

# Empirical Evidence and Earnings Taxation: Lessons from the Mirrlees Review

## Lecture 2: Taxation of Earnings

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# Empirical Evidence and Earnings Taxation

- This lecture will analyse the context, the impact and the design of earnings tax reforms
- It will focus on two questions:
  - How should we measure the impact of taxation on work decisions and earnings?
  - How should we assess the optimality of tax reforms?

# Empirical Evidence and Earnings Taxation

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- A discussion on the role of evidence 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

# Empirical Evidence and Earnings Taxation

- Sub-heading (and subtext) for the lecture:  
*Labor Supply Responses at the Extensive Margin:  
What Do We Know and Why Does It Matter?*
- Key chapter (in Mirrlees Review): Brewer, Saez and Shephard,  
<http://www.ifs.org.uk/mirrleesReview>
- + commentaries by Moffitt, Laroque and Hoynes

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

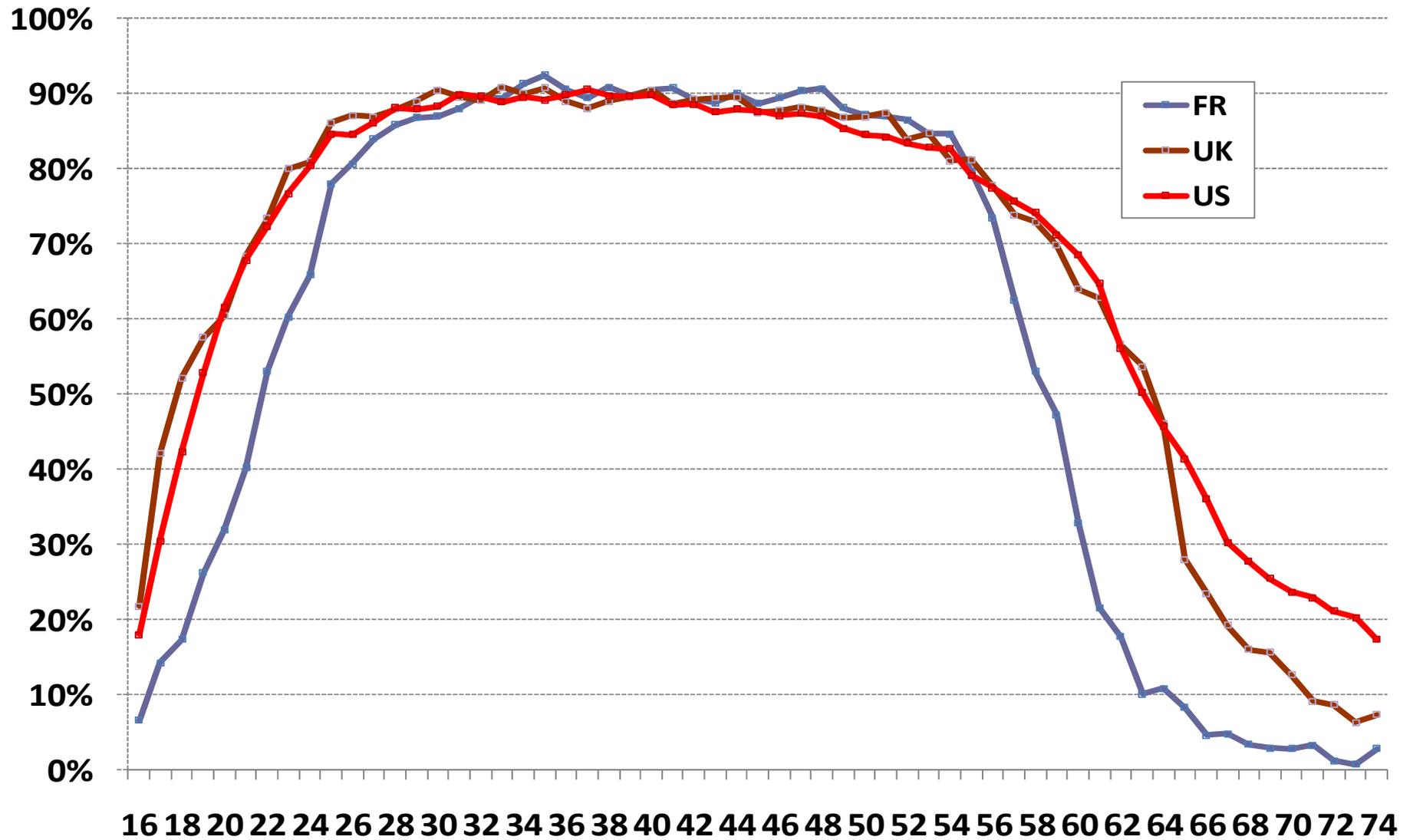
- Understanding responses to tax and welfare reform
  - Jim Heckman, David Wise, Ed Prescott, etc.. all highlight the importance of extensive labour supply margin,
  - a balance needs to be struck between the two margins....
- The size of extensive and intensive responses are also key parameters in the 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

## Draw on new empirical evidence: – 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

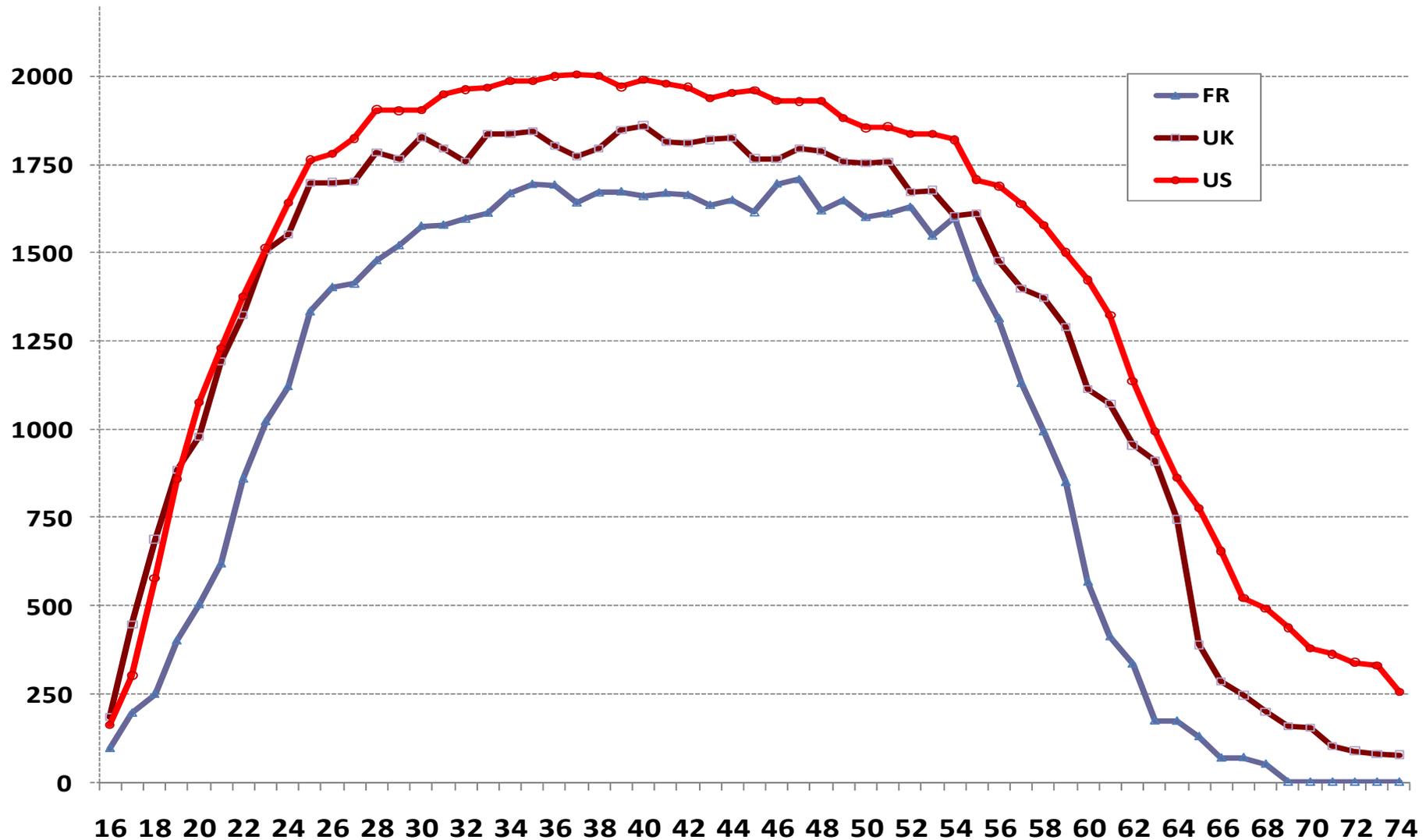
- So where are the key margins of response?
- Evidence suggests they are not all the extensive margin..
  - intensive and extensive margins both matter
  - they matter for tax policy evaluation and earnings tax design
  - and they matter in different ways by age and demographic groups
- Getting it right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

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



Blundell, Bozio and Laroque (2010)

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

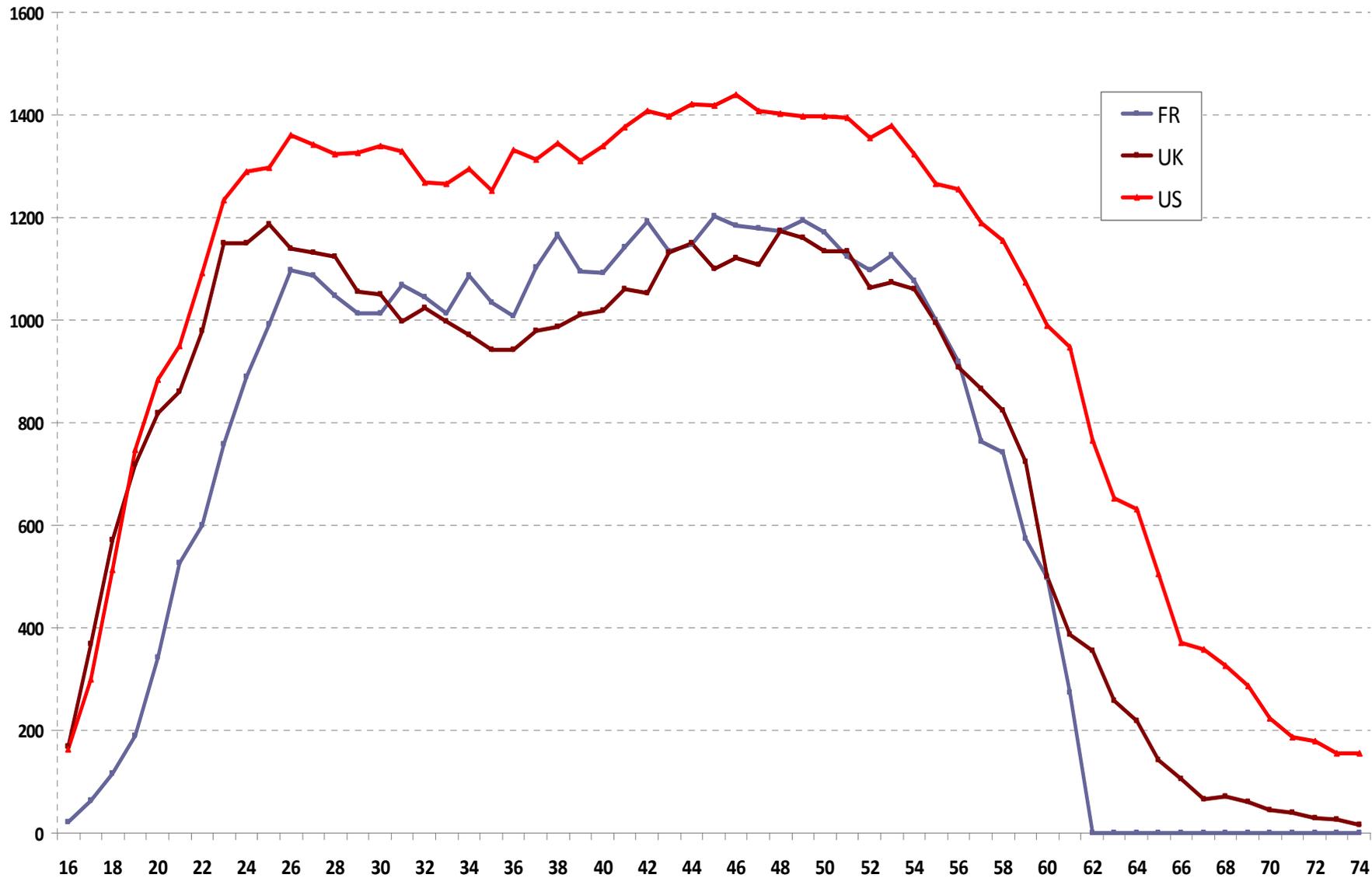


Blundell, Bozio and Laroque (2010)

# Key Margins of Adjustment

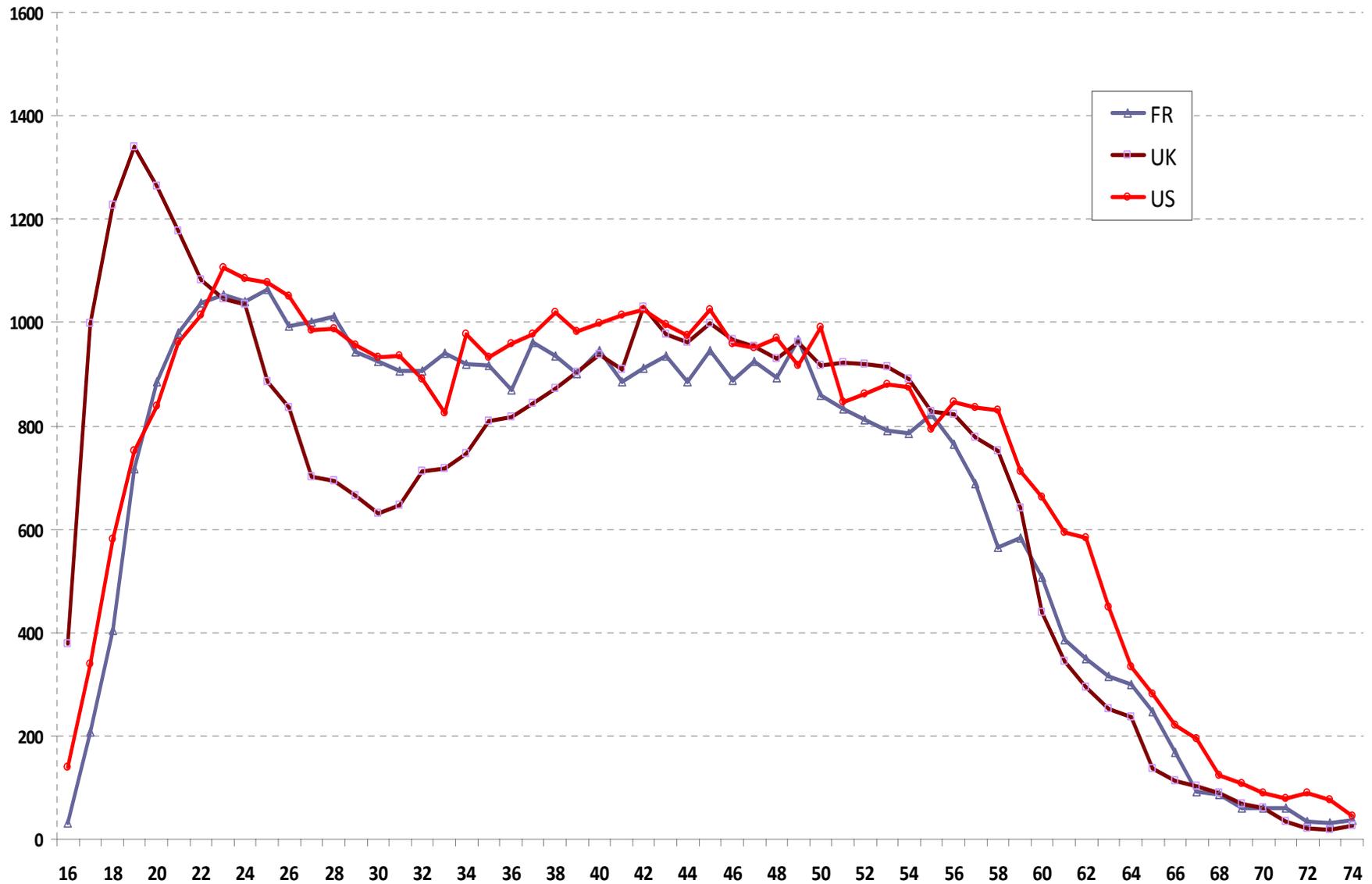
- and for women .....

