Female Labour Supply, Human Capital and Tax Reform

(NBER Working Paper, also on my webpage)

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1. How should labour supply, work experience dynamics and education decisions be accounted for in the evaluation of tax and welfare reform?

2. Especially in the design, and in the impact evaluation, of transfers to low wage families in the form of 'in-work benefits' or 'earned income tax credits'.

3. To what extent do dynamic 'longer-run' issues change our view of the impact and of the evaluation of these policies directed at low income workers?

4. What is the 'insurance value' of redistributive policies of this kind? And how does the trade-off between insurance and incentives play out?

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- Labour supply of women has been found to be be more responsive to incentives, especially low wage women with school age children.

- Time 'out of paid work' points towards the potential importance of returns to experience.

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Policy Background

Tax and Welfare Reform in the UK:

- We study a specific reform - Working Families Tax Credit (WFTC) and Income Support (IS) in 1999/2000.

- This involved an increase in the generosity of the welfare and earned income tax credit system for families with children.

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IS and Tax credit award for lone parent with 1 child
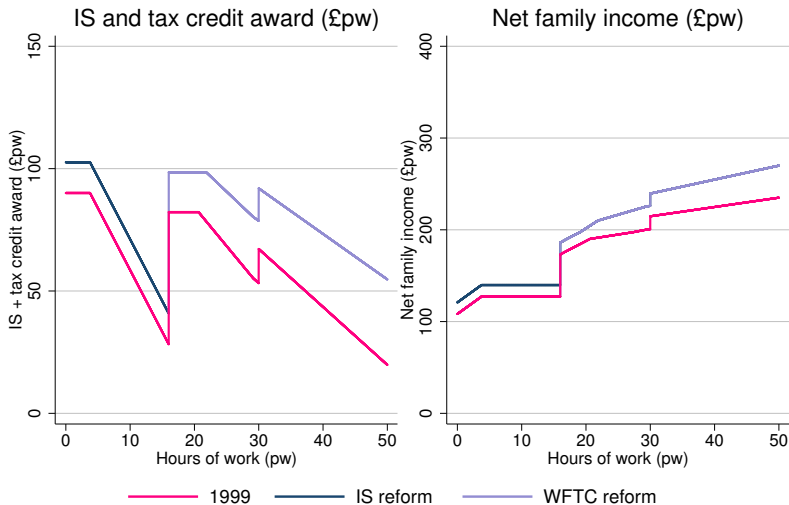
The budget constraint for second-earner parents
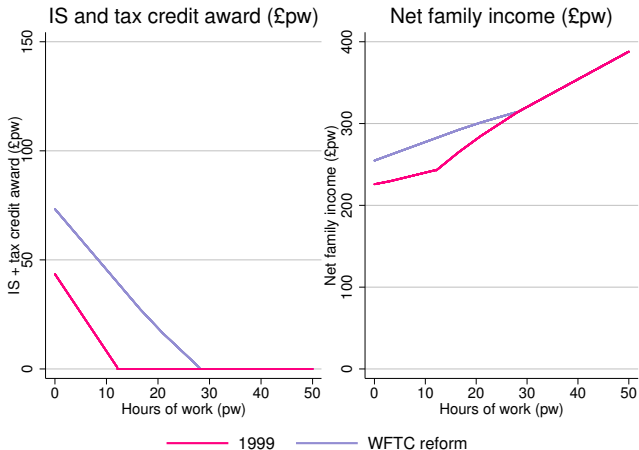
Hours rules

- In a static Mirrlees setting, Blundell & Shephard (2012) have shown part-time hours rules of this type are unlikely to be optimal, even where there is some justification for an earned income tax credit.

