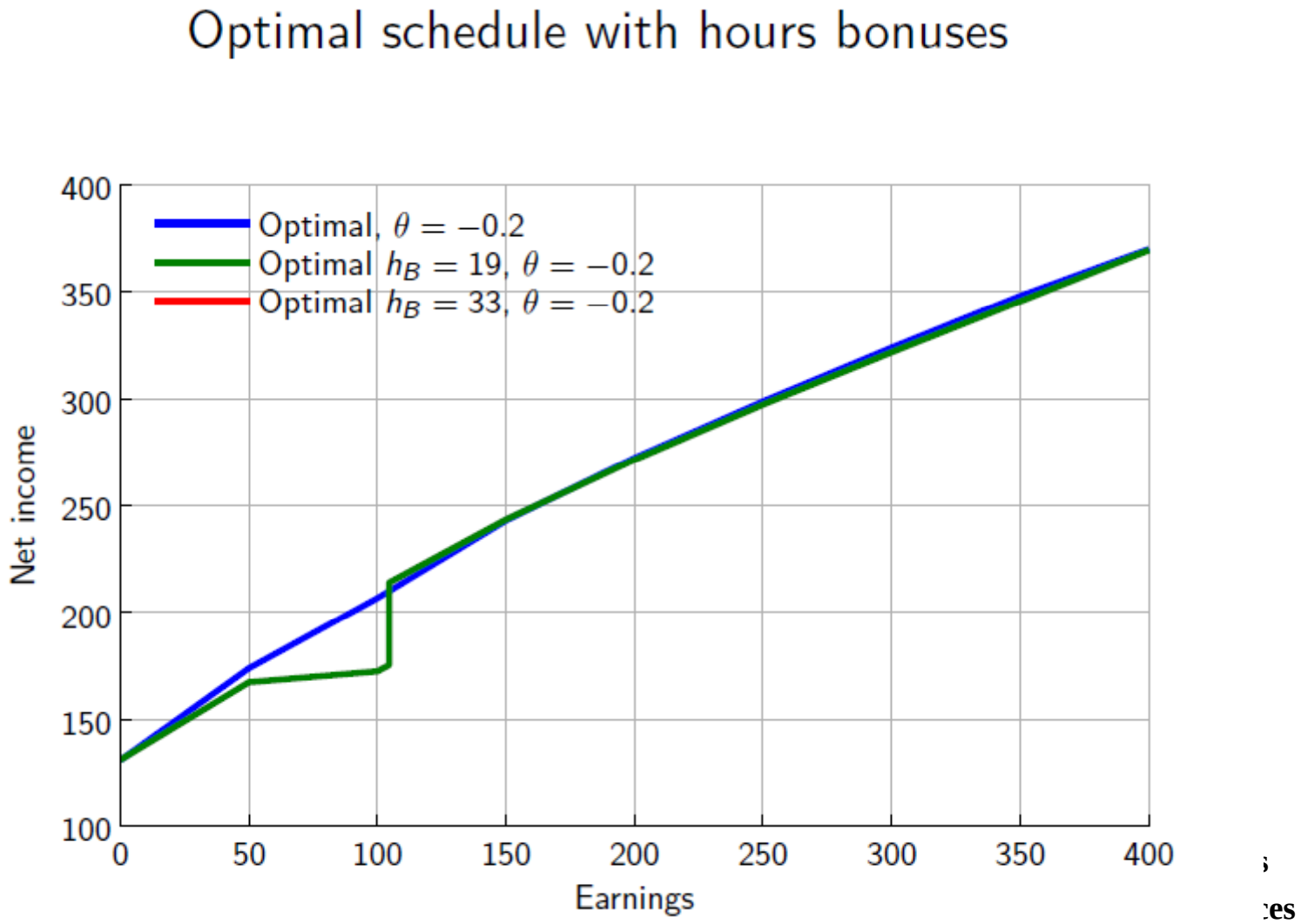

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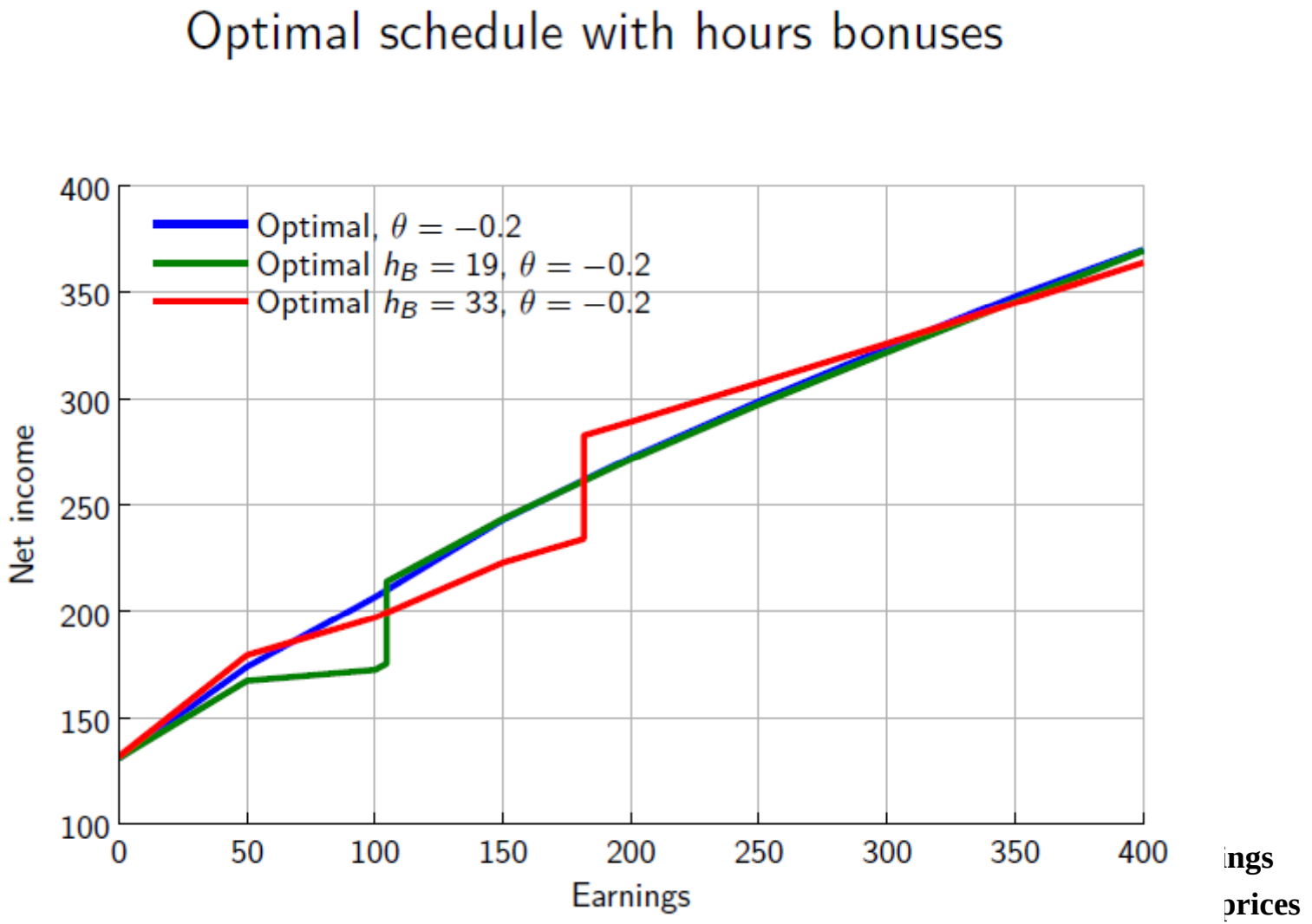
Implied Optimal Schedule