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



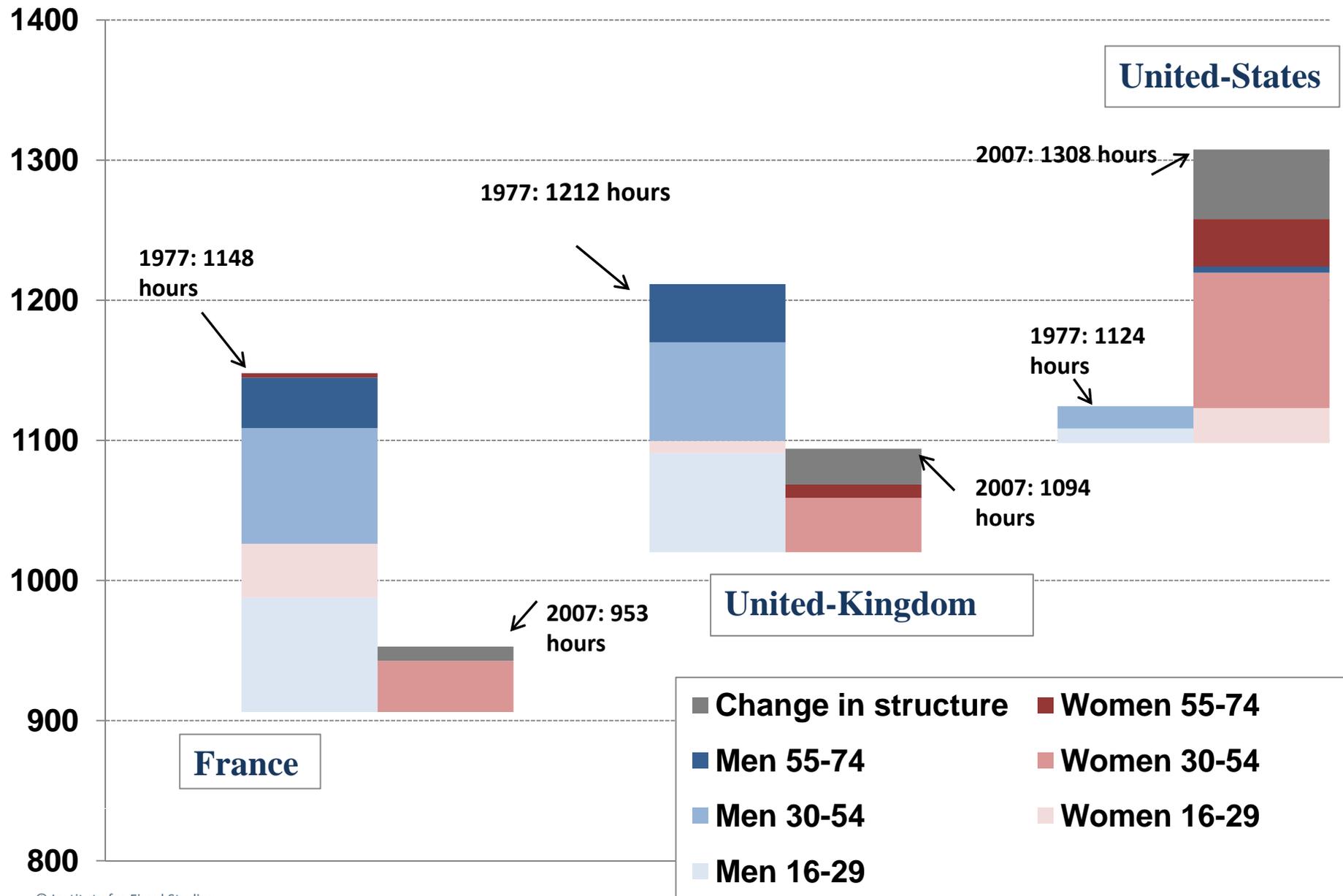
Blundell, Bozio and Laroque (2010)

# Female Hours by age – US, FR and UK 1977



Blundell, Bozio and Laroque (2010)

# Decomposition of change in annual hours worked (1977-2007)



# Thinking about Responses at the Intensive and Extensive Margin

- Write within period utility as 
$$U = \begin{cases} c - \frac{h^{1+1/\alpha}}{1+1/\alpha} - \beta & \text{if } h > 0 \\ c & \text{if } h = 0 \end{cases}$$
- $\alpha$  is the intensive labour supply elasticity and she works when the value of working at wage  $w$  exceeds the fixed cost  $\beta$ .
- Convenient to describe the distribution of heterogeneity through the conditional distribution of  $\beta$  given  $\alpha$ ,  $F(\beta | \alpha)$  and the marginal distribution of  $\alpha$ .
- The labour supply and employment rate for individuals of type  $\alpha$ , is

$$h(w, \alpha) = w^\alpha \quad \text{and} \quad p(w, \alpha) = F\left(\frac{w^{1+\alpha}}{1+\alpha}\right)$$

# Thinking about Responses at the Intensive and Extensive Margin

- The intensive and the employment rate elasticity are

$$\varepsilon_I(\alpha) = \alpha \quad \text{and} \quad \varepsilon_E(\alpha) = w^{(1+\alpha)} f\left(\frac{w^{(1+\alpha)}}{1+\alpha}\right) / F\left(\frac{w^{(1+\alpha)}}{1+\alpha}\right)$$

- The aggregate hours elasticity is a weighted sum across the intensive and extensive margins

$$\begin{aligned} \frac{d \ln H}{d \ln w} &= \frac{1}{H} \int_{\alpha} [\alpha w^{\alpha} F\left(\frac{w^{1+\alpha}}{1+\alpha} \mid \alpha\right) + w^{\alpha} w^{1+\alpha} f\left(\frac{w^{1+\alpha}}{1+\alpha} \mid \alpha\right)] dG(\alpha) \\ &= \frac{1}{H} \int_{\alpha} p(w, \alpha) h(w, \alpha) [\varepsilon_I(\alpha) + \varepsilon_E(\alpha)] dG(\alpha) \end{aligned}$$

- Of course, quasi-linear utility is highly restrictive and we expect income effects to matter, at least for some types of households – we use more general models with fixed costs

# Measuring Responses at the Intensive and Extensive Margin

- Suppose the population share at time  $t$  of type  $j$  is  $q_{jt}$ , then

total hours 
$$H_t = \sum_{j=1}^J q_{jt} H_{jt} \quad \text{and} \quad H_{jt} = p_{jt} h_{jt}$$

- Changes in total hours per person written as the sum of changes across all types of workers and the change in structure of the population

$$H_t - H_{t-1} = \Delta_t + S_t$$

where 
$$\Delta_t = \sum_{j=1}^J \Delta_{jt} \quad \text{with} \quad \Delta_{jt} = q_{jt-1} [H_{jt} - H_{jt-1}]$$

- We can also mirror the weighted elasticity decomposition

$$\frac{\Delta H}{H} \simeq \frac{1}{H} \sum_{j=1}^J q_j \left[ p_j h_j \frac{\Delta h_j}{h_j} + p_j h_j \frac{\Delta p_j}{p_j} \right]$$

- And derive *bounds* on extensive and intensive responses for finite changes

# 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]
	$\Delta$	-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]
	$\Delta$	-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]
	$\Delta$	-19	22	-19	90	6	38

# Bounds on Intensive and Extensive Responses (1977-2007)

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## 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

# An Empirical 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’

# Focus first on tax rates on lower incomes

## Main defects in 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...

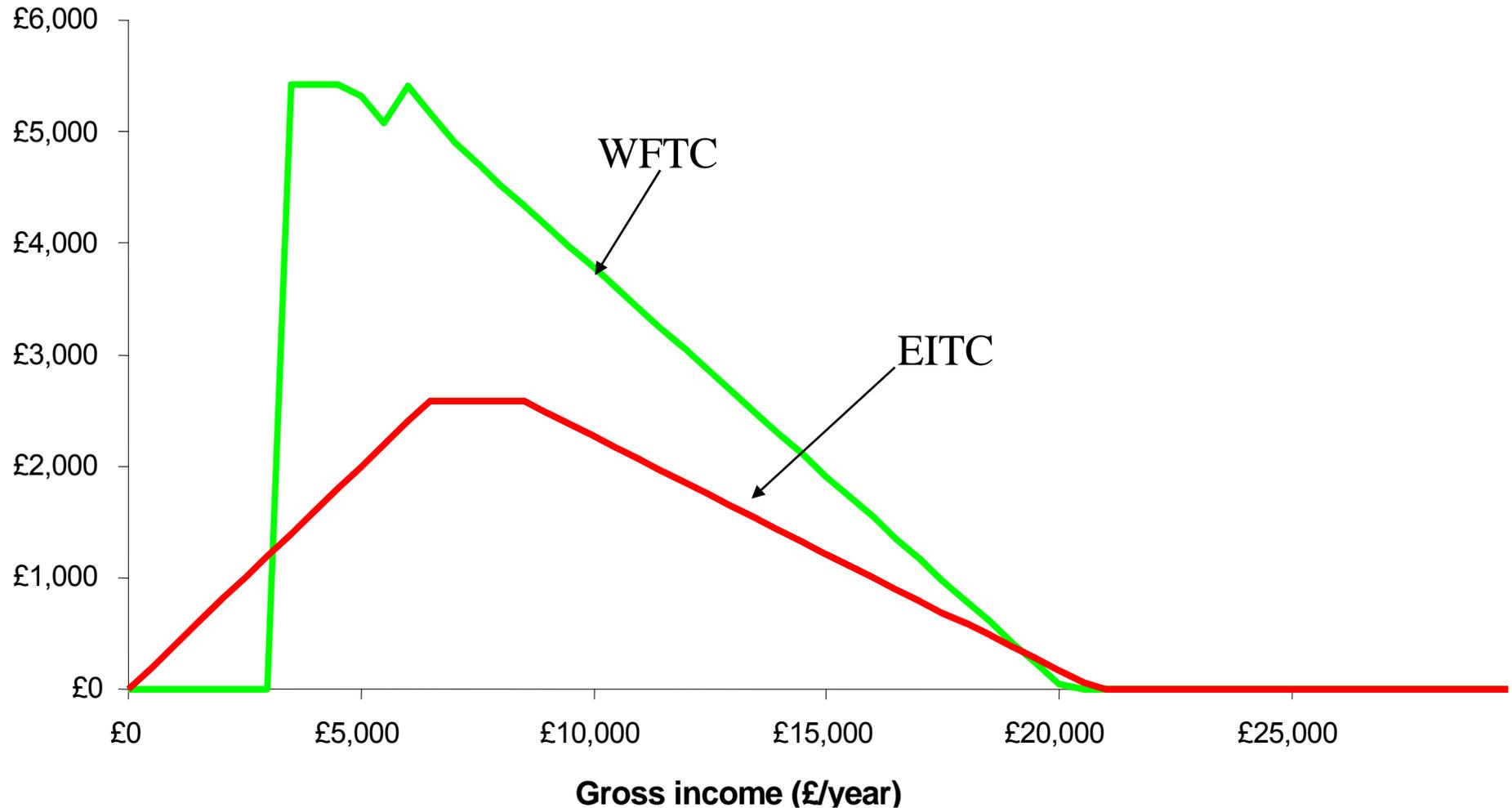
# Particular Features of the UK Working Tax Credit

- hours of work condition
  - minimum hours rule - 16 hours per week
  - an additional hours-contingent payment at 30 hours
- family eligibility
  - children (in full time education or younger)
  - adult credit plus amounts for each child
- income eligibility
  - family net income below a certain threshold
  - credit is tapered away at 55% (previously 70% under FC)