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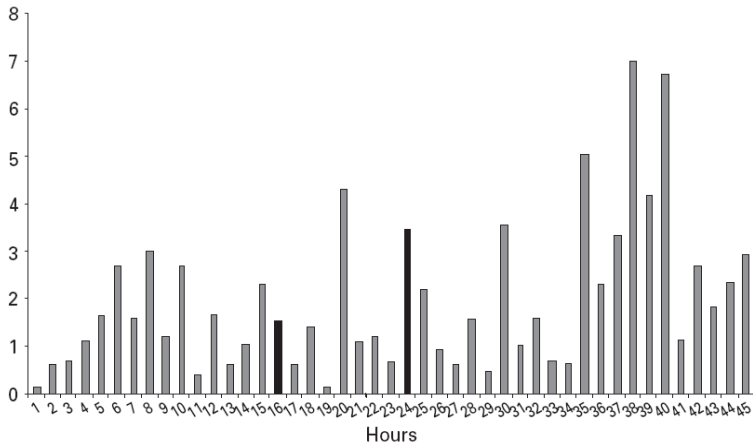## Low Education Single Women with and without Children in the 1993 FRS.
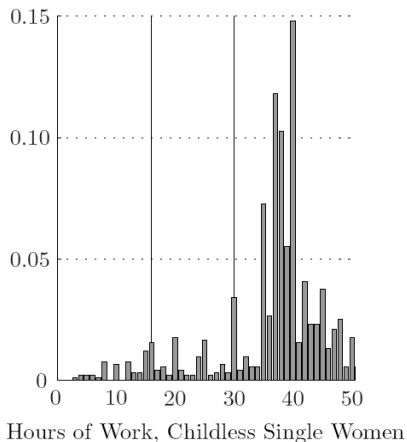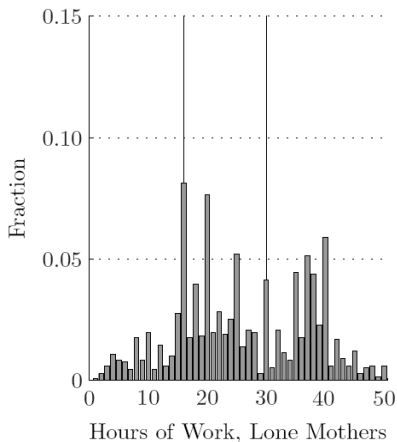
Before 16 Hour Rule (1990)

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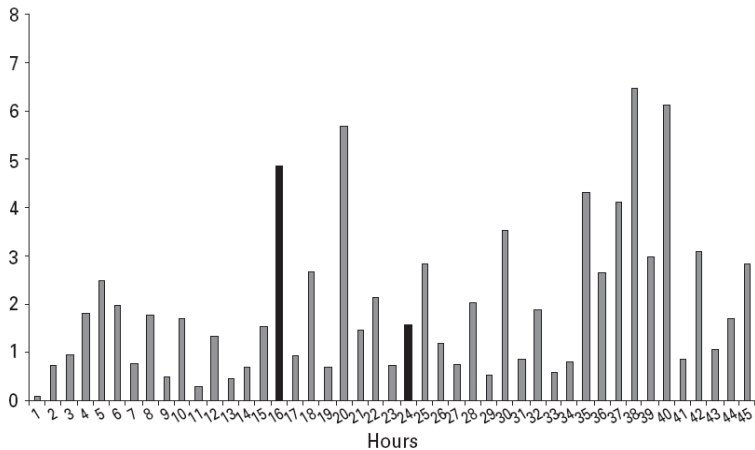
Hours

The key question we ask is:

- How do the features of this broad kind of tax, tax-credit and welfare benefit system affect education choices, experience capital accumulation, employment and hours of work over the life-cycle?

The approach we take:

- A structural evaluation/estimation approach, using the time series of tax, tax credit, welfare benefit and tuition reforms for new cohorts of women to identify parameters. Conditioning on life-history family background variables.
- Comparing with Diff-in-Diff/quasi-experimental contrasts where possible.

What we find

- **Incentive effects**: labour supply elasticities are found to vary systematically by education group, family type and age.

- **Experience matters**: but only for those with more than basic formal education, and especially for those in full-time employment.

- **Education choices**: there is a small but important impact of tax policy reforms on education choices.

- **Part-time wage penalty**: experience effects can explain the part-time penalty in female wages.

- **Previous WFTC/IS policy reform evaluations**: the results can explain why our previous evaluations for low educated women provided a relatively accurate prediction of the 'shorter-run' impact of these policy reforms.

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British Household Panel Survey (BHPS)

Unbalanced panel of 4,200 females over 17 waves, 1991-2007

Measures of education, labour market outcomes, work-related and not-work-related training, childcare, detailed demographics, (limited) assets information.

IFS taxben working on every wave:

- Taxes: income tax, NI, council tax
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Linked life histories capture choices at age 16: educational qualifications; and detailed family background measures, including

- parental education, number of siblings, sibling order, whether lived with parents when aged 16, books at home as a child, etc