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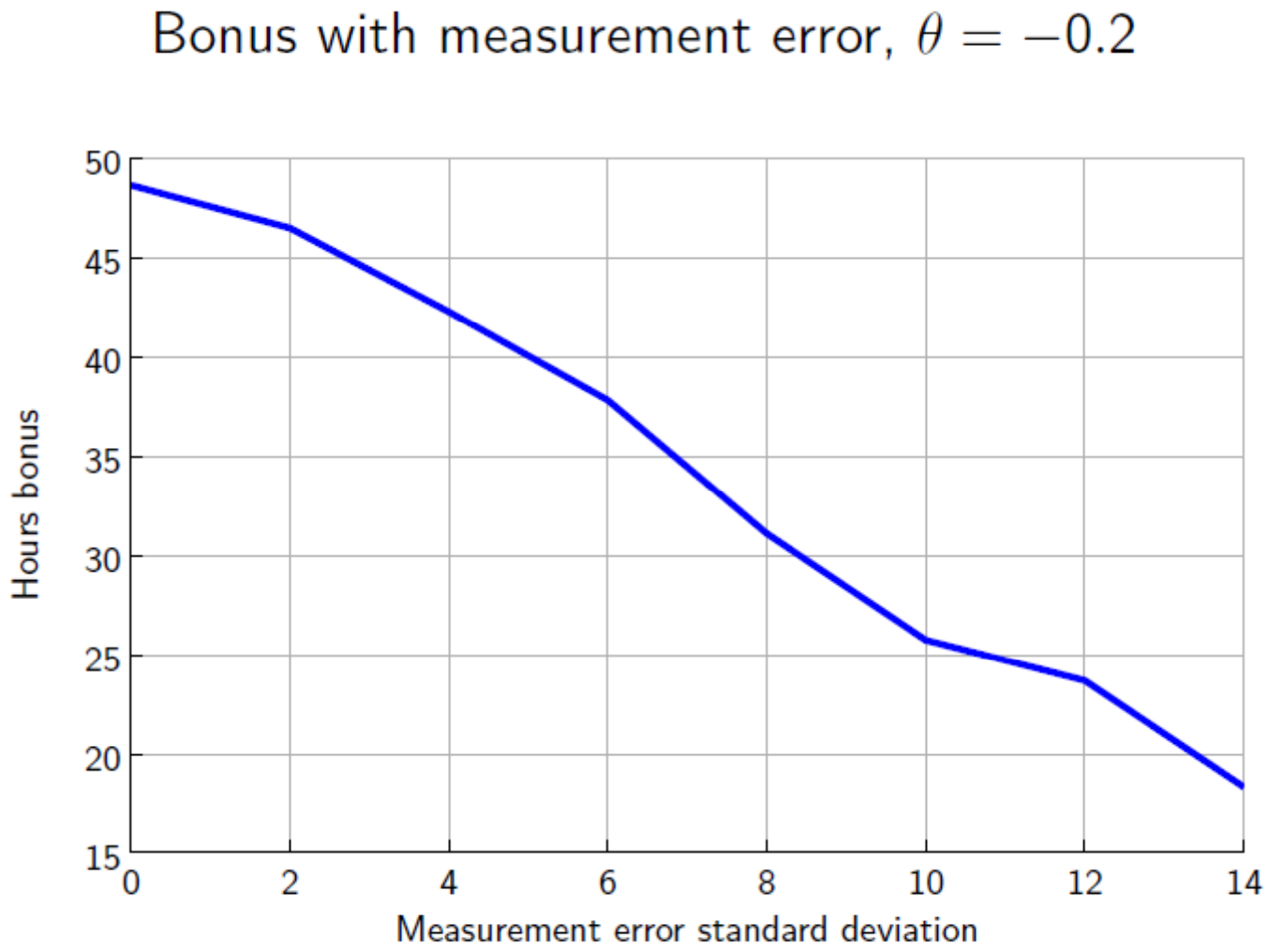
Quantifying Welfare Gains

We ask: what increase in expenditure dR/R is required to achieved the same level of social welfare if only earnings is revealed?

19 hours			optimal hours		
$\theta = -0.4$	$\theta = -0.2$	$\theta = 0.0$	$\theta = -0.4$	$\theta = -0.2$	$\theta = 0.0$
0.9%	0.8%	0.2%	2.2%	2.5%	1.8%

Blundell and Shephard (2010)