# The UK Working Families Tax Credit

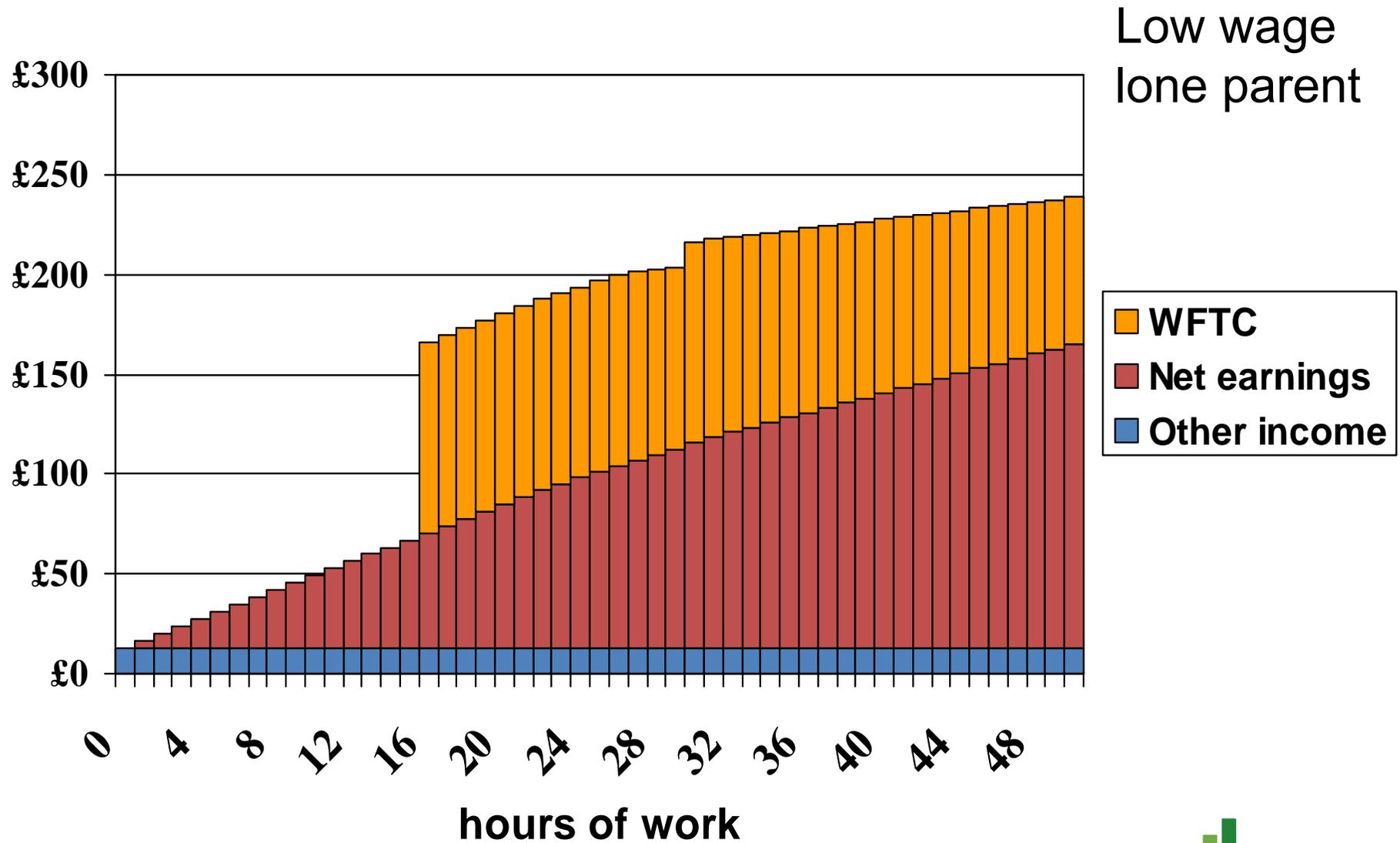


# The US EITC and the UK WFTC compared



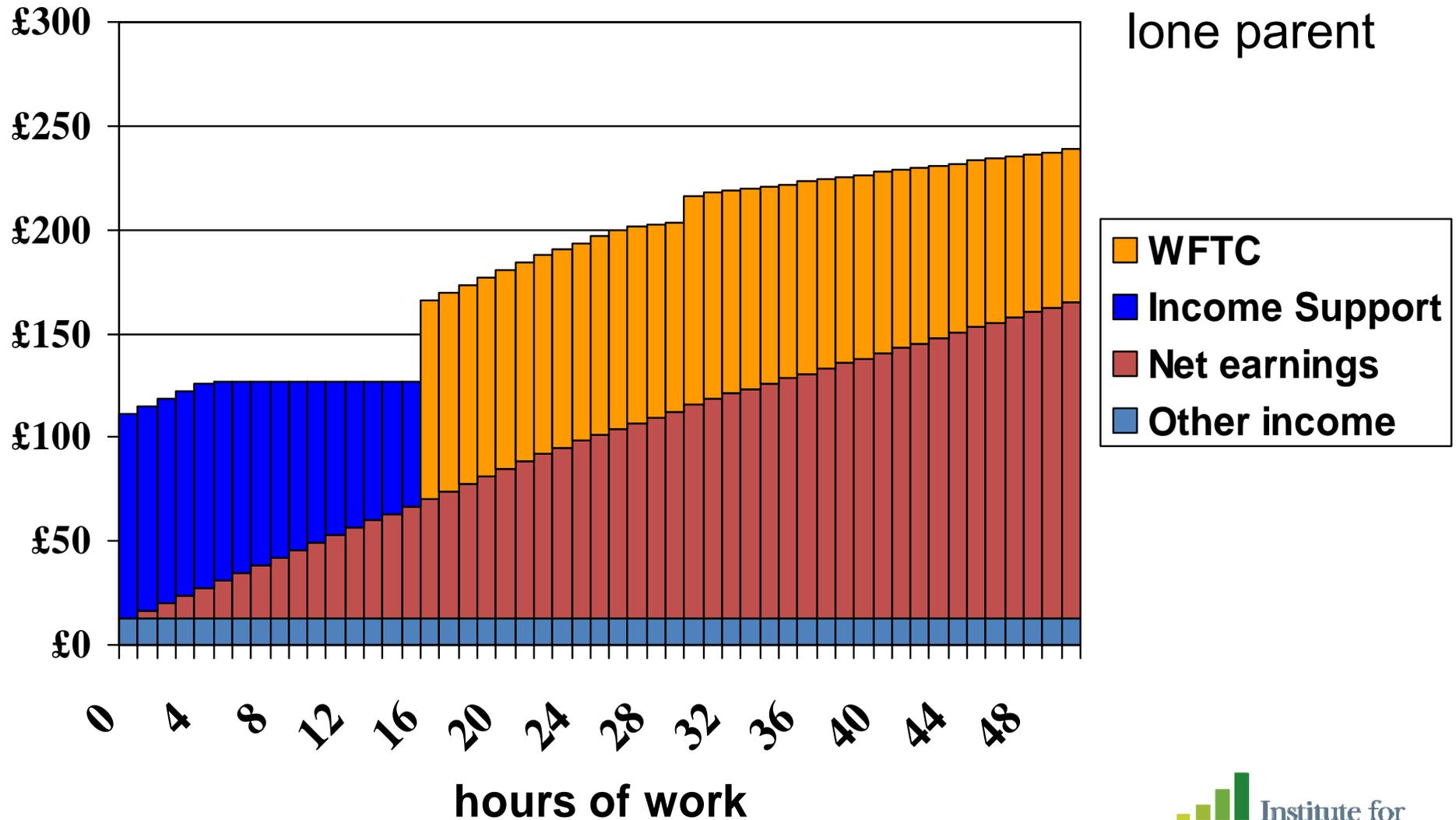
- **Puzzle: WFTC about twice as generous as the US EITC but with about half the impact. Why?**

# The interaction of WFTC with other benefits in the UK

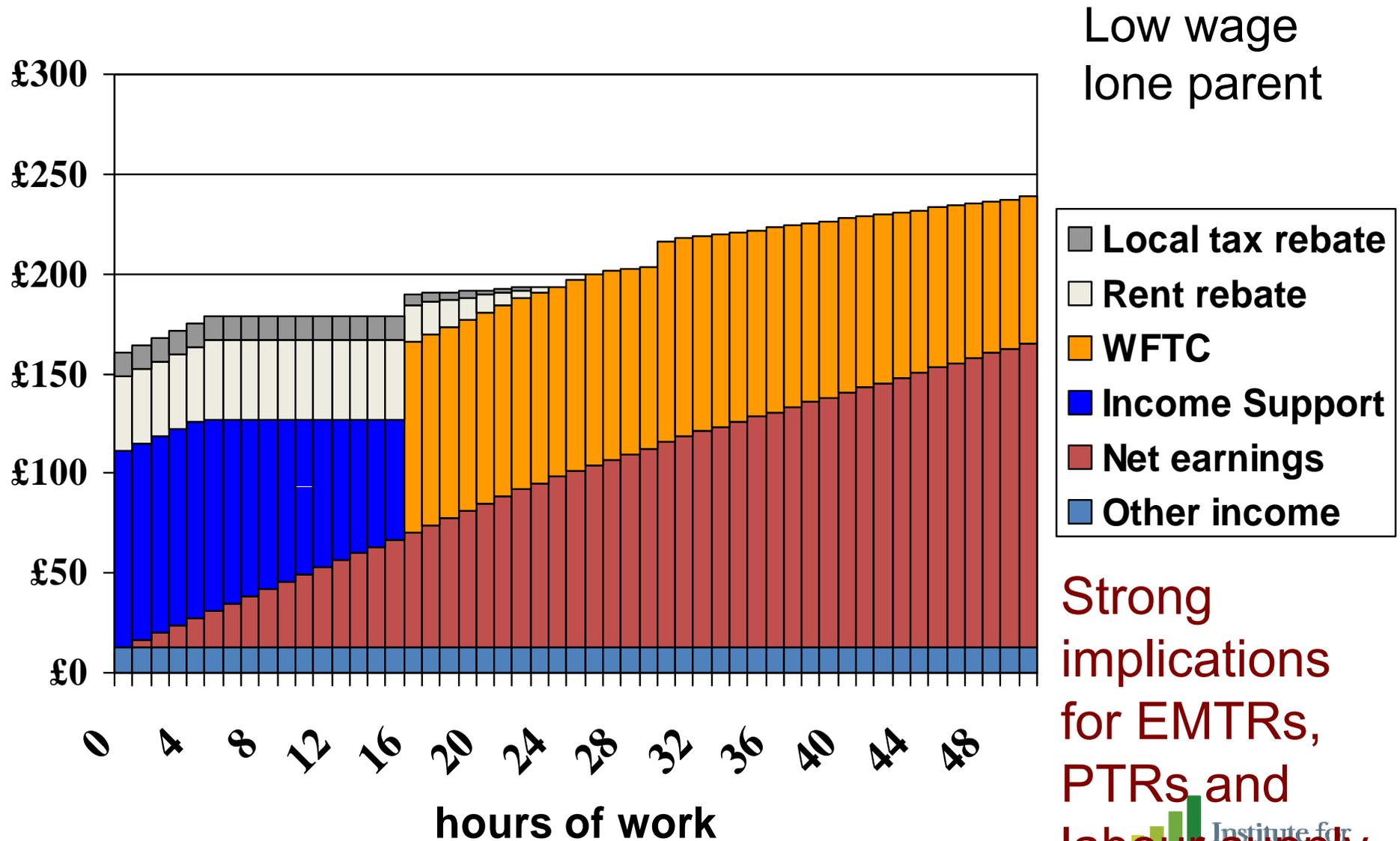


# The interaction of WFTC with other benefits in the UK

Low wage  
lone parent

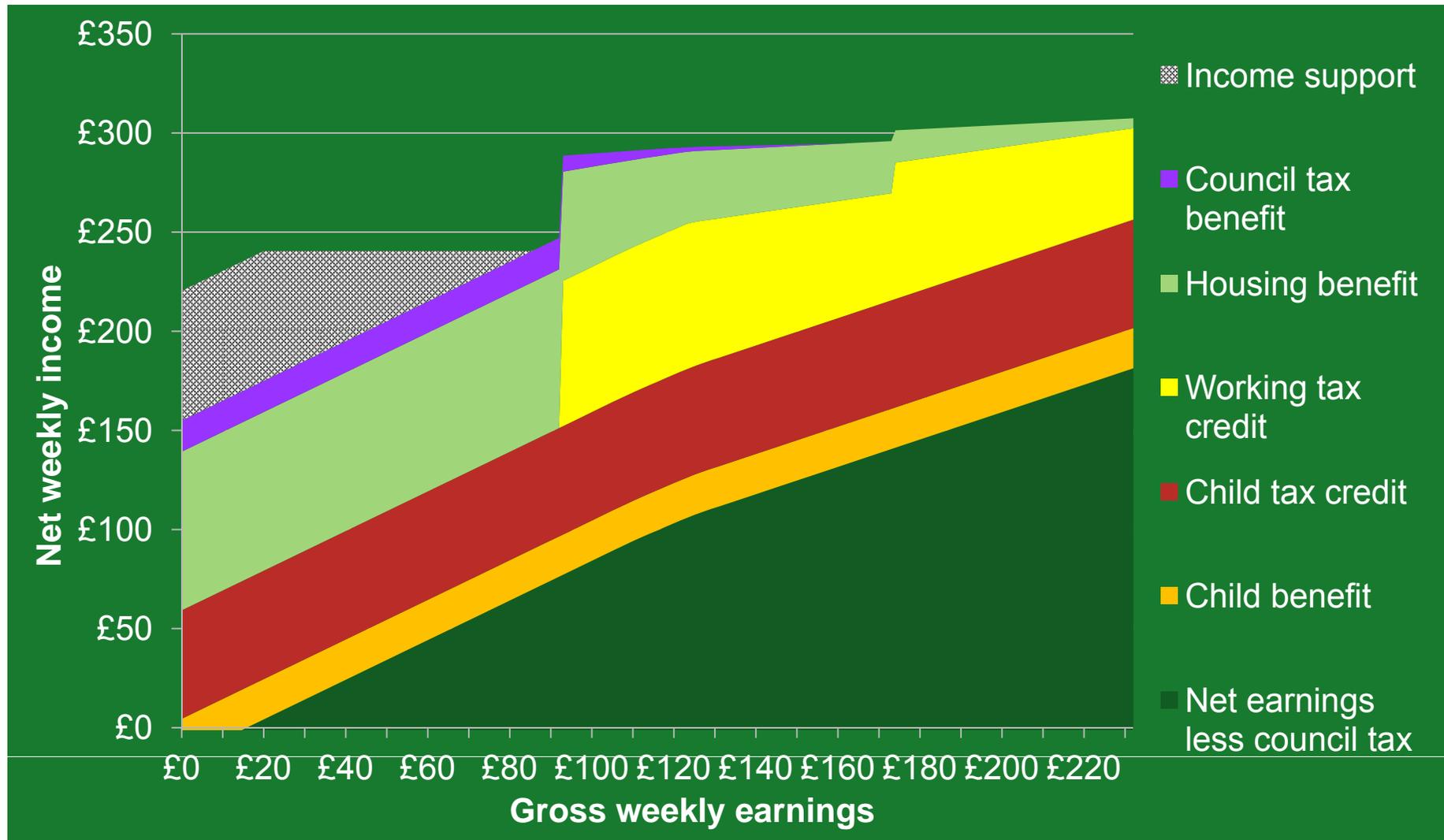


# The interaction of WFTC with other benefits in the UK



Strong implications for EMTRs, PTRs and labour supply

# The interaction between taxes, tax credits and benefits



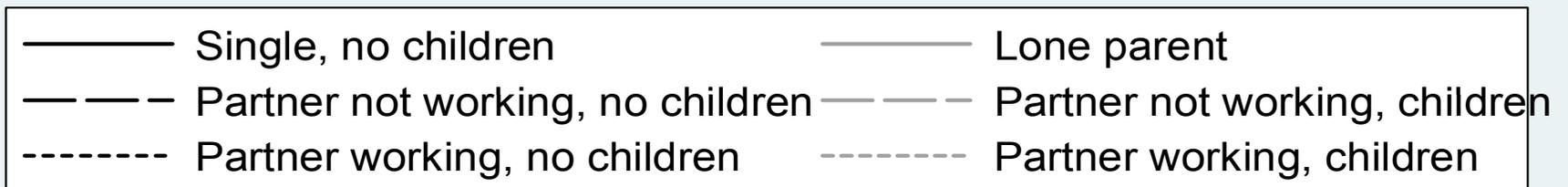
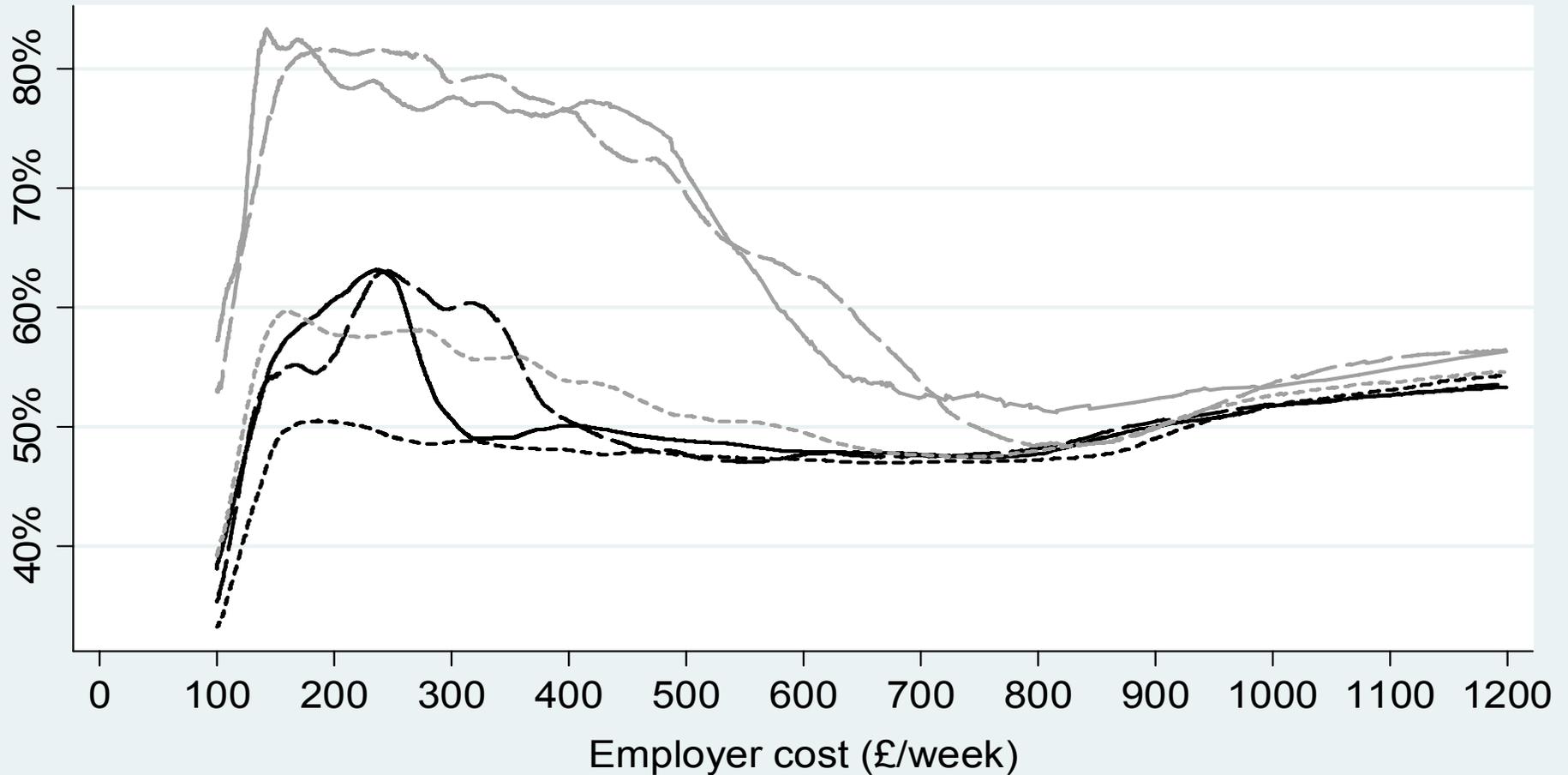
Notes: Lone parent, with one child aged between one and four, earning the minimum wage (£5.80 per hour), with no other private income and no childcare costs, paying £80 per week in rent to live in a council tax Band B property in a local authority setting council tax rates at the national average