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Wage Profiles by Education by Age
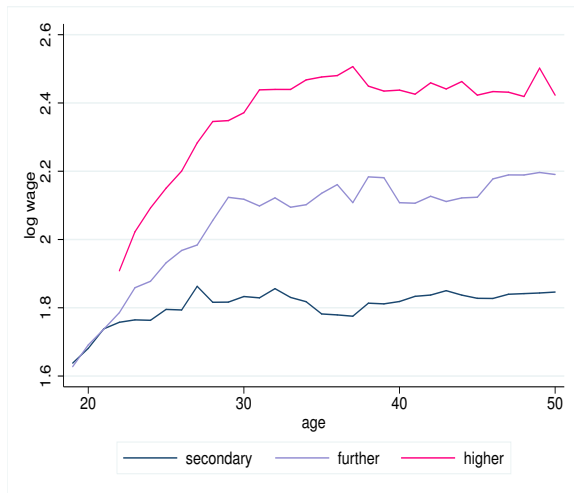
Employment over the life-cycle

Employment of mothers
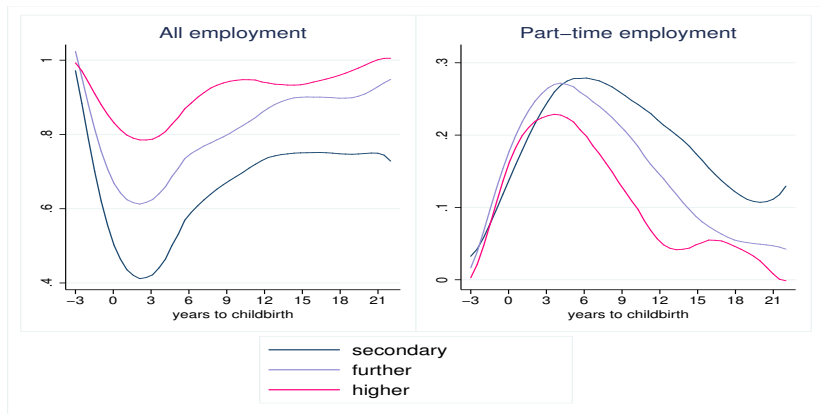
Family Composition by Age

Key Model Features

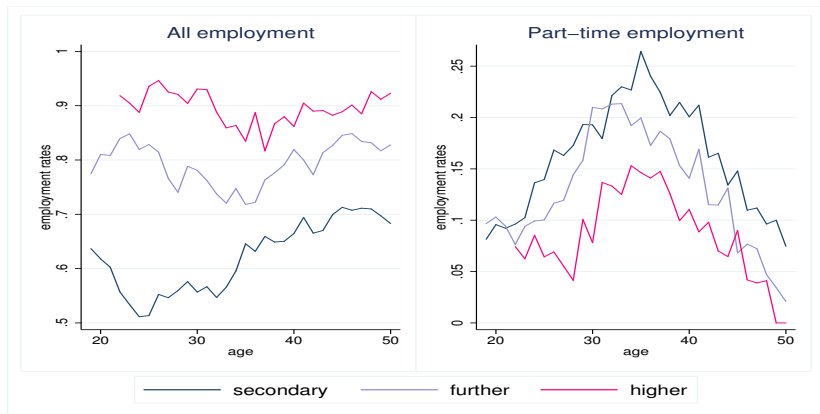**We estimate a dynamic model of labour supply and human capital with the following features:**

- Labour supply and consumption choices are heterogeneous and are made in an uncertain environment with credit constraints.

- Women can work part-time, full time, or not at all.

- Wages depend on accumulated part-time and full-time experience. They are stochastic and subject to potentially persistent shocks.

- The value of experience is allowed to differ by education and by part-time/full time work.

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- Marriage/partner, partner income and children, while 'external' are stochastic and add further uncertainty.

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Model: female life-cycle

Life in three stages:

- Education 's=0,1,2': three levels chosen sequentially up to age 18/21
    - secondary (GCSE-level at 16), further/high school (A-levels or vocational at 18), higher (university and college at 21)

- Working life:
    - consumption 'c' and asset 'a' accumulation
    - labour supply 'l' (0, part-time and full-time)
    - experience accumulation
    - partnering
    - childbearing

- Retirement: pension incomes take effect exogenously at age 60

Model: female earnings

Wage equation for individual 'i', age 't', in each birth cohort; with school level 's', experience 'e', labour supply 'l'

$$\ln w_{sit} = \ln W_{sit} + \gamma_s \ln (e_{sit} + 1) + \upsilon_{sit} + \xi_{sit}$$
$$\upsilon_{sit} = \rho_s \upsilon_{sit-1} + \mu_{sit}$$
$$e_{sit} = e_{sit-1} (1 - \delta_s) + g_s (l_{sit})$$

- $g(l_{sit})$ set to unity for full-time, part-time is estimated.
- persistence of shocks - distinguish heterogeneity from state dependence (experience effects).
- ξ_{sit} is a transitory shock/measurement error.
- correlation of initial shock with preferences.
- concave profile of experience effects.
- depreciation of human capital - cost of not working.