Sensitivity of Optimal Hours Bonus



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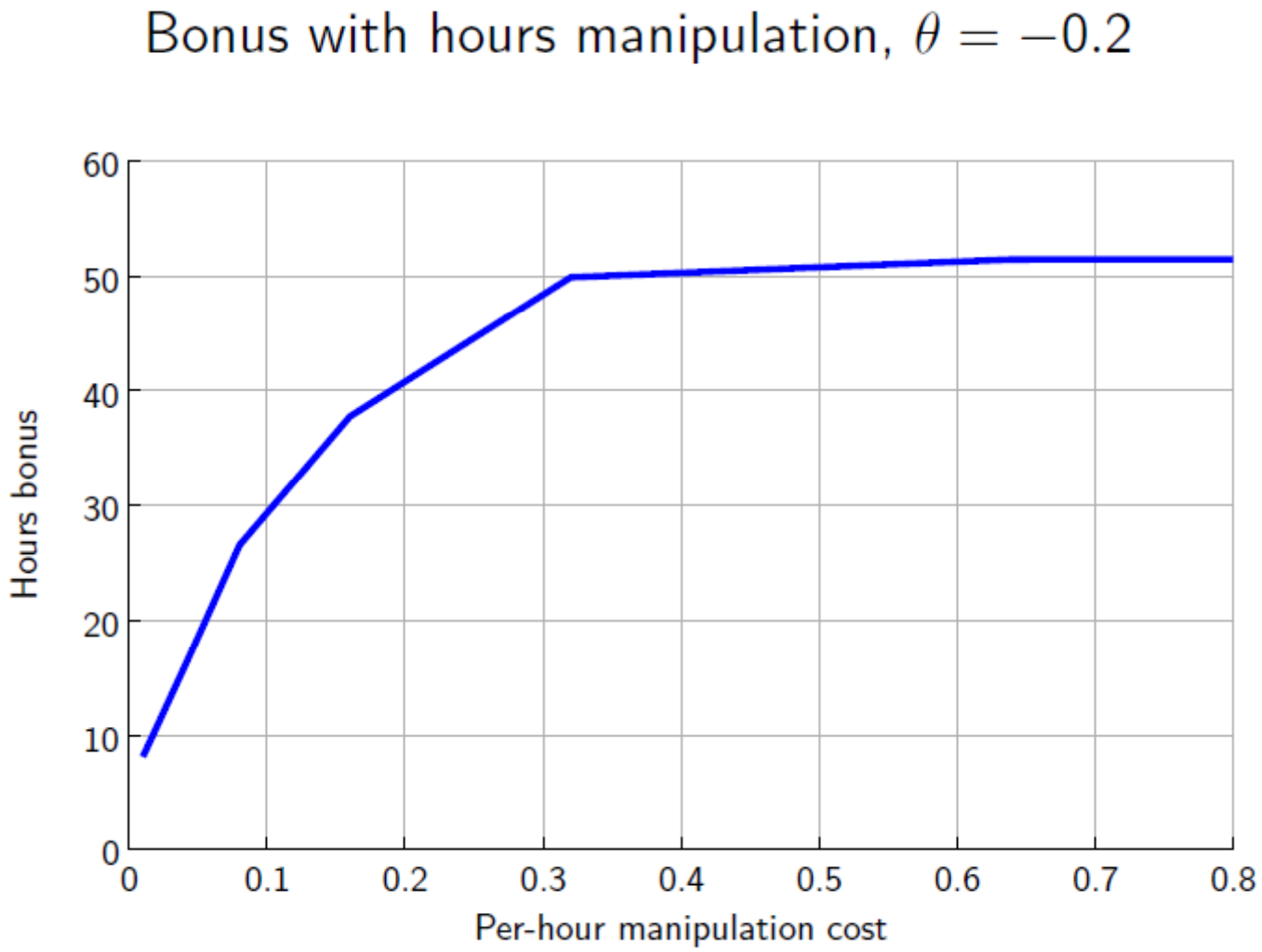
Sensitivity of Optimal Hours Bonus



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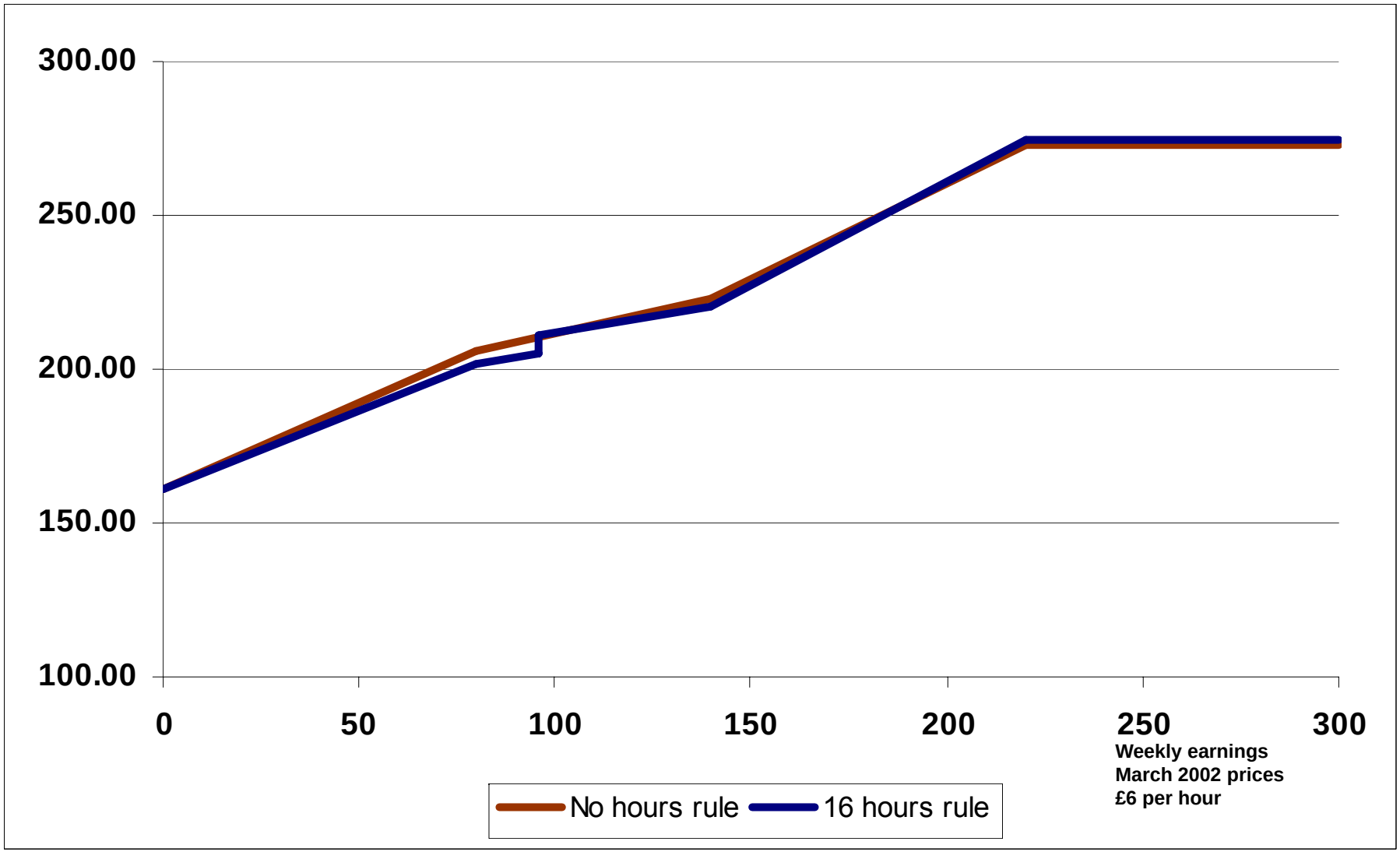
Implied Optimal Schedule, Youngest Child Aged 0-4