## But this is just an example....

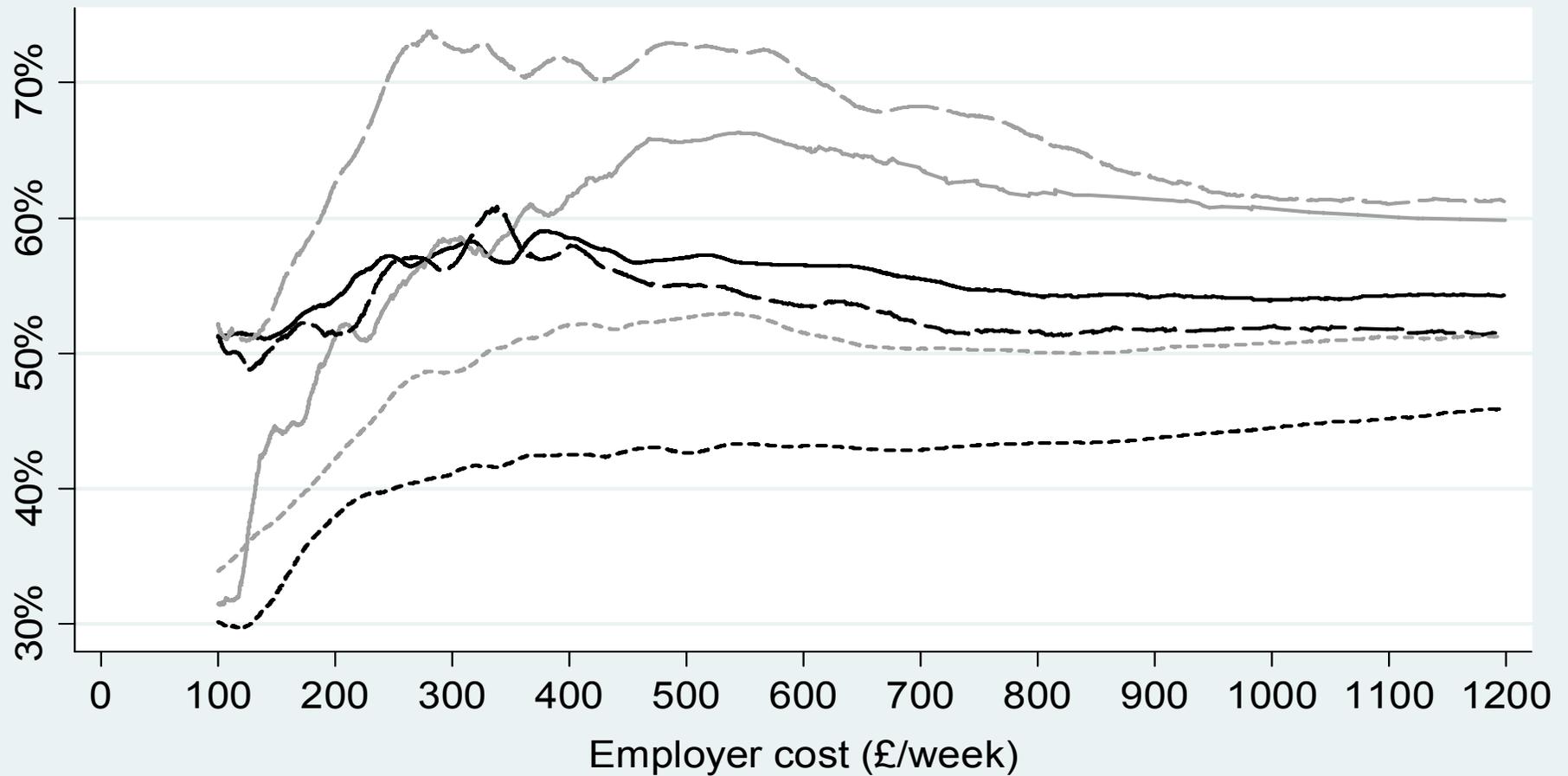
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- What does the tax and benefit system imply across the distribution of earnings and different family types?
  - What do effective marginal tax rates look like? – the proportion of a small increase in earnings taken in tax and withdrawn benefits
  - What do participation tax rates look like? – the incentive to be in paid work at all – defined by the proportion of total earnings taken in tax and withdrawn benefits.

# Average EMTRs for different family types

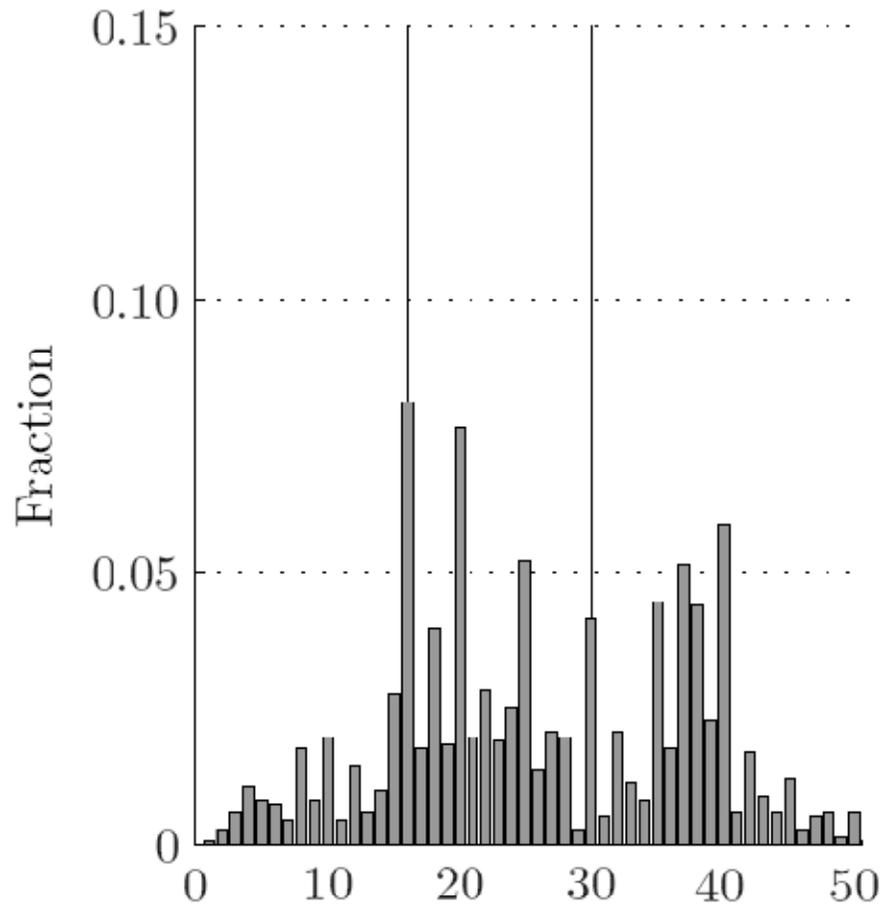


# Average PTRs for different family types

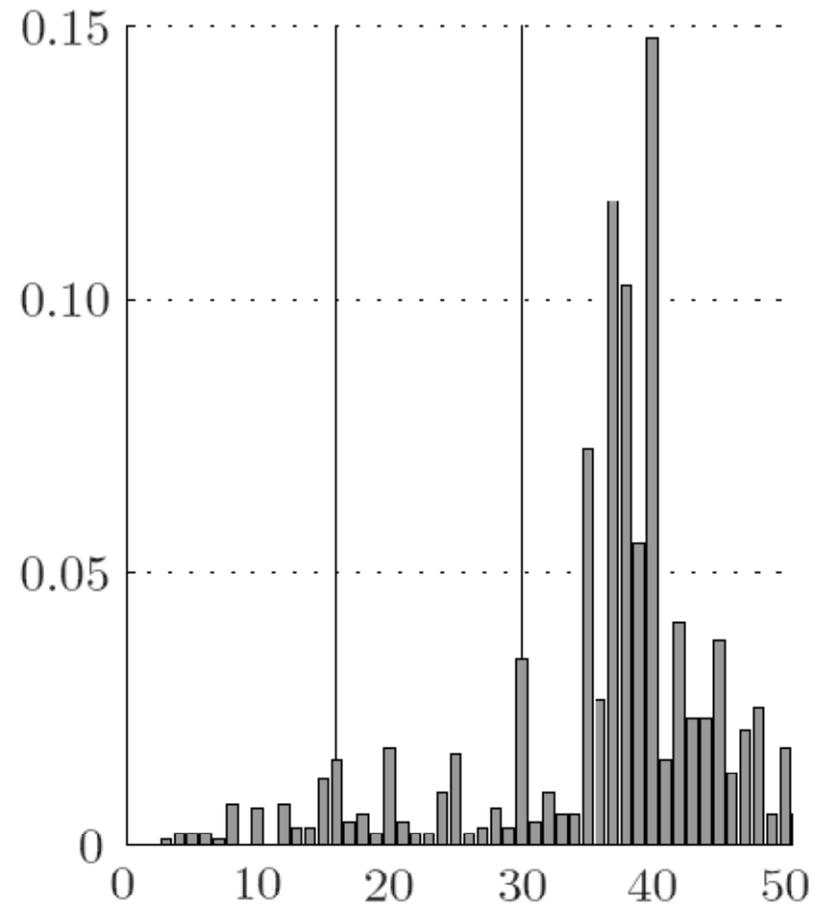


# Can the reforms explain weekly hours worked?

Single Women (aged 18-45) - 2002



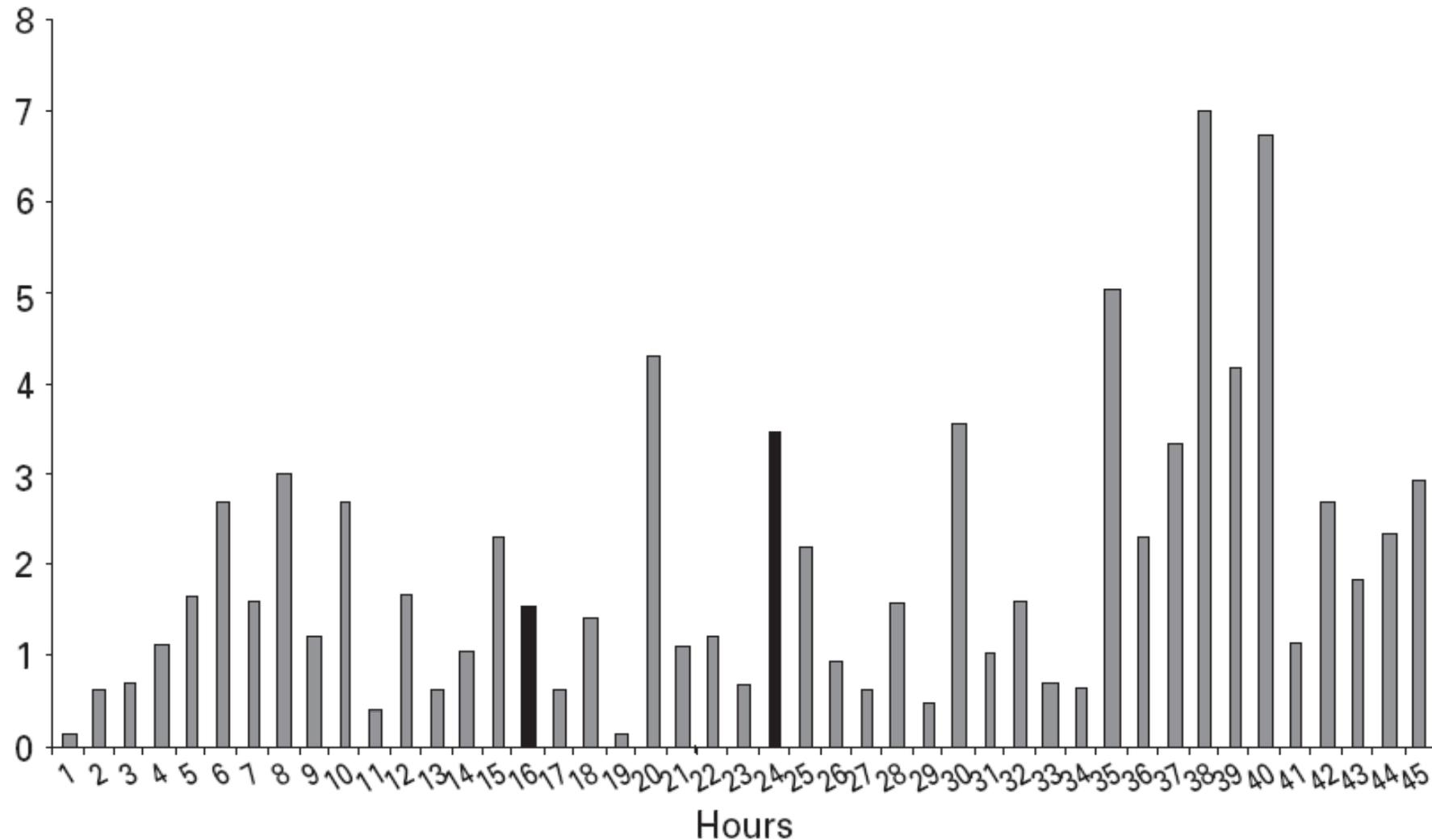
Hours of Work, Lone Mothers



Hours of Work, Childless Single Women

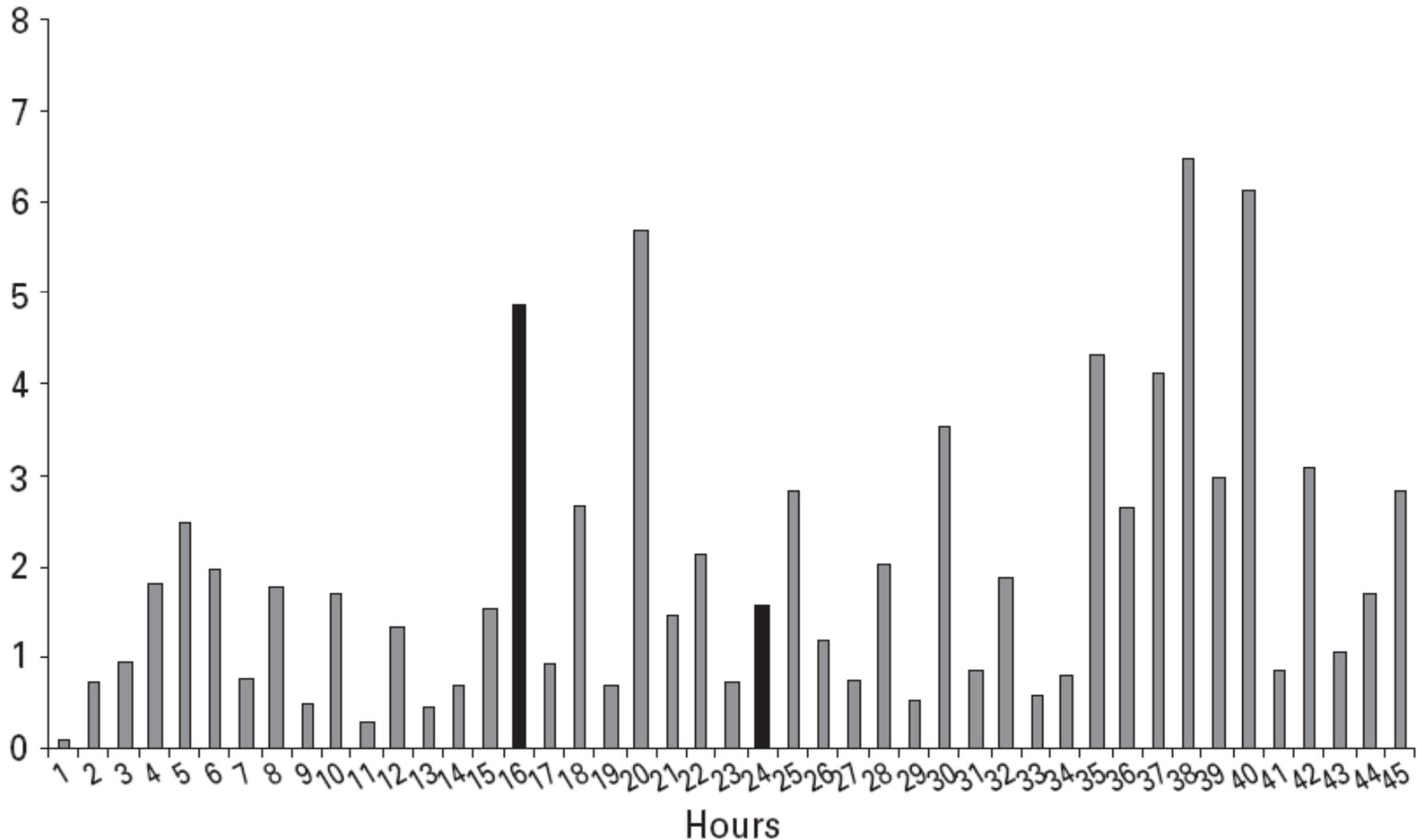
Blundell and Shephard (2009)