Children:

- Children are born with an (weakly) exogenous arrival rate,
    - arrival probability depends on female age, education, older children, next youngest child and presence of partner
    - departure with certainty when child reaches age 18
    - past employment(?).

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Partner:

- Arrival rate depending on level of education and age,
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  - arrival rate for male with given education depends on female age and education
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- Fertility and marriage behavior are 'weakly exogenous',
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  - however, individual women account for the implications of their choices on marriage and fertility.

- Male employment depends on his education and on whether he worked in the previous period or not.
- His earnings are uncertain:

male wage equation

$$
\begin{aligned}
\ln w^m_{s^m it} &= \ln W^m_{s^m it} + \gamma^m_{s^m} \ln(t-18) + \upsilon^m_{s^m it} + \xi^m_{it} \\
\upsilon^m_{s^m it} &= \rho^m_{s^m} \upsilon^m_{s^m it-1} + \mu^m_{s^m it}
\end{aligned}
$$

- Linked administrative, national insurance, earnings data are/will be key here.

Taxes and Assets

Detailed model of UK tax and benefit system (FORTAX):

- Taxes: income tax, NI, council tax
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$$V_{\underline{t}}(X_{i\underline{t}}) = E_t \left[\sum_{t=\underline{t}}^{\bar{t}} \frac{(c_{it}/n_{it})^{\eta}}{\eta} \exp\left(f\left(l_{it}, l_{it}^m, X_{it}\right) + \theta_i l_{it}\right) \middle| X_{i\underline{t}} \right]$$

subject to the budget constraint

$$a_{it+1} = (1+r)a_{it} + l_{it}w_{sit} + d_{it}^m l_{it}^m w_{it}^m - T\left(X_{it}, l_{it}, l_{it}^m\right) - CC_t\left(t_{it}^k, l_{it}, l_{it}^m, X_{it}\right) - c_{it}$$

- net worth liquidity constraints $a > 0$.
- uncertain environment: earnings (own and partner's) and family composition
- $f\left(l_{it}, l_{it}^m, X_{it}\right)$ is a function of family composition, education, partner, partner labour supply, and unobserved heterogeneity
- childcare costs and housing rents vary by location and time.

Model: post education optimisation problem

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Model: education decisions

- Education decisions are taken when the individual is 16

- Education costs correlated with initial level of productivity

- Future earnings and family composition are uncertain

- Allow for borrowing constraints, tuition costs and student loans.

- Condition on factors formed of many family background variables at age 16, including
  - parental education/occupation, financial circumstances, siblings or region of birth may affect education and earnings capacity.

$$V^{High} = x'\gamma_{high} + EV^{high} + e_{sec}$$

$$V^{Col} = x'\gamma_{col} + EV^{col} + e_{col}$$

$$ed = argmax\{V^{Sec}, V^{high}, V^{col}\}$$

- x family background (two principal components) that also enter preferences
- Also include earnings of parents when child was 16.

Table : Education Choice and Background Factors

Education at 23 - Ordered Probit				
	H/h	L/h	H/l	Parental earnings when 16
Coeff.	0.515	0.199	0.234	0.509
t-stat	(3.48)	(3.09)	(3.19)	(3.24)

Notes: Two factors (f1/f2) drawn from parental characteristics includingeducation, number of siblings, birth order, lived with parents when 16and books at home. H is high for the first factor and L is low. Lower case for 2nd factor.

- Factors enter wages and preferences
- Parental earnings act as an an exclusion restriction

- Estimate processes for male earnings and employment, family dynamics and childcare costs, recursively 'outside' the model.

- Method of Simulated Moments for the remaining parameters: Simulate individuals under different tax regimes; Compute overall moment to match with those in the data.

- Matched moments include employment rates by family type, employment and hours transition rates, means, variances and percentiles of earnings distribution, earnings at entrance in working life, change in earnings by past hours, education achievement,...
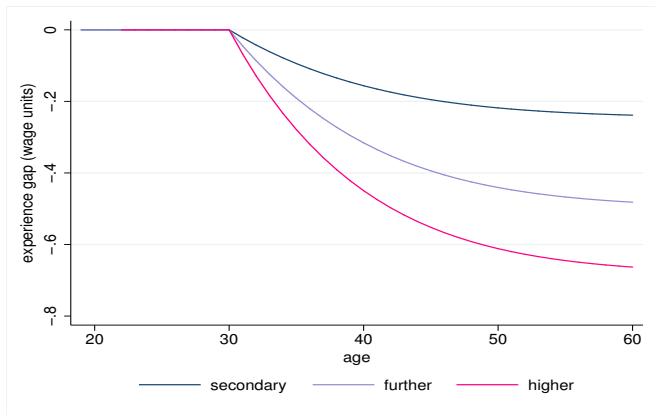
Female wage equation estimates