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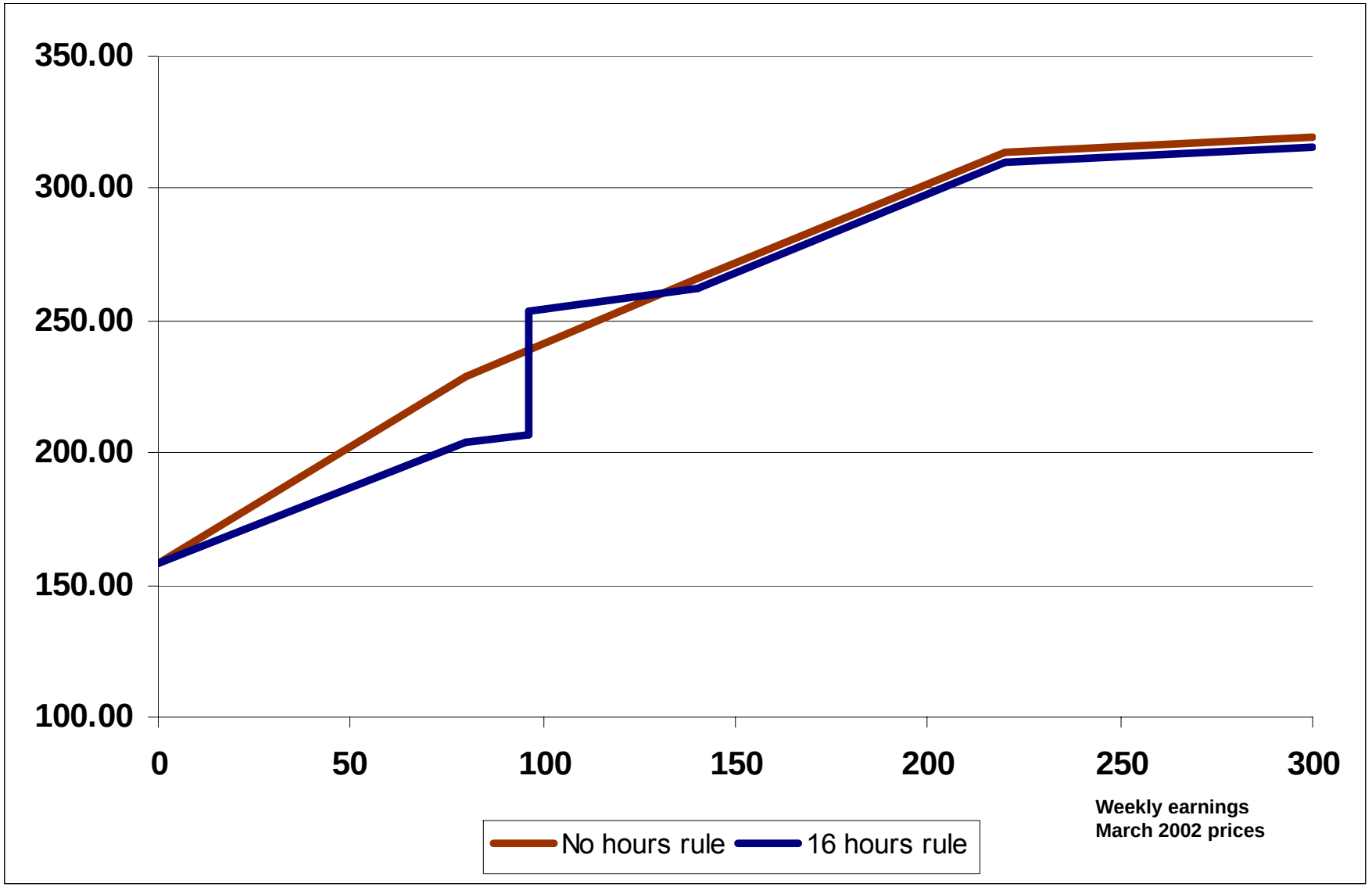
Implied Optimal Schedule, Youngest Child Aged 5-10



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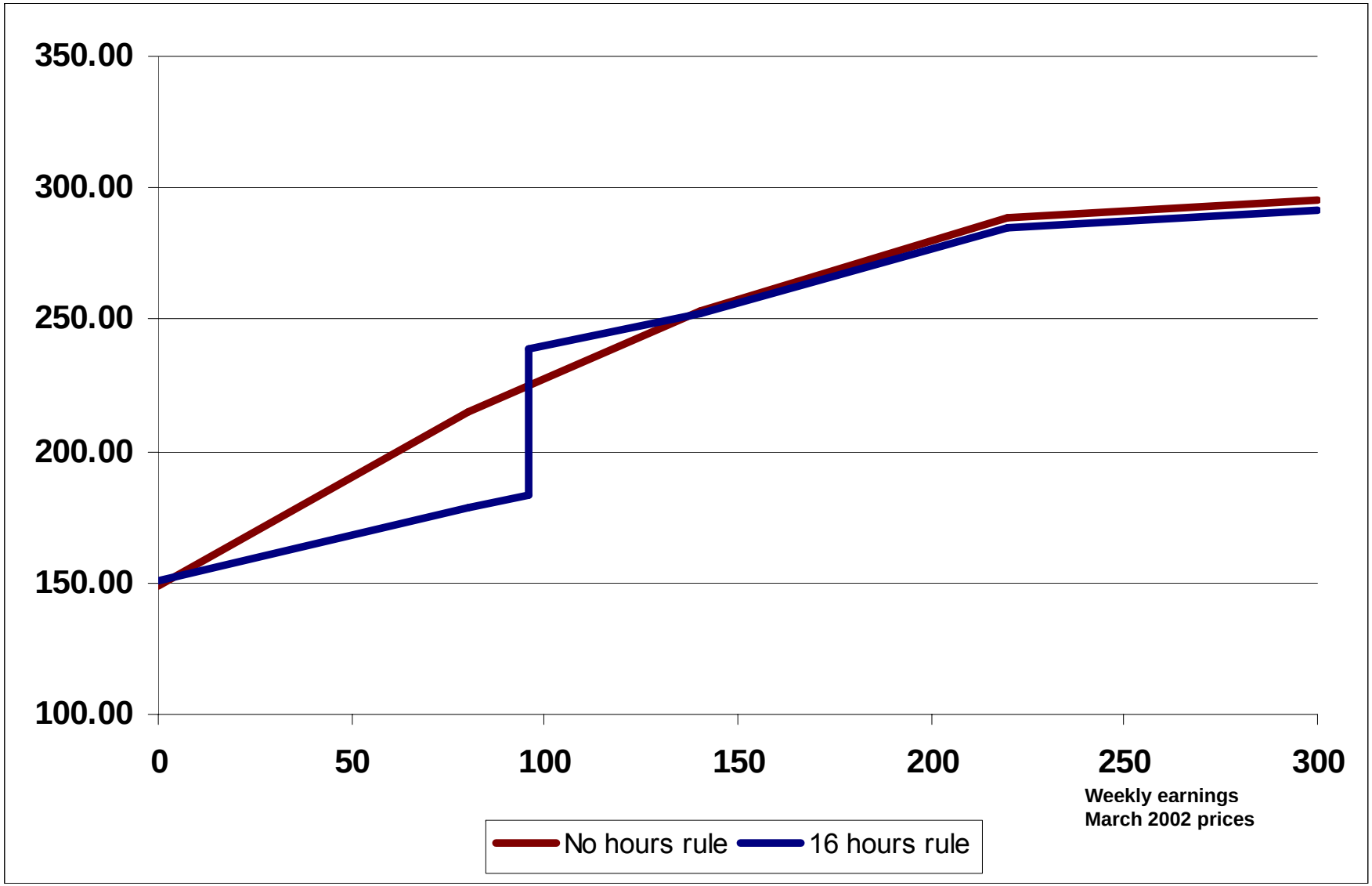
Implied Optimal Schedule, Youngest Child Aged 11-18