# Hours' distribution for lone parents, before WFTC



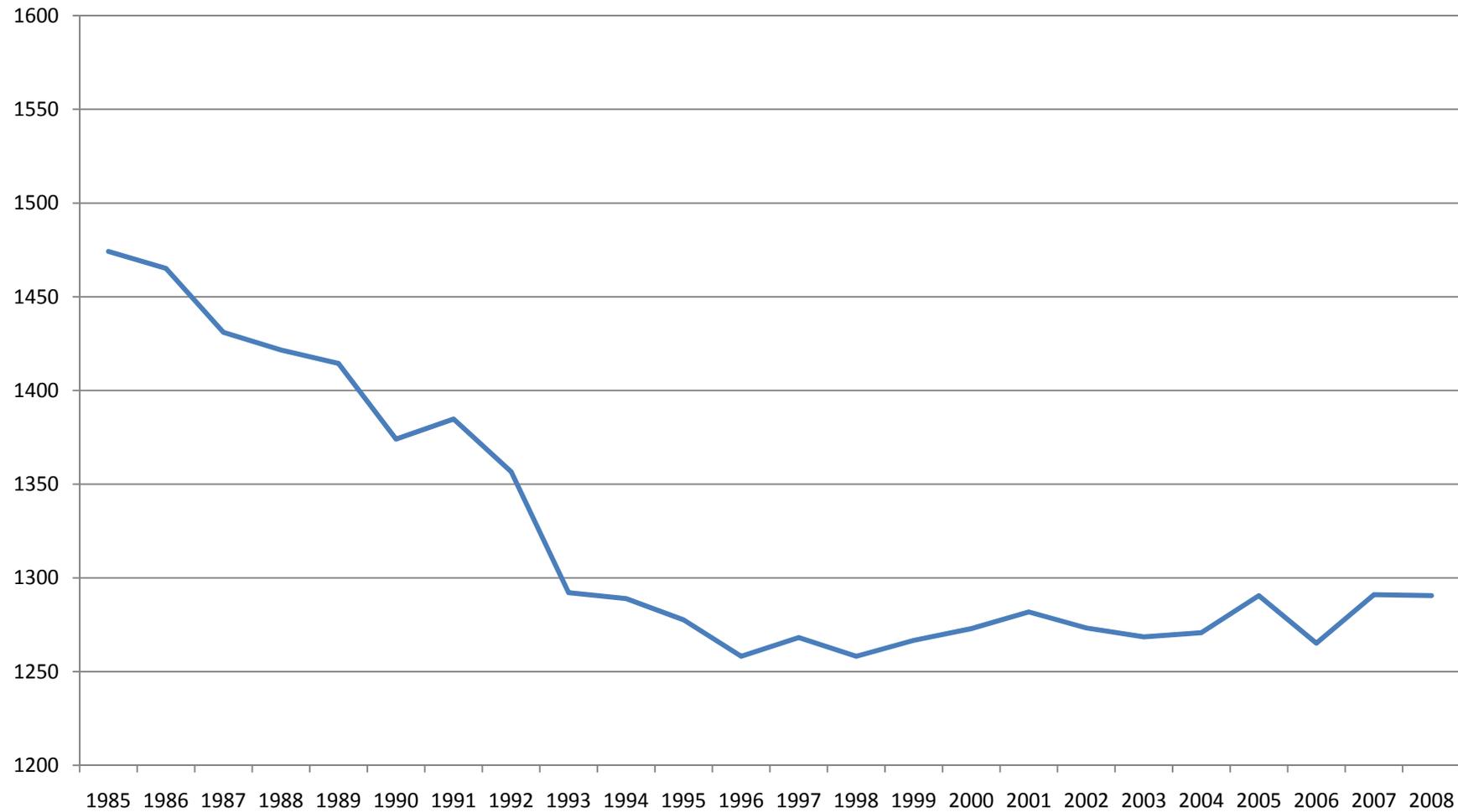
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# Hours' distribution for lone parents, after WFTC

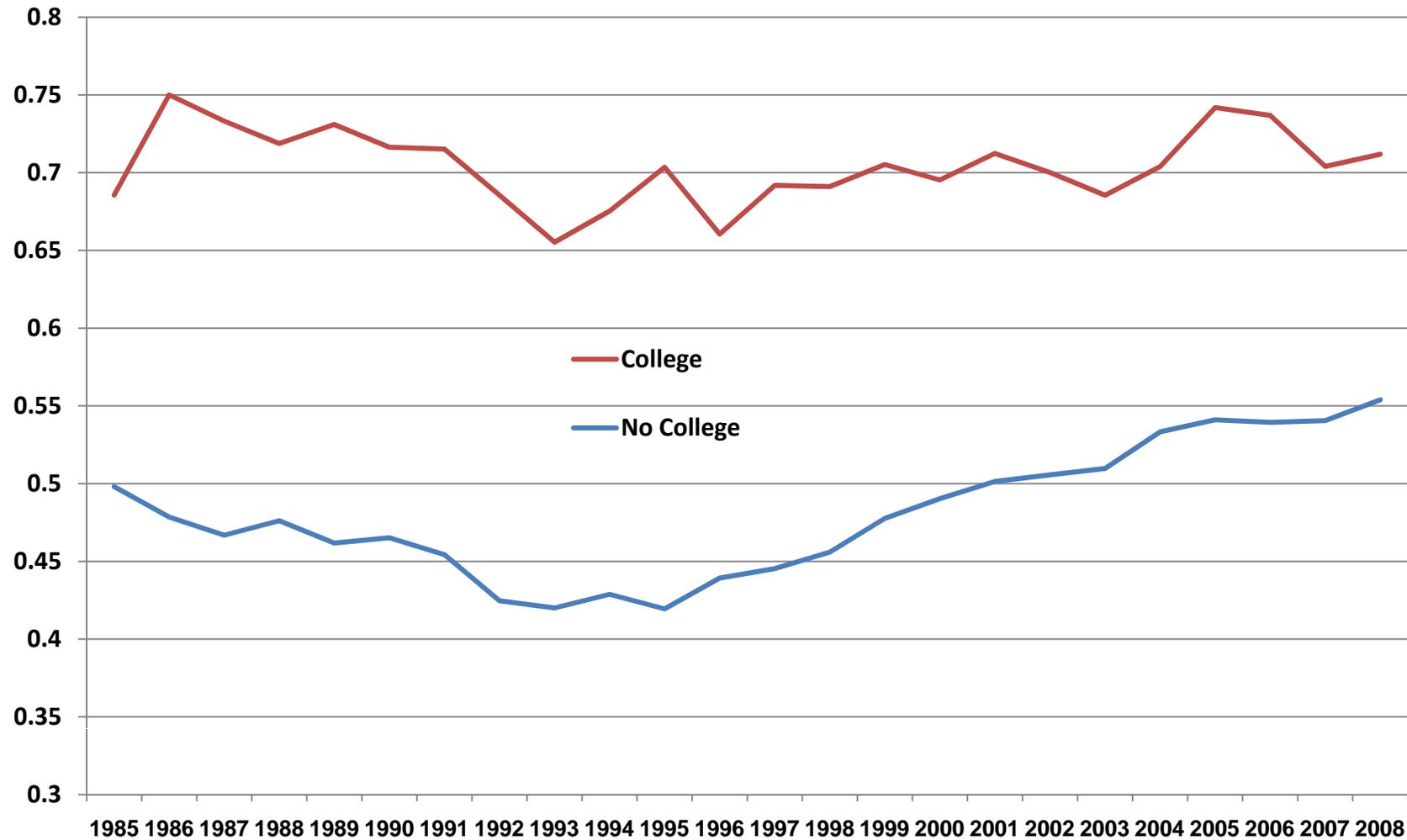


Blundell and Shephard (2010)

# Hours trend for low ed lone parents in UK



# Employment trends for lone parents in UK



# WFTC Reform: Quasi-experimental Evaluation

## Matched Difference-in-Differences

Average Impact on % Employment Rate of Single Mothers

<i>Single Mothers</i>	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,..

# Alternative approaches to measuring the impact:

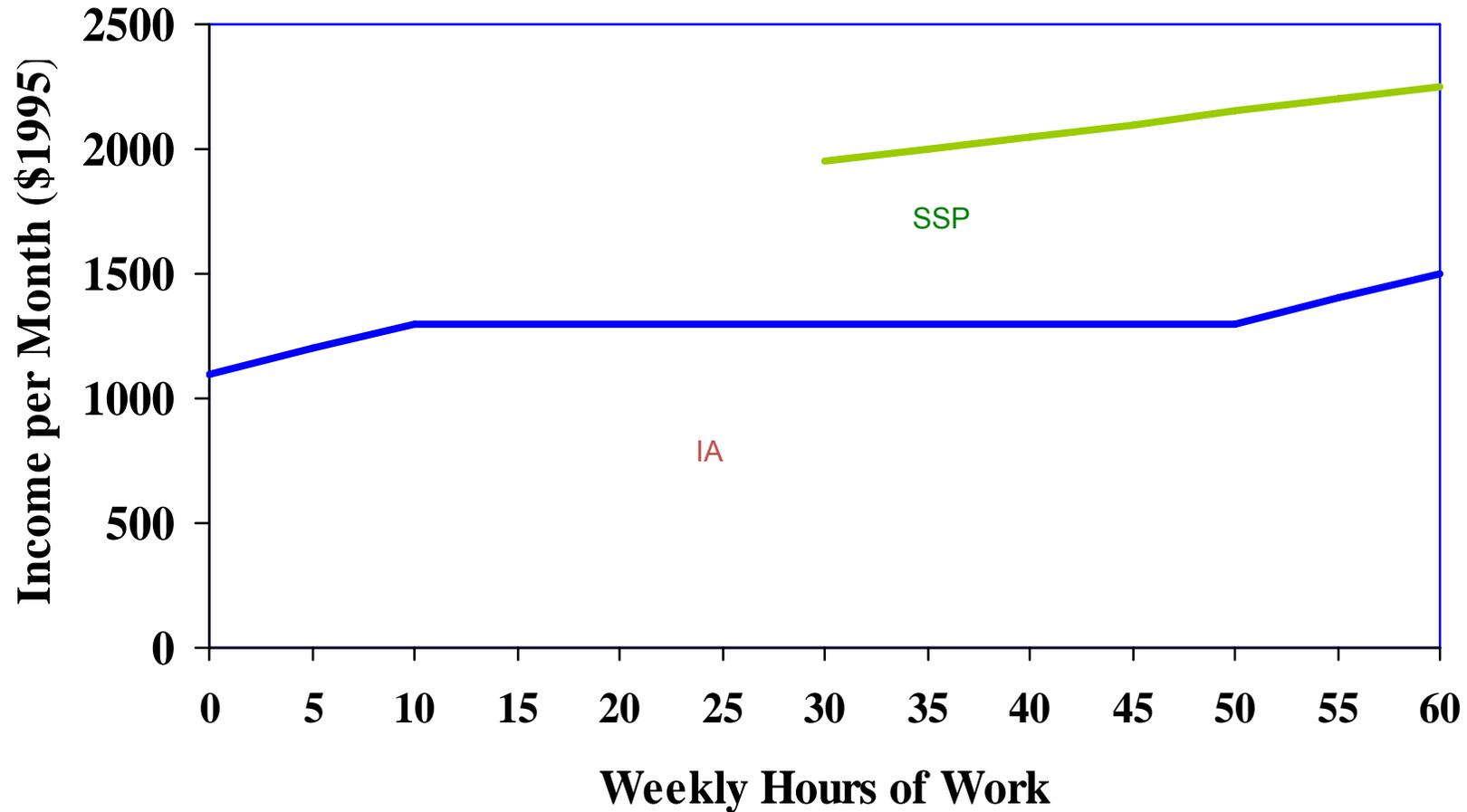
- Structural model
  - Simulate effect of actual or hypothetical reforms
  - Useful for (optimal) design too, but, robust?
- Quasi-experiment/Difference-in-differences
  - Compares outcomes of eligibles and non-eligibles and estimates 'average' impact of past reform
  - Only indirectly related to what is needed for optimal design
  - Can use this quasi-experimental evidence to (partially) validate the structural model
- Randomised experiment? SSP?

## Canadian Self Sufficiency Program

- Randomised-Control experimental design
- Do financial incentives encourage work among low skilled lone parents?
- The aim was to encourage employment among single parents on welfare
  - 50% earnings supplement – as a tax credit
  - at least 30 hours per week job
  - On earnings up to an annual limit of \$36000
- provided to the individual, not the employer, as in EITCs

# Canadian Self Sufficiency Program

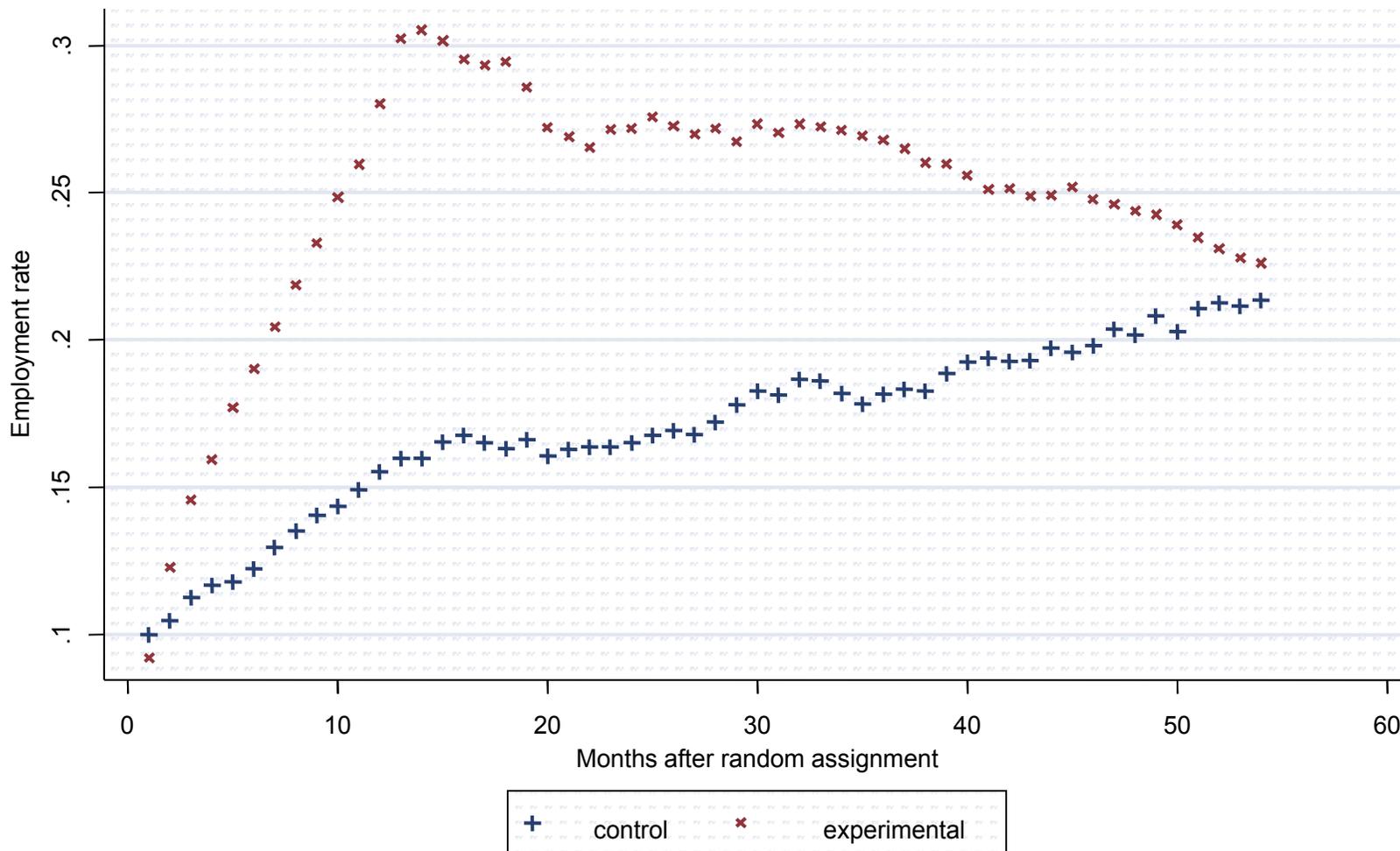
*Budget Constraint for a Single Parent on Minimum Wage*