	Secondary		Further		Higher	
wage rate (0 experience)	4.5	(.01)	4.9	(.02)	6.3	(.03)
returns to experience	.14	(.01)	.23	(.01)	.28	(.01)
autocorrelation coef	.92	(.00)	.95	(.00)	.89	(.01)
se innovation	.13	(.00)	.13	(.00)	.12	(.01)
initial prod	.10	(.01)	.10	(.01)	.20	(.01)
initial productivity: se	.30	(.01)	.26	(.01)	.26	(.03)
depreciation rate	.12	(.02)	.11	(.01)	.11	(.03)
accumulation of HC in PTE	.15	(.01)	.12	(.01)	.10	(.01)

Experience Effects
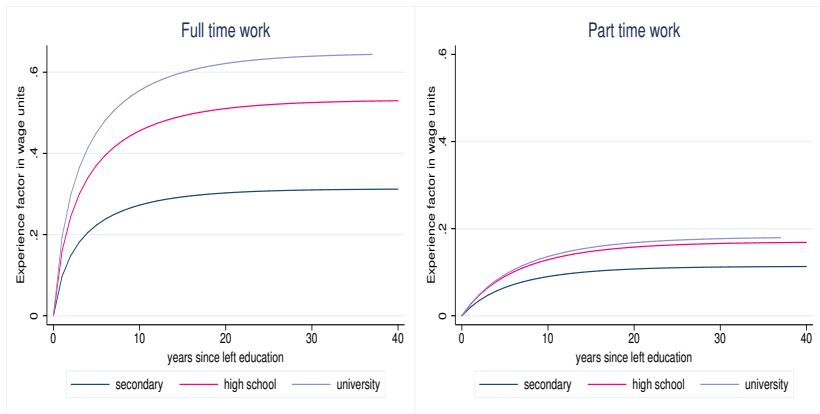
Estimates: (conditional) preference parameters

	all employment			part-time employment		
	secondary	further	university	secondary	further	university
intercept	0.41 (.00)	0.41 (.00)	0.47 (.01)	-0.15 (.01)	-0.16 (.01)	-0.20 (.02)
children		0.05 (.01)			-0.06 (.01)	
child aged 0-2		0.15 (.01)			-0.05 (.01)	
child aged 3-5		0.07 (.01)			-0.06 (.01)	
child aged 6-10		-0.02 (.01)			0.03 (.01)	
child aged 11-18		-0.07 (.01)			0.06 (.01)	
male		-0.06 (.01)			-0.02 (.02)	
male working		-0.17 (.01)			0.09 (.01)	

Life-cycle profiles of wages
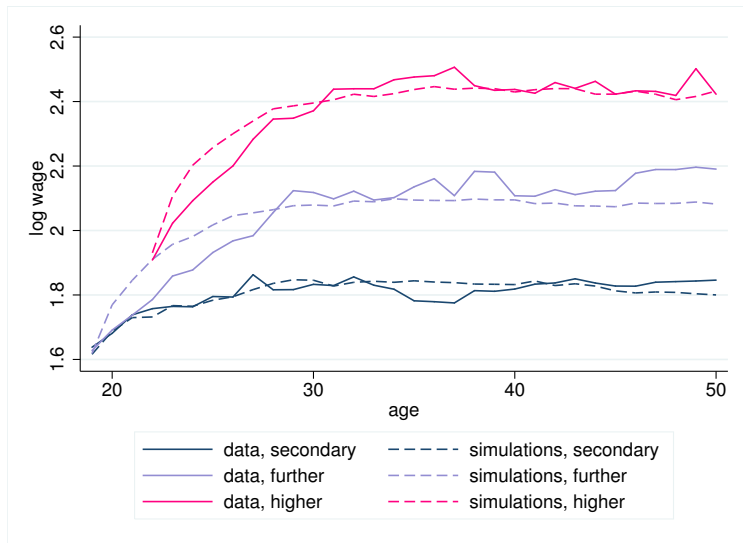
Distribution of female wage rates by age