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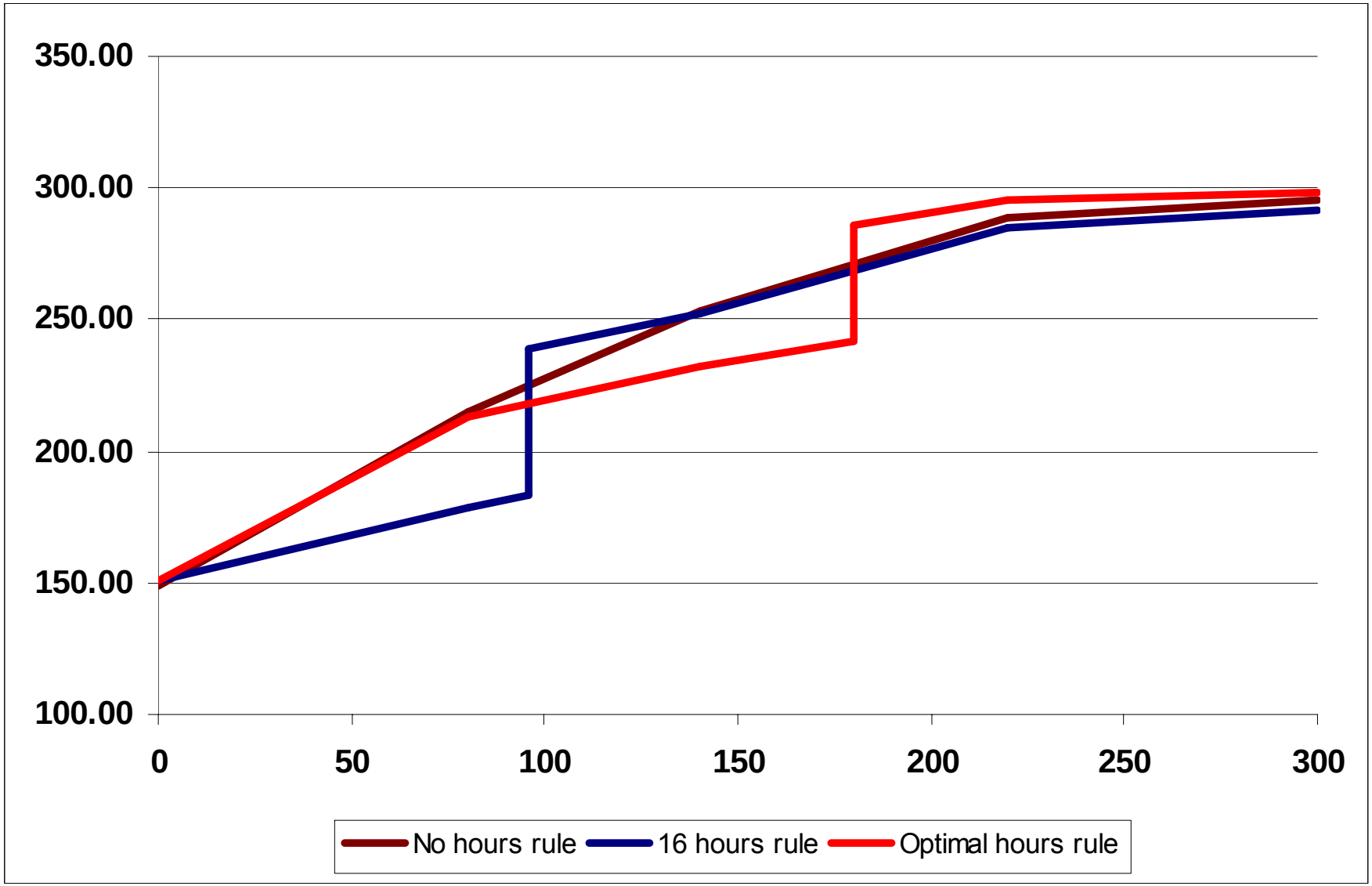
Implied Optimal Schedule, Youngest Child Aged 11-18



Implications for Tax Reform

- Change transfer/tax rate structure to match lessons from 'new' optimal tax analysis and empirical evidence
- 'Life-cycle' view of taxation
  - 'tagging' by age of (youngest) child for mothers/parents
  - (also pre-retirement ages)
  - a 'life-cycle' rearrangement of tax incentives and welfare payments to match elasticities and early years investments
  - simulation results in *Tax by Design* show significant employment and earnings increases
- Hours rules? – at full time for older kids,
  - welfare gains depend on ability to monitor hours
- Dynamics and frictions?
- Undo distributional effects of the rest of the package…

Broadening the VAT base

- Evidence on consumer behaviour => exceptions to uniformity
  - Childcare strongly complementary to paid work
  - Various work related expenditures (QUAIDS on FES, MRI)
  - 'Vices': alcohol, tobacco, betting, possibly unhealthy food have externality / merit good properties ➔ keep 'sin taxes'
  - Environmental externalities (three separate chapters in MRII)
- These do not line up well with existing structure of taxes

  ⇒Broadening the base – many zero rates in UK VAT
- Compensating losers, even on average, is difficult
  - Worry about work incentives too
  - Work with set of direct tax and benefit instruments as in earnings tax reforms