— Income Assistance — Self Sufficiency Program

40

# SSP: Employment Rate by months after RA



## Key features of the structural model

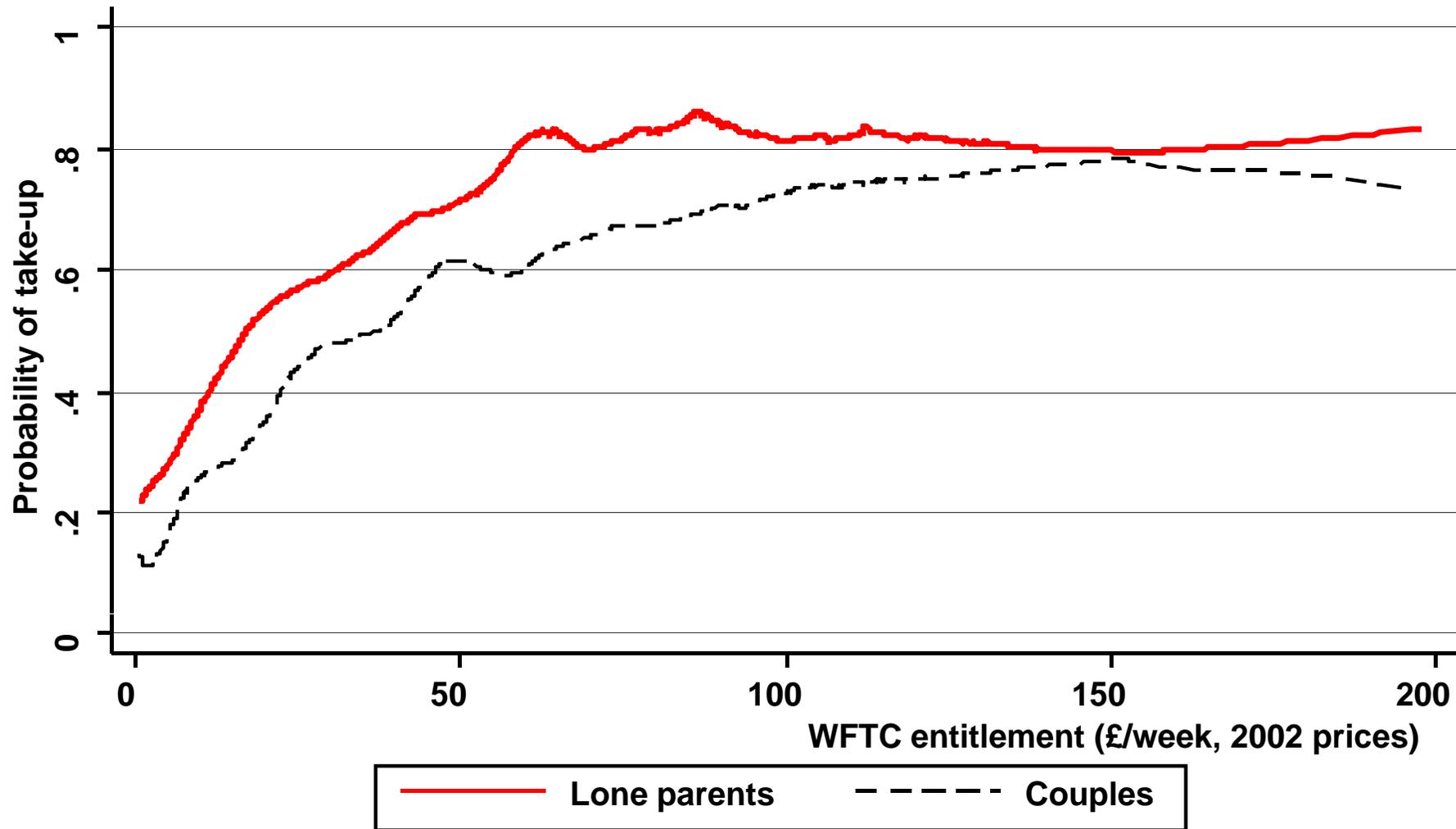
Preferences  $U(c_h, h, P; X, \varepsilon)$

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



## Net Income schedule :

$$y_{hP} = wh + I - \overset{\text{Tax}}{t(wh, I)} - C_h + \overset{\text{Transfers}}{\Psi_0(w, h, I)} + \overset{P: \text{take-up}}{P\Psi_1(w, h, I)}$$

or  $y_{hP} = \tilde{y}_{hP} + P\Psi_1(w, h, I)$

the tax-credit payment function  $\Psi_1(w, h, I)$  depends on:

hours (through the hours condition of entitlement)

other income /

demographic characteristics  $X$

## Structural Model Elasticities – low education lone parents

### (a) Youngest Child Aged 5-10

<i>Weekly Earnings</i>	<i>Density</i>	<i>Extensive</i>	<i>Intensive</i>
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)
<i>Employment elasticity</i>		0.820 (.042)	

## Structural Model Elasticities – low education lone parents

### (c) Youngest Child Aged 0-4

<i>Weekly Earnings</i>	<i>Density</i>	<i>Extensive</i>	<i>Intensive</i>
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)
<i>Participation elasticity</i>		0.536 (.047)	

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

# Structural Simulation of the WFTC Reform:

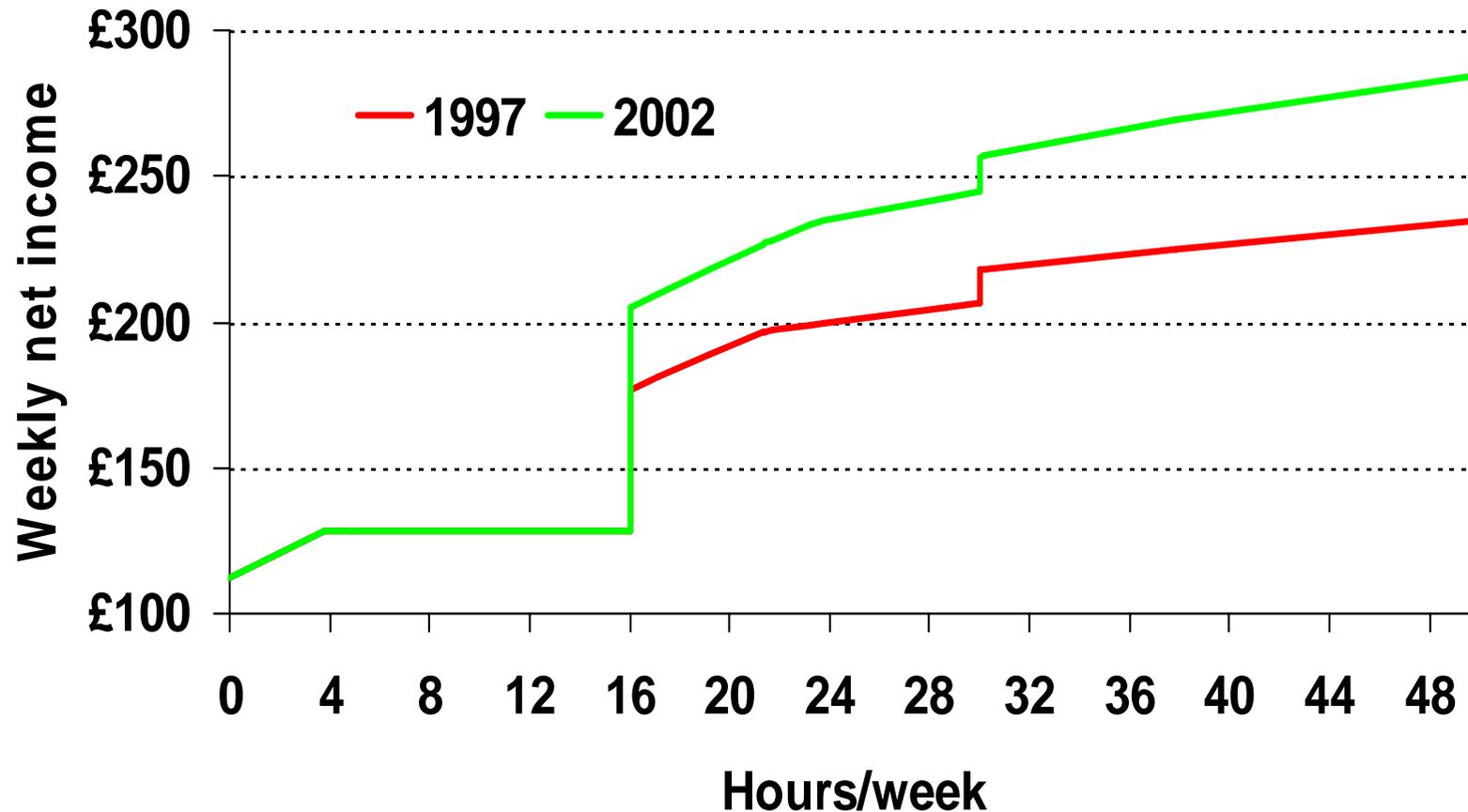
## WFTC Tax Credit Reform

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

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

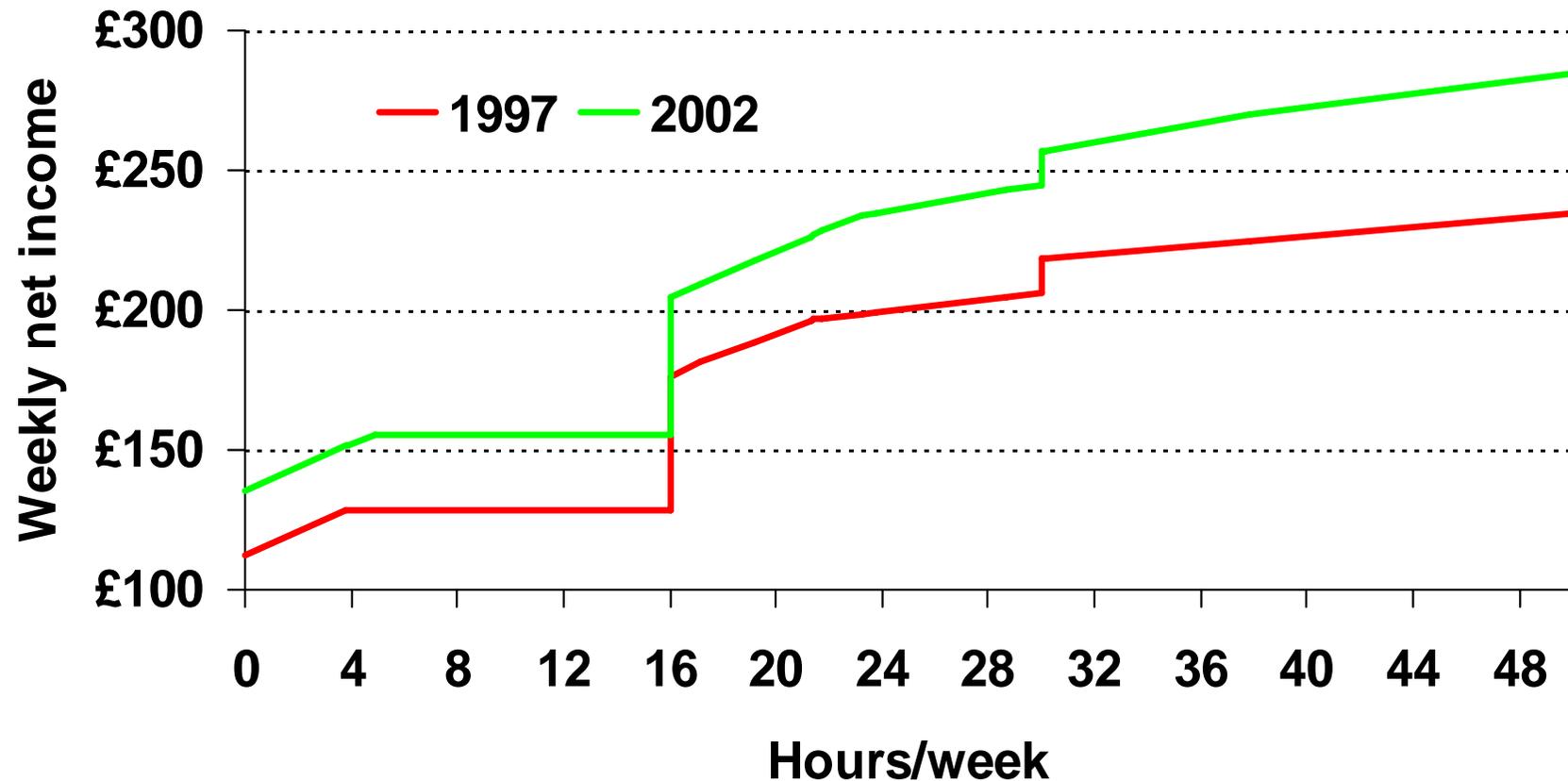
– relatively 'large' impact

# 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.*

# Impact of WFTC and IS reforms 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.

# Structural Simulation of the WFTC Reform:

## Impact of all Reforms (WFTC and IS)

	All	y-child	y-child	y-child	y-child
		0 to 2	3 to 4	5 to 10	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.

## 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:

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

- 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)

## How do we think about an optimal design?

- Assume we want to redistribute ‘£R’ to low ed. single parents, what is the ‘optimal’ way to do this?
- Recover optimal tax/credit schedule in terms of earnings
  - use Diamond-Saez approximation in terms of extensive and intensive elasticities at different earnings

$$\frac{T_i - T_{i-1}}{c_i - c_{i-1}} = \frac{1}{e_i h_i} \sum_{j \geq i}^I h_j \left[ 1 - g_j - \eta_j \frac{T_j - T_0}{c_j - c_0} \right].$$

- also ‘complete’ Mirrlees optimal tax computation

## A 'microeconomic' 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  $X$

$$W = \int_{w,X} \int_{\varepsilon} \Gamma(U(wh - T(w, h; X), h; X, \varepsilon)) dF(\varepsilon) dG(w; X)$$

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

$$\int_{w,X} \int_{\varepsilon} T(wh, h; X) dF(\varepsilon) dG(w; X) \geq \bar{T} (= -R)$$

for a given  $R$ .