Percentiles 10, 25, 50 75 and 90
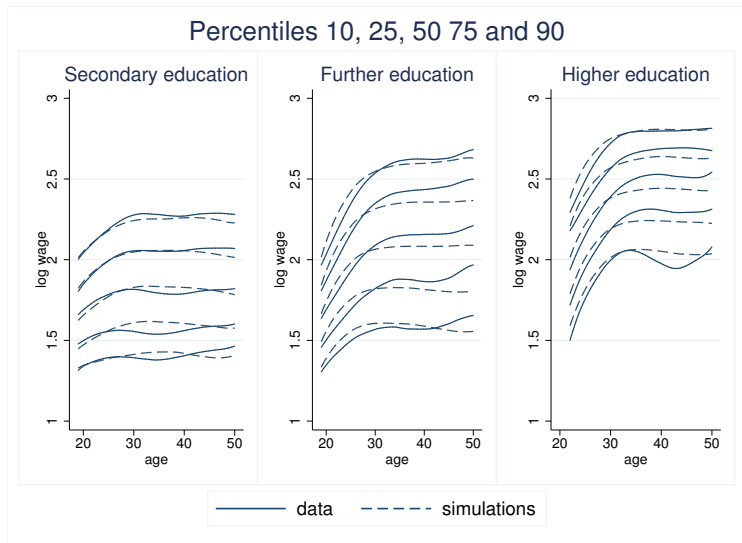
Employment over life-cycle
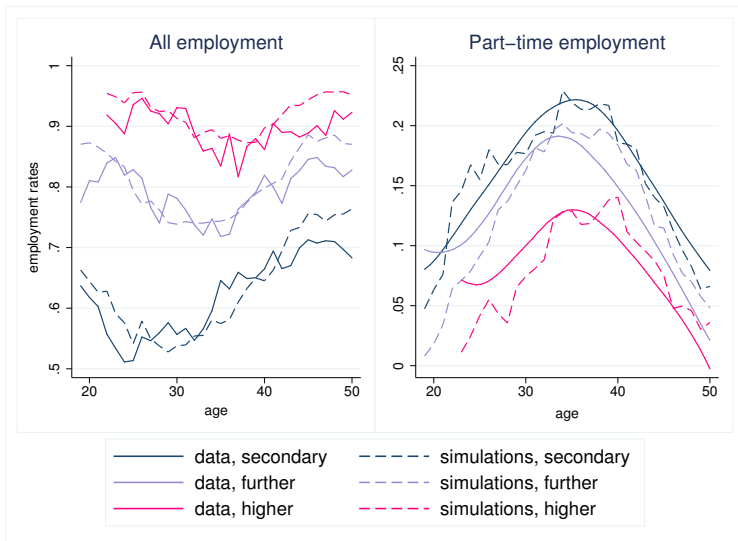
Employment of mothers
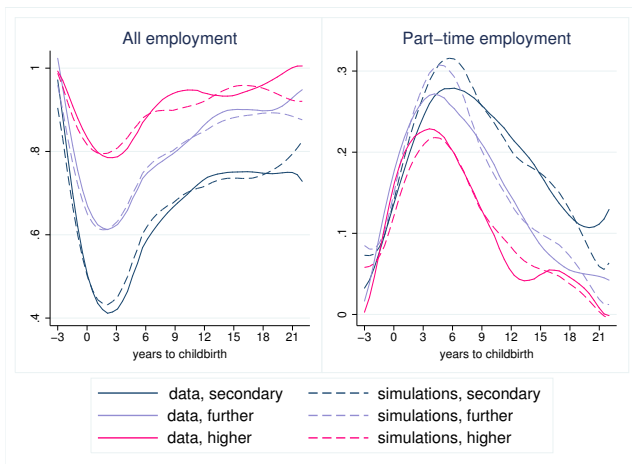
WFTC and IS Reforms for Lone Mothers

% Point employment impact and matched diff-in-diff for low educated lone parents:

1999 - 2002	Average Impact
Simulations	+3.8
Matched Diff-in-diff	+3.6 (0.3)

Overall Marshallian Labour Supply Elasticities

	extensive	intensive
All	0.47	0.23
Secondary	0.71	0.31
High School	0.43	0.23
University	0.28	0.15
Lone mother	1.65	0.41
Mothers in couples	0.53	0.29
Childless women	0.22	0.22