Indirect Taxation – UK case

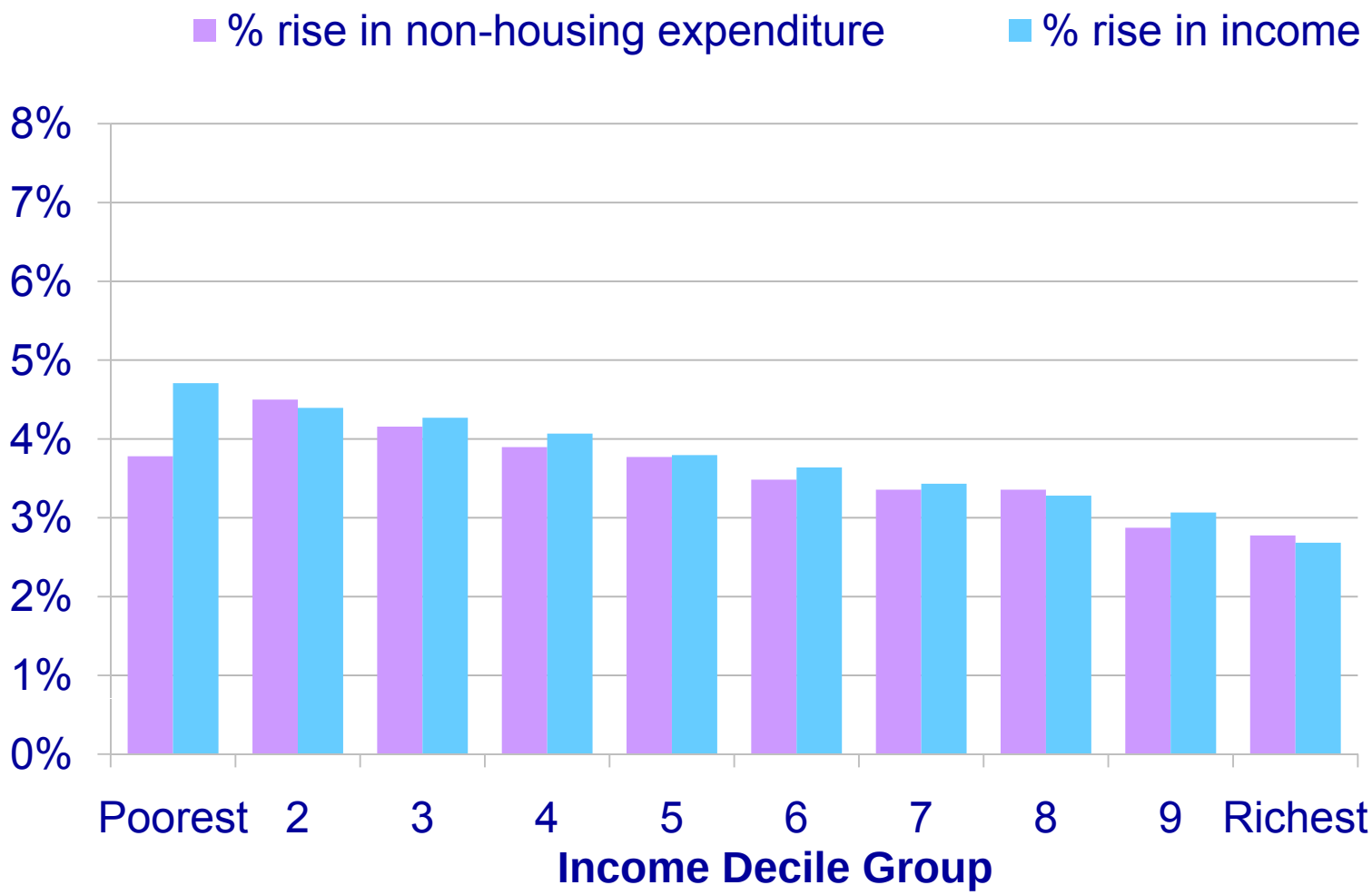
Zero-rated:	Estimated cost (£m)
Food	11,300
Construction of new dwellings	8,200
Domestic passenger transport	2,500
International passenger transport	150
Books, newspapers and magazines	1,700
Children's clothing	1,350
Drugs and medicines on prescription	1,350
Vehicles and other supplies to people with disabilities	350
Cycle helmets	10
Reduced-rated:	
Domestic fuel and power	2,950
Contraceptives	10
Children's car seats	5
Smoking cessation products	10
Residential conversions and renovations	150
VAT-exempt:	
Rent on domestic dwellings	3,500
Rent on commercial properties	200
Private education	300
Health services	900
Postal services	200
Burial and cremation	100
Finance and insurance	4,500

Impact on budget share of labour supply
Conditional on income and prices

Bread and Cereals	**Negative**
Meat and Fish	**Negative**
Dairy products	**Negative**
Tea and coffee	**Negative**
Fruit and vegetables	**Negative**
Food eaten out	**Positive**
Beer	**Positive**
Wine and spirits	**Positive**
Domestic fuels	**Negative**
Household goods and services	**Positive**
Adult clothing	**Positive**
Childrens' clothing	**Negative**
Petrol and diesel	**Positive**

Source: QUAIDS on UK FES

VAT reform: effects by income



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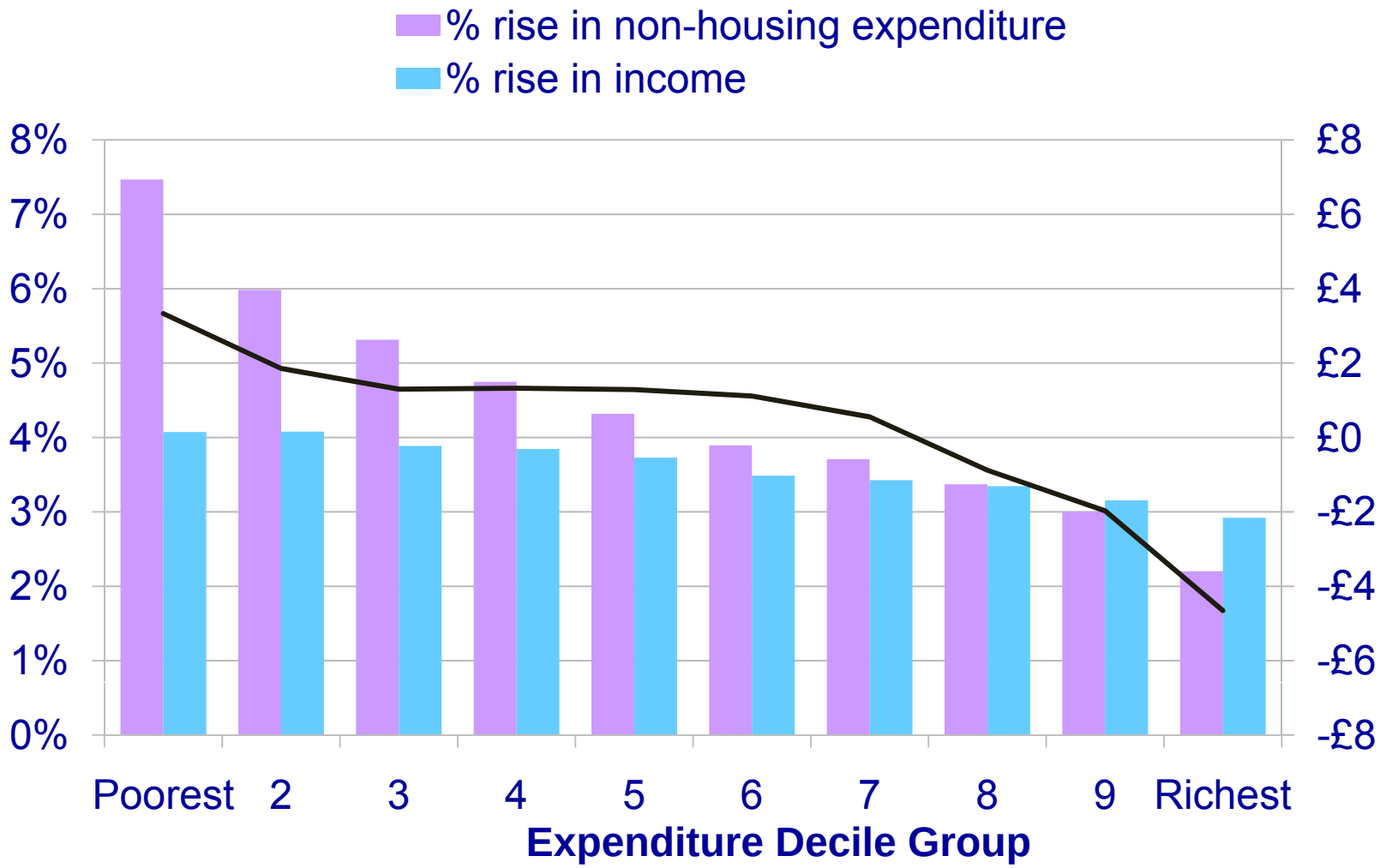
VAT reform: effects by expenditure