Control preference for equality by transformation function:

$$\Gamma(U | \theta) = \frac{1}{\theta} \{(\exp U)^\theta - 1\}$$

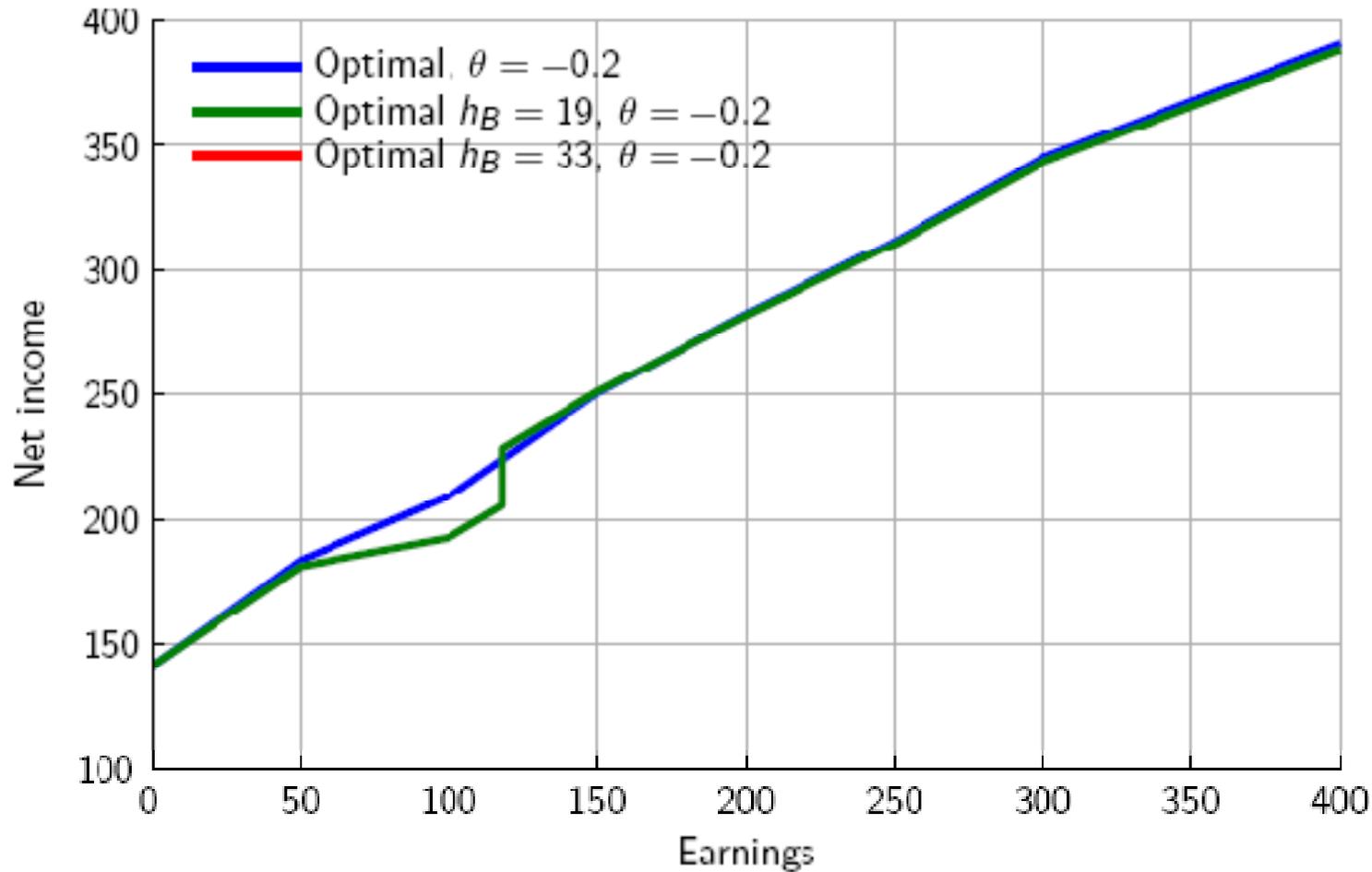
when  $\theta$  is negative, the function favors the equality of utilities.  $\theta$  is the coefficient of absolute inequality aversion.

If  $\theta < 0$  then analytical solution to integral over (Type I extreme-value)  $j$  state specific errors (BS, 2010)

$$\frac{1}{\theta} \left[ \Gamma(1 - \theta) \cdot \left( \sum_h \exp u(j) \right)^\theta - 1 \right]$$

Objective: robust policies for fairly general social welfare weights, document the weights in each case

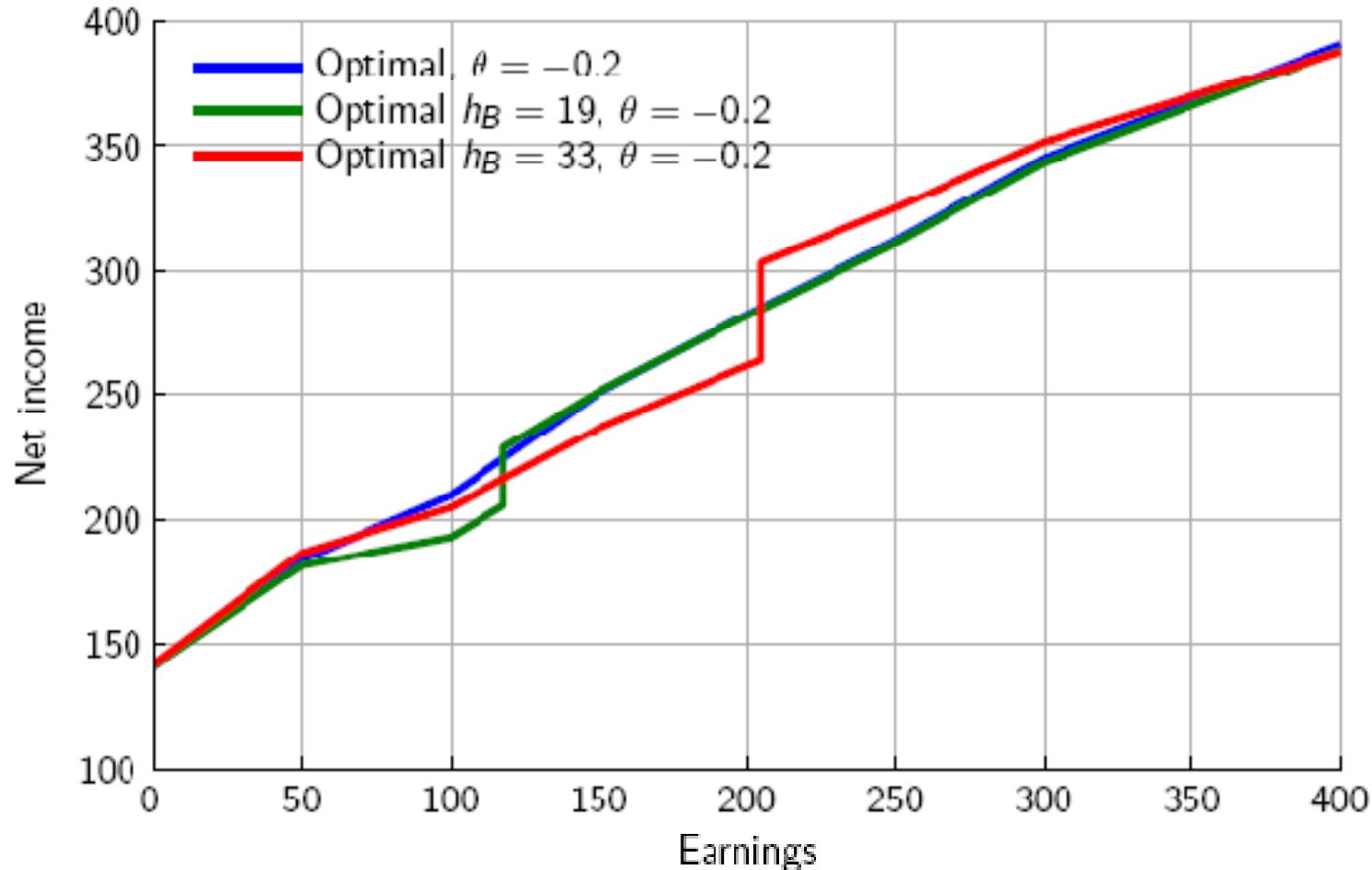
# Implied Optimal Schedule, Youngest Child Aged 5-10



March 2002 prices

Blundell and Shephard (2010)

## Implied Optimal Schedule, Youngest Child Aged 5-10



- Results Suggests ‘dynamic’ tax incentives according to age of (youngest) child
- Redistributing towards early years (see Table 10 in Blundell and Shephard, 2010)

# Implications for Tax Reform

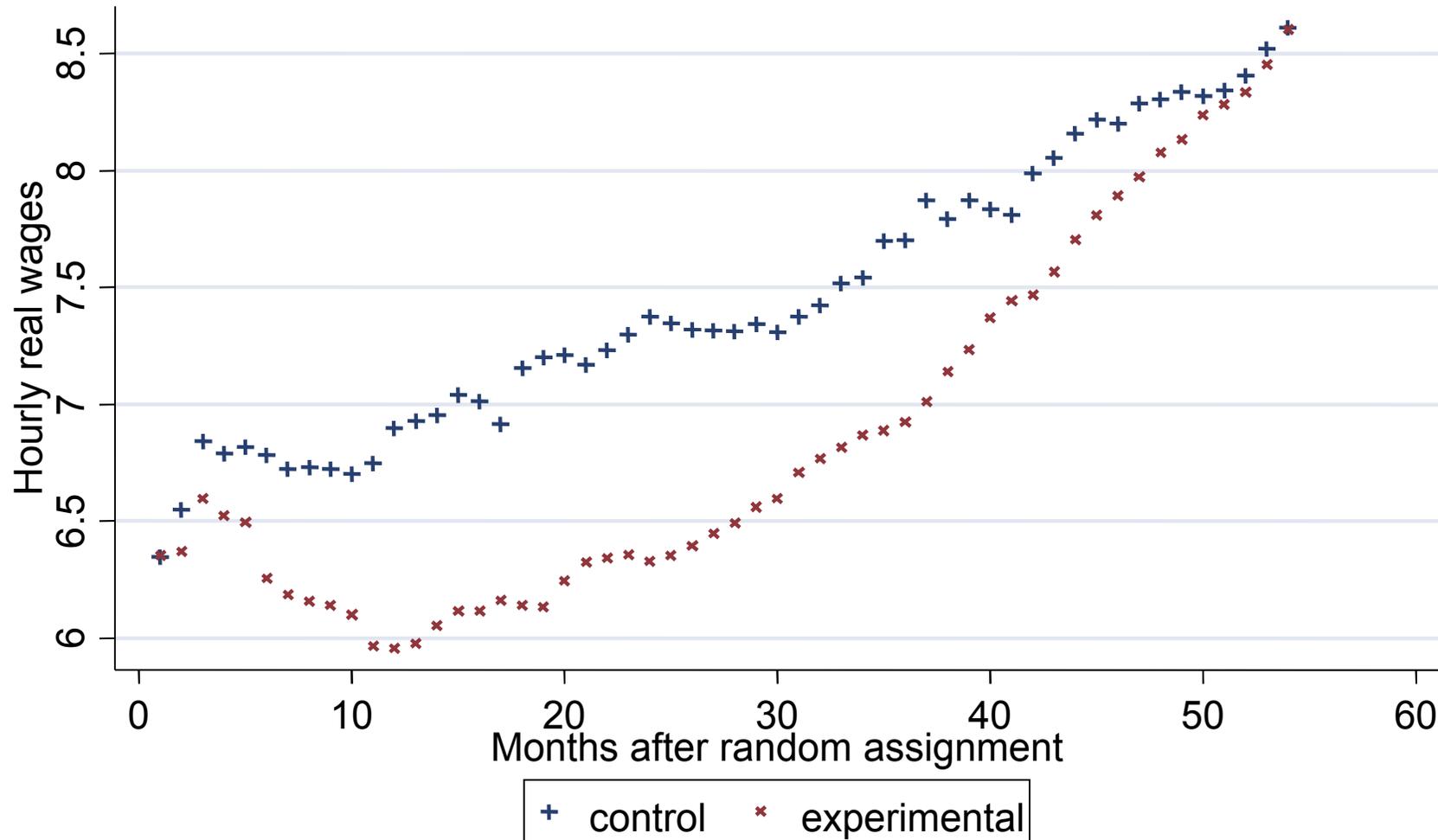
- Change transfer/tax rate structure to match lessons from 'new' optimal tax analysis and empirical evidence
  - in the Review we use a similar design framework for family labour supply and early retirement
- Key role of labour supply responses at the extensive and intensive margins
- Both matter but differ by gender, age, education and family composition
  - lone parents, married parents, pre-retirement low earners.
- Results for lone parents suggest lower marginal rates at the bottom
  - means-testing should be less aggressive
  - at least for some key groups =>

# Implications for Tax Reform

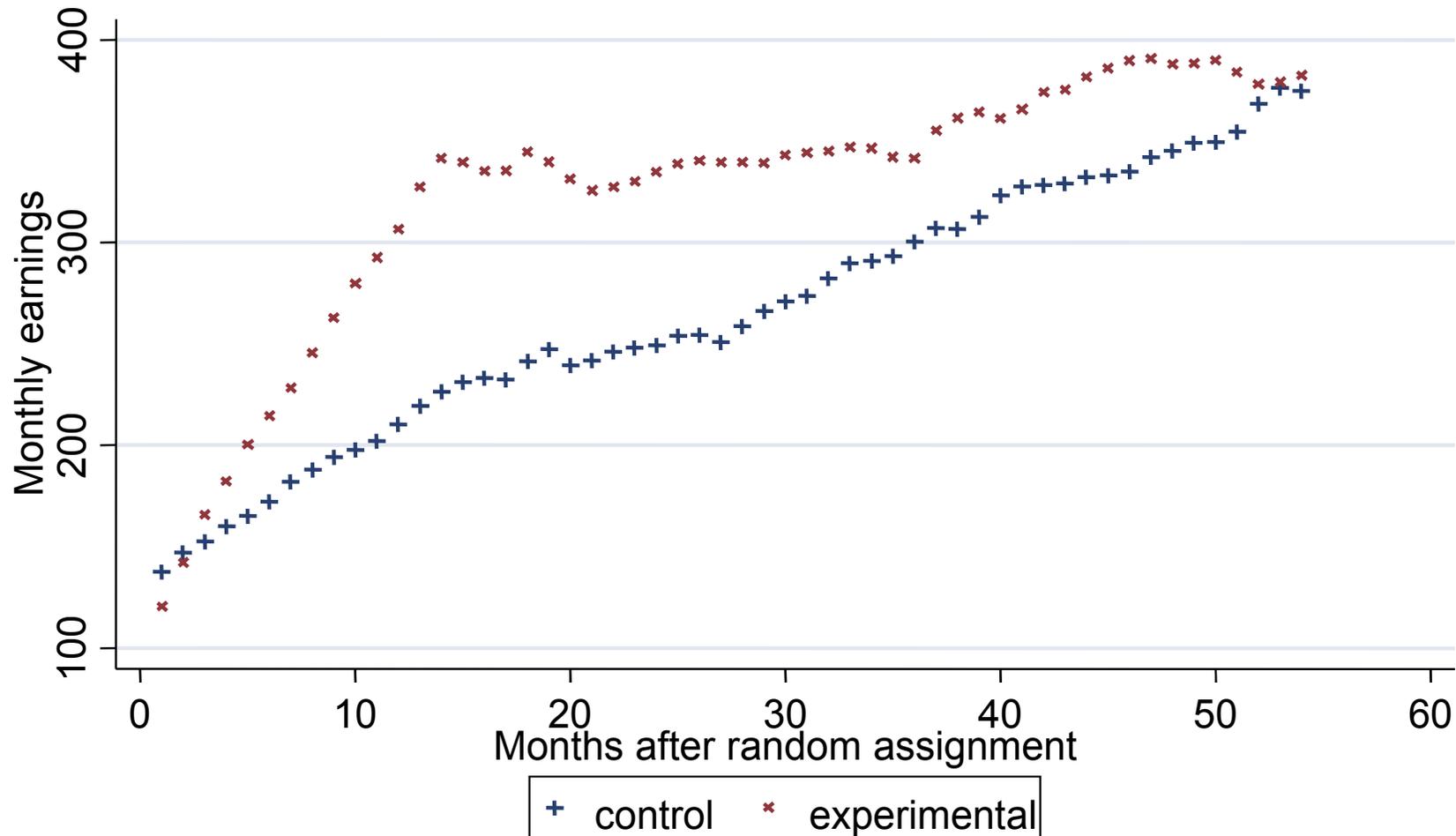
- 'Life-cycle' view of taxation
  - distinguish by age of (youngest) child for mothers/parents
  - pre-retirement ages
  - effectively redistributing across the life-cycle
  - a 'life-cycle' rearrangement of tax incentives and welfare payments to match elasticities and early years investments
  - results 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?
  - some time to adjust but little in the way of experience effects for low-skilled