marshall elasticities
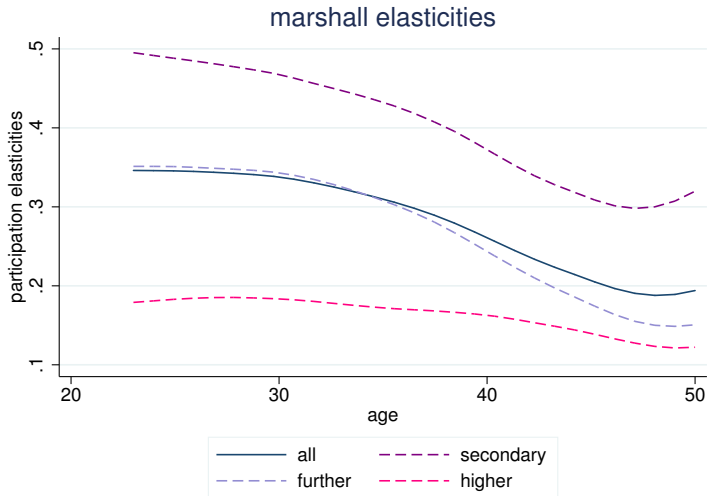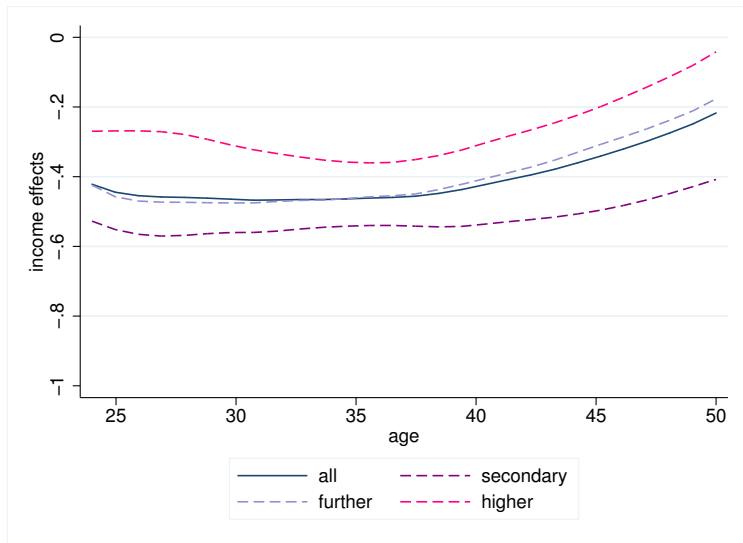
	extensive	intensive
All	0.66	0.28
Secondary	1.01	0.40
High School	0.61	0.27
University	0.36	0.15
Lone mother	1.65	0.45
Mothers in couples	0.69	0.30
Childless women	0.29	0.22

Results: Impact of WFTC & Child IS Reform

Revenue Neutral Reform, basic tax rate adjustment

I. Impact on Employment of Younger Women:

No Education Choice						
	Single Mother			Couple with Kids		
	Sec.	Fur.	Uni.	Sec.	Fur.	Uni.
employment	3.8	1.5	-0.5	-2.5	-1.2	-0.8

II. Impact on Education Shares:

	Sec.	Fur.	Uni.
1999	30.2	47.2	22.5
2002	31.1	46.9	21.8

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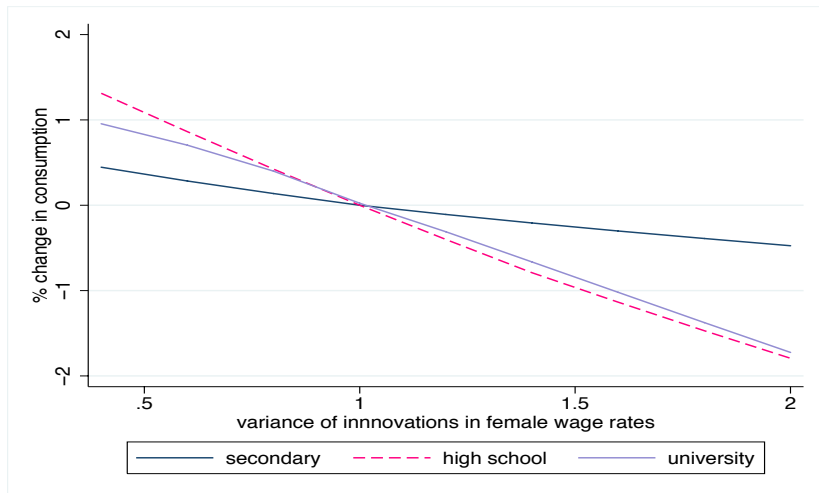| With Education Choice						
	Single Mother			Couple with Kids		
	Sec.	Fur.	Uni.	Sec.	Fur.	Uni.
employment	3.8	1.2	-0.6	-2.6	-1.3	-0.9

Classified according to original education choice.