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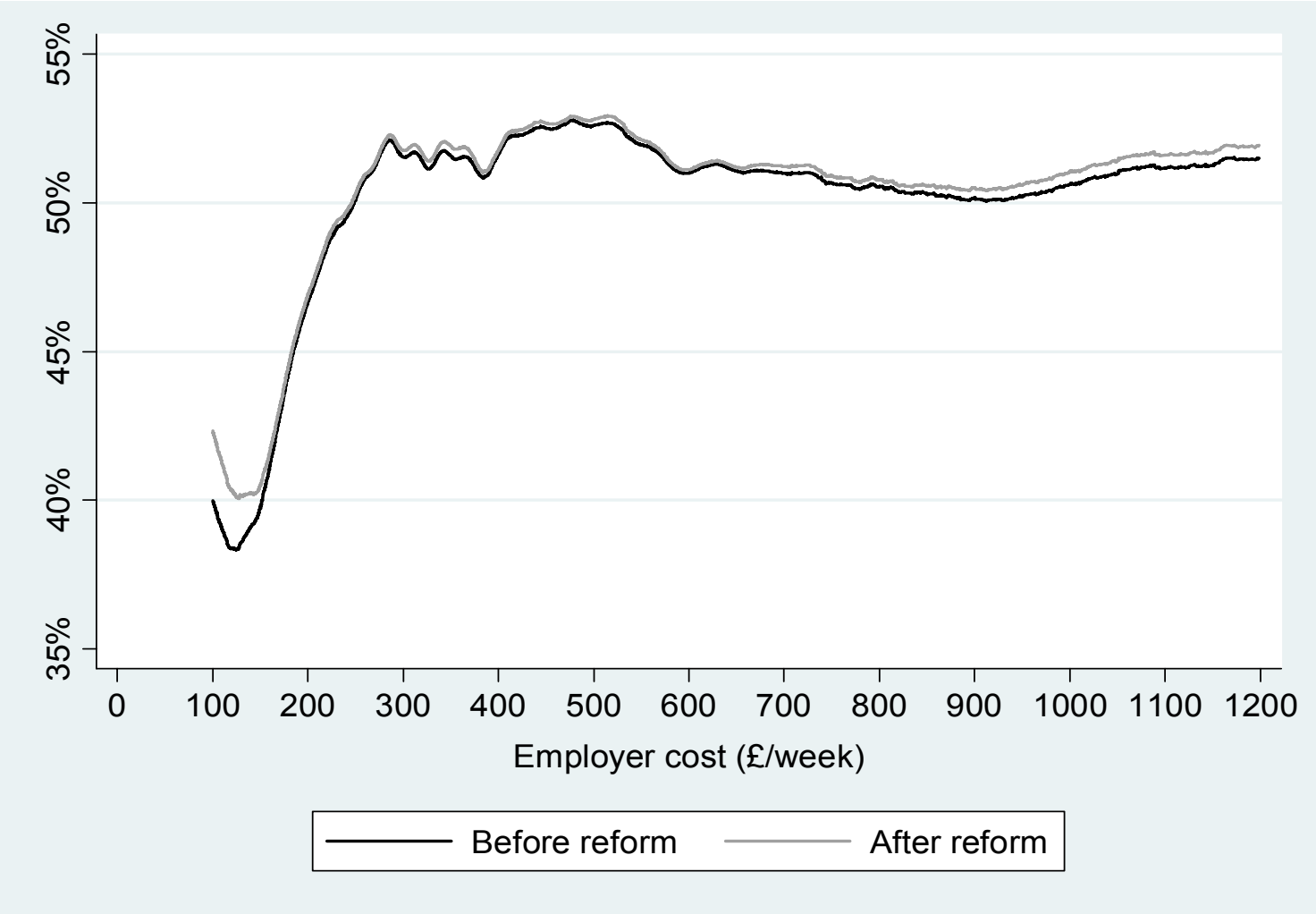
VAT reform: incentive to work at all

Participation tax rates



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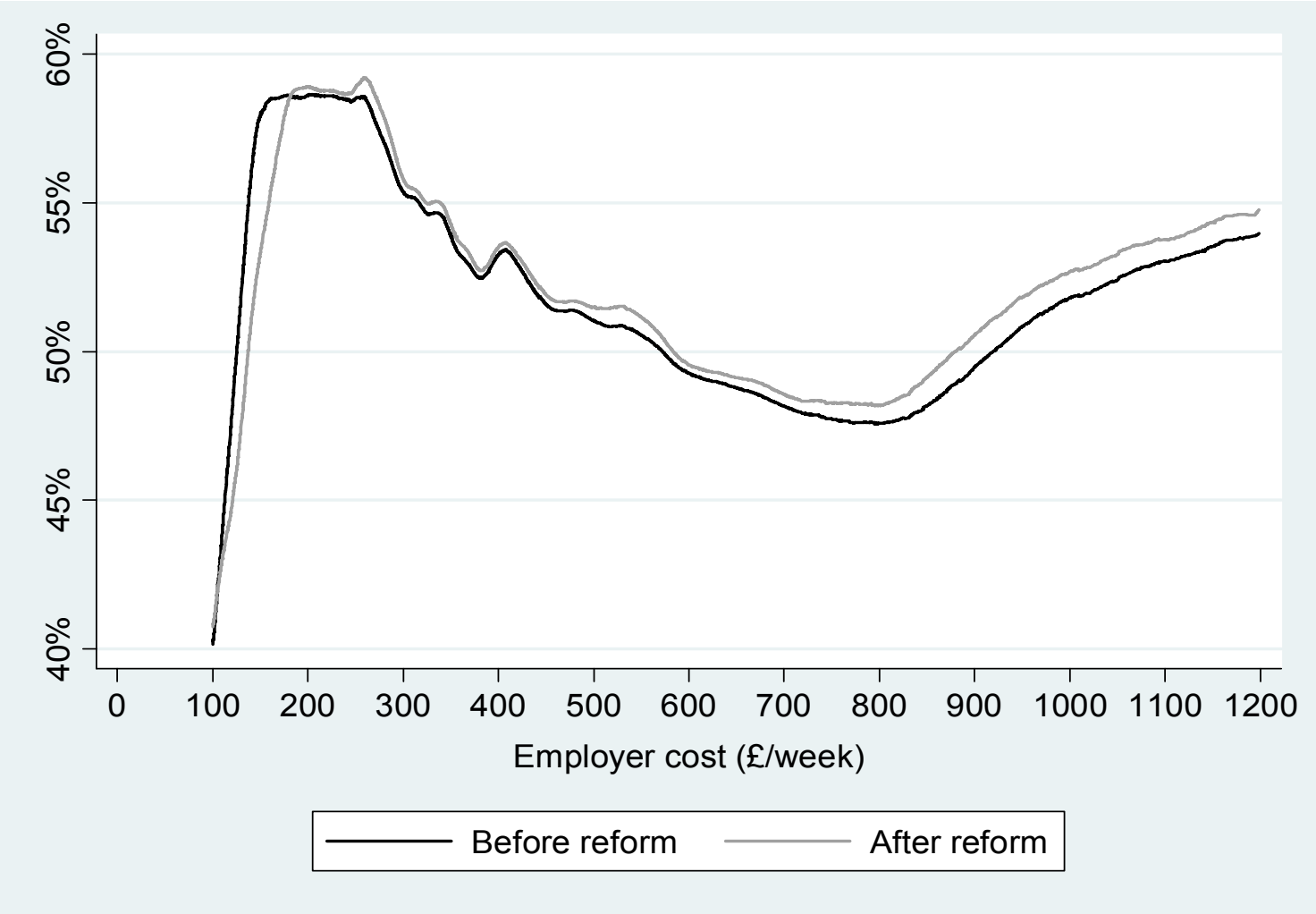
VAT reform: incentive to increase earnings