# Dynamic effects on wages for low income welfare recipients?

SSP: Hourly wages by months after RA



# SSP: Monthly earnings by months after RA

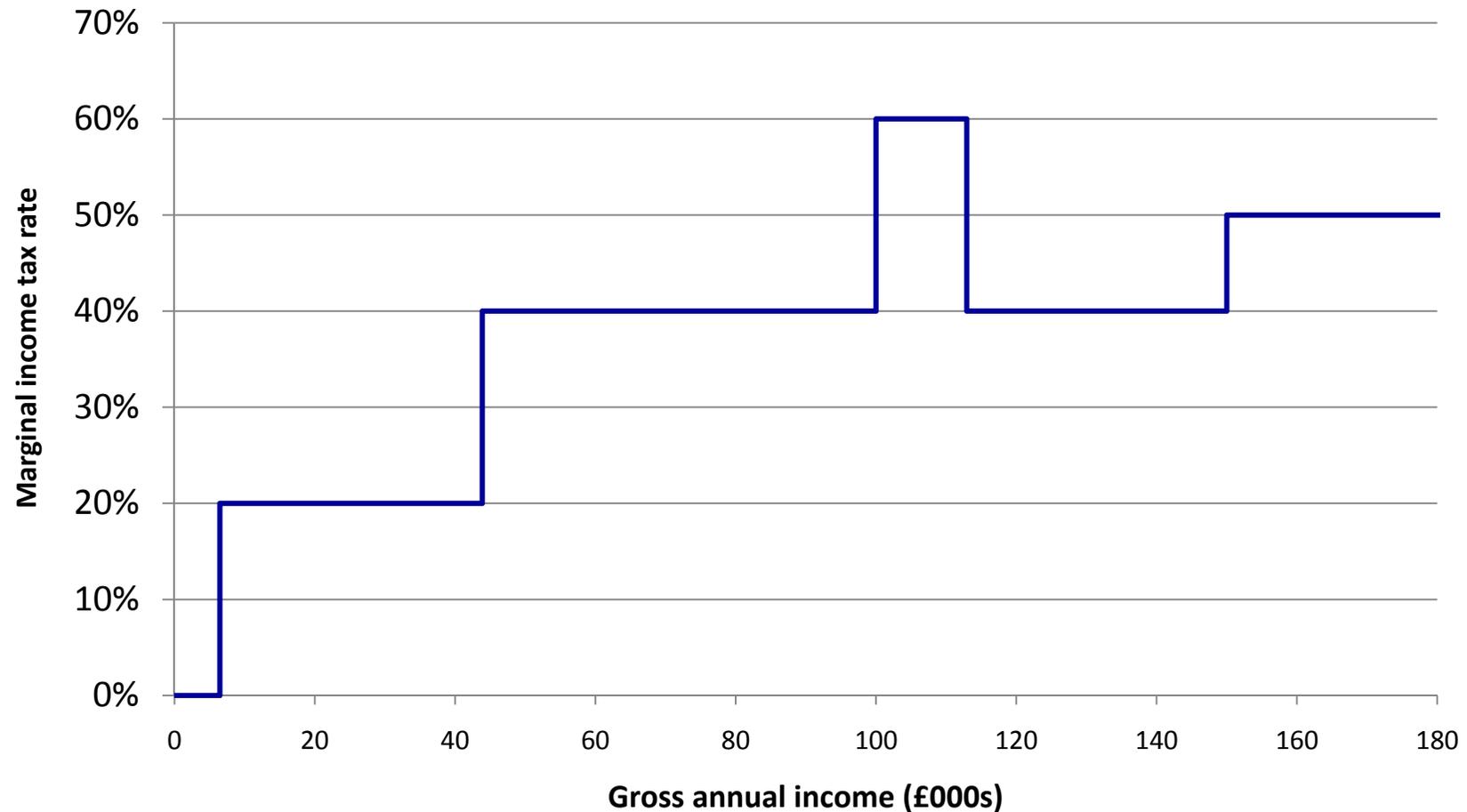


# Evidence on experience effects from the SSP

- Little evidence of employment enhancement or wage progression
- Other evidence, Taber etc, show some progression but quite small
- Remains a key area of research
  - ERA Policy in UK.

# At the top too... the income tax system lacks coherence

## Income tax schedule for those aged under 65, 2010–11



# Top tax rates and taxable income elasticities

An 'optimal' top tax rate (Brewer, Saez and Shephard, MRI)

$e$  – taxable income elasticity

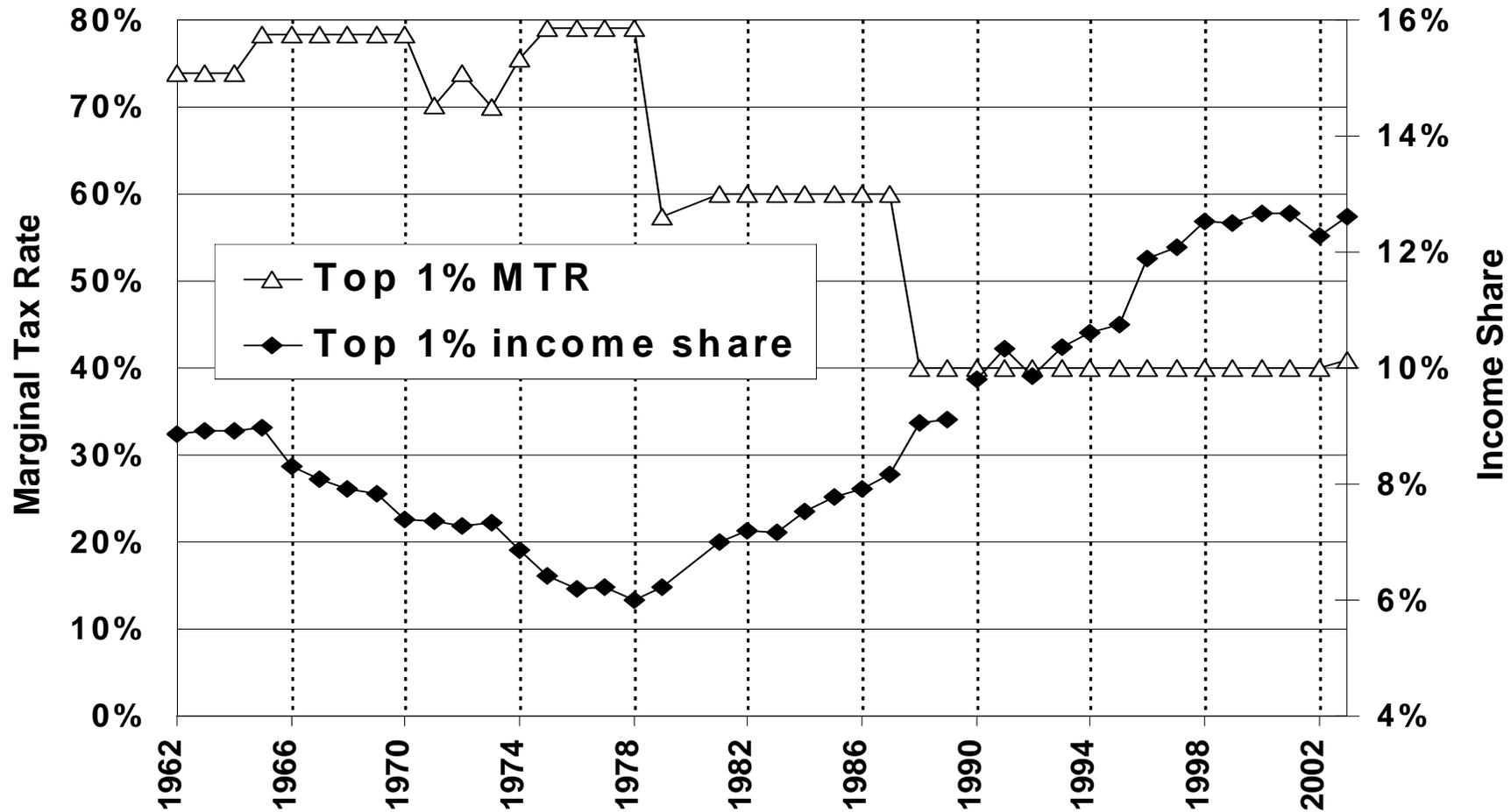
$t = 1 / (1 + a \cdot e)$  where  $a$  is the Pareto parameter.

Estimate  $e$  from the evolution of top incomes in tax return data following large top MTR reductions in the 1980s

Estimate  $a$  ( $\approx 1.8$ ) from the empirical distribution

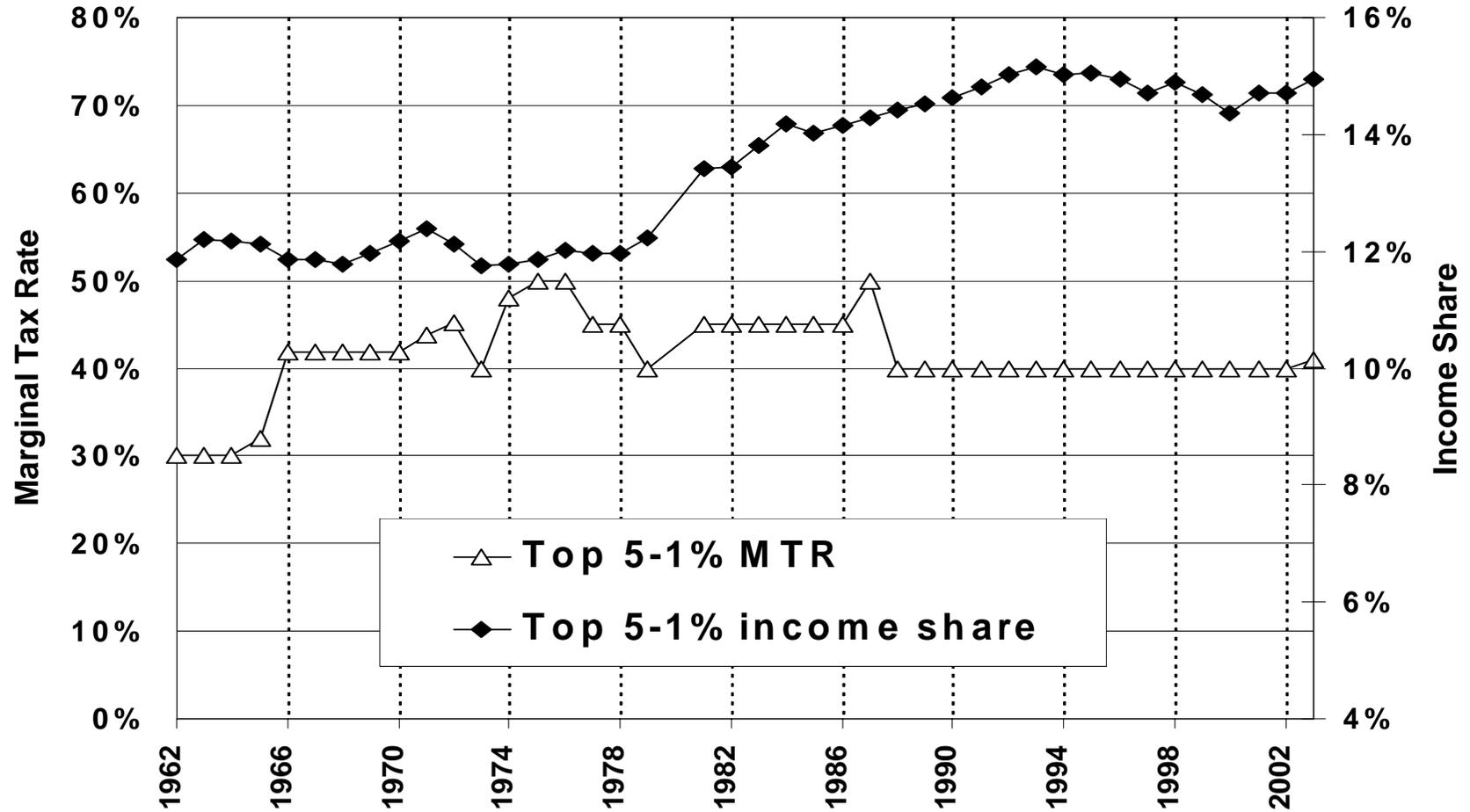
# Top incomes and taxable income elasticities

A. Top 1% Income Share and MTR, 1962-2003



Source: MR1, UK SPI (tax return data)

## B. Top 5-1% Income and MTR, 1962-2003



# Taxable Income Elasticities at the Top

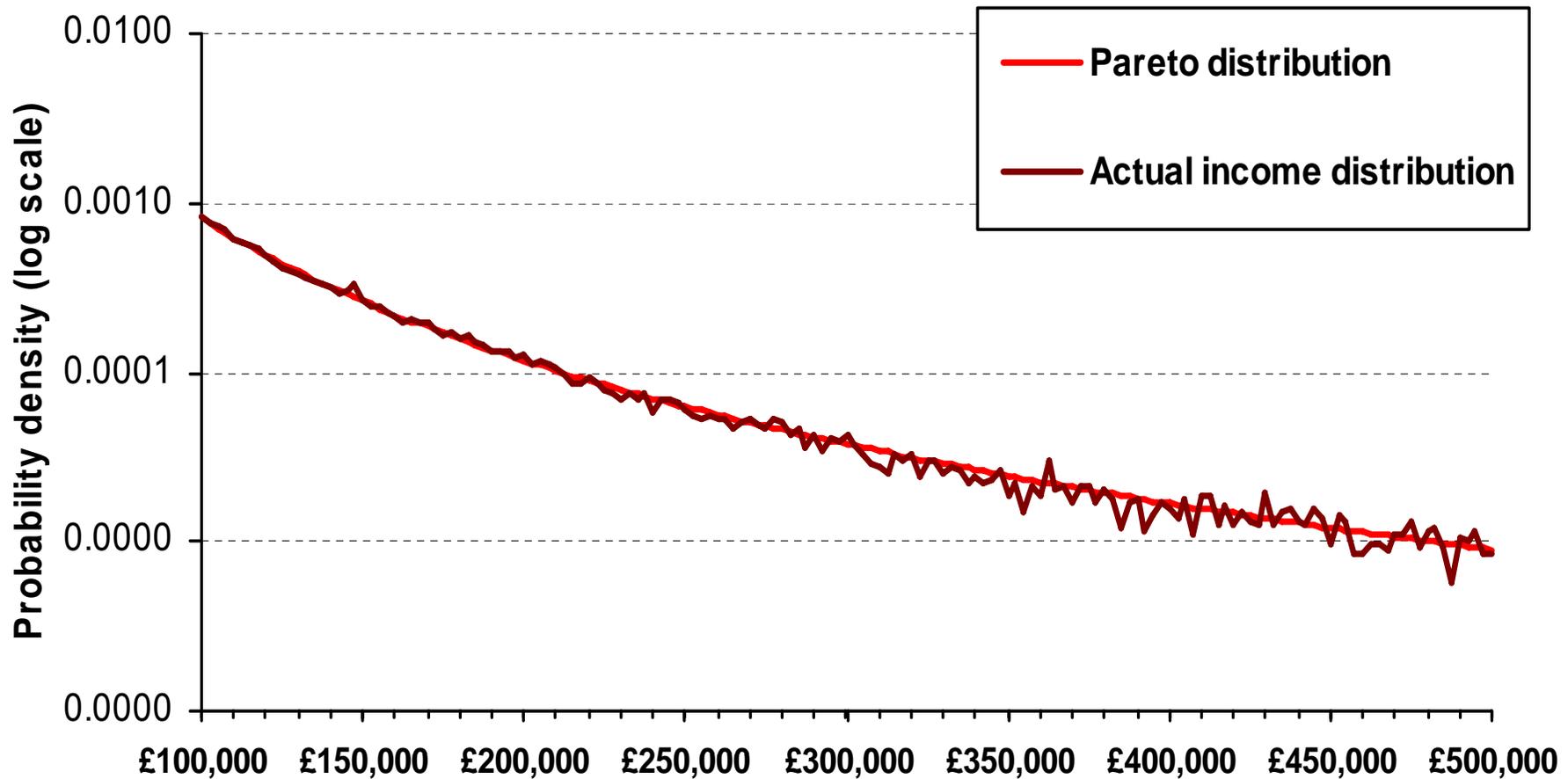
Simple Difference (top 1%)      DD using top 5-1%  
as control

1978 vs 1981	0.32	0.08
1986 vs 1989	0.38	0.41
1978 vs 1962	0.63	0.86
2003 vs 1978	0.89	0.64
Full time series	0.69 (0.12)	0.46 (0.13)

With updated data the estimate remains in the .35 - .55 range with a central estimate of .46, but remain quite fragile

Note also the key relationship between the size of elasticity and the tax base (Slemrod and Kopczuk, 2002)

# Pareto distribution as an approximation to the income distribution



Pareto parameter quite accurately estimated at 1.8  
=> revenue maximising tax rate for top 1% of 55%.

# Reforming Taxation of Earnings

- Change transfer/tax rate structure to match lessons from ‘new’ optimal tax analysis
- lower marginal rates at the bottom
  - means-testing should be less aggressive
  - distinguish by age of youngest child
- age-based taxation
  - pre-retirement ages
- limits to tax rises at the top, but
  - base reforms - anti-avoidance, domicile rules, revenue shifting
- Integrate different benefits and tax credits
  - improve administration, transparency, take-up, facilitate coherent design
- Undo distributional effects of the rest of the package.

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

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