Impact on Welfare and Income

WFTC and IS	pre education choice			post education choice		
	Sec.	Fur.	Uni.	Sec.	Fur.	Uni.
Welfare ($\triangle\%$)	1.45	.54	-.18	1.69	-.32	-1.66
Lifetime Income ($\triangle\%$)	.63	-.85	-1.7	.11	-1.76	-4.15

		Pre-reform education choice			
		by baseline educ			
		sec	further	higher	all
		(1)	(2)	(3)	(4)
Panel A: Adjustment in basic tax rate					
(1)	Pre-Tax Earnings	.29	.21	.09	.20
(3)	Welfare (post-ed)	.40	.94	.77	.71
Panel B: Adjustment in tax credits maximum award					
(5)	Pre-Tax Earnings	1.32	-.01	-.18	.37
(7)	Welfare (post-ed)	1.58	1.30	.21	1.03
Panel C: Adjustment in IS award					
(9)	Pre-Tax Earnings	-2.49	-1.34	-.38	-1.40
(11)	Welfare (post-ed)	.90	.70	.09	.56

- Welfare Effects of increasing Expenditure by 0.5% of Earnings
- Tax rate decreases by 0.93pp or Max Tax Credit increases by 22 pounds or IS increases by 4.2 pounds

Program Preference - Insurance versus Incentives
With Education Adjustment

		Post-reform education choice by baseline educ			
		sec	further	higher	all
		(1)	(2)	(3)	(4)
Panel A: Adjustment in basic tax rate					
(1)	Earnings	.63	.23	.10	.32
(3)	Welfare (post-ed)	.42	.98	.81	.74
(4)	Welfare (pre-ed)				.68
Panel B: Adjustment in tax credits maximum award					
(5)	Earnings	.95	-.13	-1.04	-.07
(7)	Welfare (post-ed)	1.11	.91	.15	.72
(8)	Welfare (pre-ed)				.78
Panel C: Adjustment in IS award					
(9)	Earnings	-2.05	-1.16	-.89	-1.36
(11)	Welfare (post-ed)	.72	.55	.07	.45
(12)	Welfare (pre-ed)				.46

- Tax rate decreases by 0.97pp or Max Tax Credit increases by 16.6 pounds or increases IS by 3.4 pounds

Summary and Discussion

- Experience effects are lower for the lower educated, *complementarity between formal education and human capital on-the-job*

- Experience effects are lower for those in part-time work, *explaining the part-time penalty*.

- Women with low labour market attachment have more elastic labour supply at younger ages and large income responses.

- There is a small effect of tax credits on education choice, with some women obtaining less education, and attenuating the employment gains of the reform.

- The insurance value of the welfare program is substantial, *particularly for the lowest education/skill groups*.

- The results can explain previous structural and quasi-experimental results for WFTC type reforms.

- Provide an empirically driven approach to structural analysis of tax reform. Next steps: sector choice, training, and frictions.

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Work−related training participation rates (50h+)
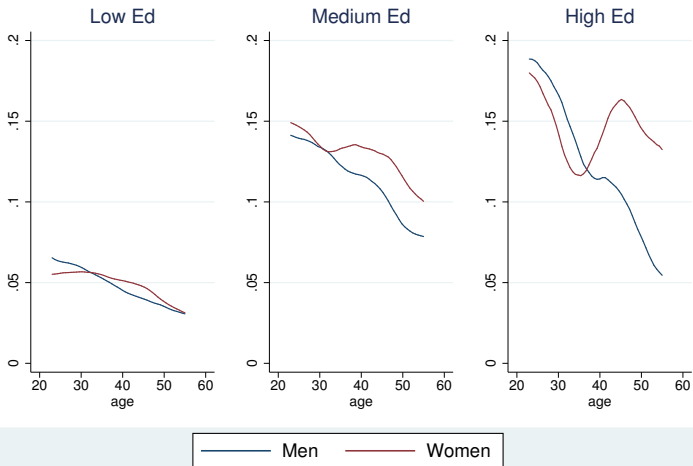
Table : Descriptive statistics - family demographics in 2002

	Mothers		Childless	Number of
	singles	in couples	women	observations
women aged 18-50	0.137	0.439	0.424	2073
	(0.008)	(0.011)	(0.011)	
women aged 30-45	0.165	0.582	0.253	1151
	(0.011)	(0.015)	(0.013)	
Women aged 30-45, by education				
secondary	0.213	0.571	0.216	610
	(0.017)	(0.020)	(0.017)	
high school	0.144	0.612	0.244	353
	(0.019)	(0.026)	(0.023)	
university	0.048	0.564	0.388	188
	(0.016)	(0.036)	(0.036)	

Notes: Based on BHPS data for 2002, standard errors in parenthesis under estimates.