Effective marginal tax rates



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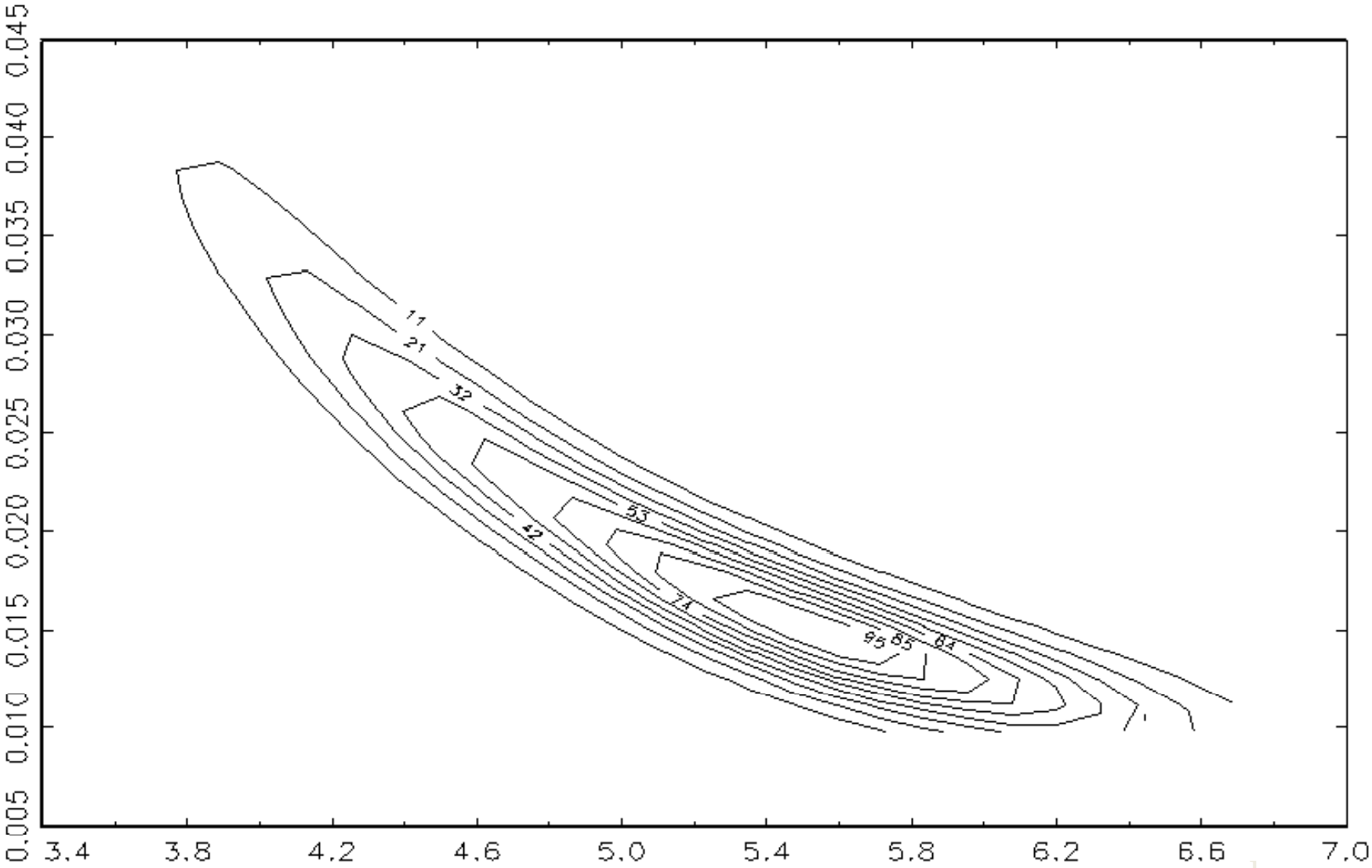
Welfare gains - Distribution of EV/x by ln(x)



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Broadening the VAT base

- We simulate removing almost all zero and reduced rates
- Raises £24bn (with a 17.5% VAT rate) if no behavioural response
- Reduces distortion of spending patterns
  - With responses we find, could (in principle) compensate every household and have about £3-5bn welfare gain
- On its own base broadening would be regressive and weaken work incentives
- Can a practical package avoid this?

http://www.ifs.org.uk/mirrleesReview

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The Mirrlees Review
Reforming the Tax System for the 21st Century

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Dimensions of Tax Design: commissioned chapters and expert commentaries (1)

- The base for direct taxation

  James Banks and Peter Diamond; Commentators: Robert Hall; John Kay; Pierre Pestieau

- Means testing and tax rates on earnings

  Mike Brewer, Emmanuel Saez and Andrew Shephard; Commentators: Hilary Hoynes; Guy Laroque; Robert Moffitt

- Value added tax and excises

  Ian Crawford, Michael Keen and Stephen Smith; Commentators: Richard Bird; Ian Dickson/David White; Jon Gruber

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  Don Fullerton, Andrew Leicester and Stephen Smith; Commentators: Lawrence Goulder; Agnar Sandmo

- Taxation of wealth and wealth transfers

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Dimensions of Tax Design: commissioned chapters and expert commentaries (2)

- International capital taxation

  Rachel Griffith, James Hines and Peter Birch Sørensen; Commentators: Julian Alworth; Roger Gordon and Jerry Hausman

- Taxing corporate income

  Alan Auerbach, Mike Devereux and Helen Simpson; Commentators: Harry Huizinga; Jack Mintz

- Taxation of small businesses

  Claire Crawford and Judith Freedman

- The effect of taxes on consumption and saving

  Orazio Attanasio and Matthew Wakefield

- Administration and compliance, *Jonathan Shaw, Joel Slemrod and John Whiting; Commentators: John Hasseldine; Anne Redston; Richard Highfield*

- Political economy of tax reform, *James Alt, Ian Preston and Luke Sibieta; Commentator: Guido Tabellini*

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