Female Labour Supply, Human Capital and Welfare Reform

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

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How do 'in-work benefits' and the welfare system affect the education choices, employment, hours of work and the accumulation of working experience of women?
Motivation

Long-standing interest in the labour supply of women

- Many end up being lone mothers, vulnerable to poverty
- Women labour supply found to be more responsive to incentives, especially that of low wage women with young children
- Time out of paid work and short working hours are especially prevalent among mothers and point to the potential importance of returns to experience

Suggests that accounting for the interaction between human capital dynamics and the labour supply of women is important for the evaluation of tax and welfare reform
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Suggests that accounting for the interaction between human capital dynamics and the labour supply of women is important for the evaluation of tax and welfare reform
Key issues to be addressed

1. How are education and working experience related and how do they affect wages?

2. How do these aspects of human capital interact with the labour supply decisions of women?

3. How should labour supply, working experience and education investments be accounted for in the design and evaluation of welfare reform?
   - Focus on transfers to low wage families in the form of in-work benefits

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Policy Background

Tax and Welfare Reform in the UK:

- Focus on 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
- Motivation for these policies: incentivising women into work, even when they have young children, helps preserving labour market attachment and reducing skill depreciation
- Peculiarity of the UK tax-credit system: minimum hours eligibility rules focus incentives on part-time work
The UK (WFTC) Tax Credit and IS Reform

IS and Tax credit award for lone parent with 1 child

![Graph showing IS and tax credit award (£pw) and Net family income (£pw) vs Hours of work (pw) for 1999, IS reform, and WFTC reform.]
The budget constraint for second-earner parents

**Impact on married women in couples**

**The budget constraint for second-earner parents**

![Graph showing the budget constraint](image)

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Female Labour Supply, Human Capital and Tax Reform
Budget constraints for women in rented accommodation

Lone mothers

![Graph showing budget constraints for lone mothers with different scenarios: 1999, 1999+WFTC, and 2002. The graph plots net family income against hours of work per week.](image-url)
Do the hours rules impact on observed behaviour?

The Distribution of Weekly Hours of Work for Low Education Single Women with and without Children in the 1993 FRS

![Graph: Hours of Work Distribution]
The approach we take

- A structural evaluation/estimation approach
  - Use the time series of tax, tax credit, welfare benefit and tuition reforms for new cohorts of women over a period of 18 years to identify parameters
  - Condition on life-history of family background variables
- Comparing with Diff-in-Diff/quasi-experimental contrasts where possible
What we find

- **Incentive effects**: labour supply elasticities vary systematically by education group, family type and age.
- **Experience matters**: but only for those with more than basic formal education, especially in full-time employment.
- **Part-time wage penalty**: experience effects can explain the part-time penalty in female wages.
- **Education choices**: there is a small but important impact of tax policy reforms on education choices.
- **Previous WFTC/IS policy reform evaluations**: the results can explain why previous evaluations for low educated women provided a relatively accurate prediction of the ‘shorter-run’ impact of these policy reforms.
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**Labour supply and taxes:** Saez (2002), Keane and Moffitt (1995), Blundell, Duncan and Meghir (1998) among many others.


**Female labour supply over the life-cycle:** Heckman and MaCurdy (1980), Eckstein and Wolpin (1989)

**Education, work experience and human capital:** Shaw (1989), Heckman, Lochner and Taber (1998), Keane and Wolpin (2007)
Empirical dynamic life-cycle model of labour supply and human capital accumulation

Life in three stages: uncertainty and credit constraints

- Education ‘s=0,1,2’: levels chosen sequentially up to age 18/21
  - secondary (16), further/high school (18), higher (21)

- Working life
  - consumption $c$ and asset $a$ accumulation
  - labour supply $l$ (0 hours, part-time and full-time)
  - accumulation of experience $e$ determines wages
  - partnering and childbearing are exogenous but stochastic
  - women account for the implications of their choices on marriage and fertility

- Retirement: pension incomes take effect exogenously at age 60
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Model: female earnings

Wage equation for individual $i$, age $t$, in each birth cohort; with school level $s$, experience $e$, labour supply $l$

\[
\ln w_{sit} = \ln W_{si} + \gamma_s \ln (e_{sit} + 1) + \nu_{sit} + \xi_{sit}
\]

\[
\nu_{sit} = \rho_s \nu_{sit-1} + \mu_{sit}
\]

\[
e_{sit} = e_{sit-1} (1 - \delta_s) + g_s (l_{sit})
\]

- $g(l_{sit})$ set to unity for full-time, part-time is estimated
- persistent shocks - distinguish heterogeneity from state dependence (experience effects)
- $\xi_{sit}$ 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
Men log wages in couples

\[
\ln w_{smit}^m = \ln W_{smit}^m + \gamma_s^m \ln (t - 18) + \nu_{smit}^m + \xi_{it}^m
\]

\[
\nu_{smit}^m = \rho_s^m \nu_{smit-1}^m + \mu_{smit}^m
\]

conditional on education, the spouses’ productivity processes are independent
in couples, female labour supply acts partly to insure shocks in other sources of income

Public transfers: detailed microsimulation model of UK tax and benefit system (FORTAX)

- Taxes: income tax, NI, council tax
- Benefits: child benefit, maternity grant, tax credits, income support, housing benefit, council tax benefit, free school meals
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Taxes: income tax, NI, council tax

Benefits: child benefit, maternity grant, tax credits, income support, housing benefit, council tax benefit, free school meals
Annual employment and consumption are chosen over the life-cycle to maximise

$$E_t \left[ \sum_{\tau=t}^{T} \beta^{\tau-t} \left( \frac{c_{i\tau}/n_{i\tau}}{\eta} \right)^{\eta} \exp \left( f(l_{i\tau}, l_{i\tau}^m, X_{i\tau}) + \theta_i l_{i\tau} \right) \mid X_{it} \right]$$

subject to the dynamics of wages, experience, other income and family as described

plus the budget constraint

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

$$a_{it+1} \geq 0$$
Model: education decisions

Education decisions are taken when the individual is 16

- Heterogeneous and uncertain returns depend on future earnings and family composition
- Allow for borrowing constraints, tuition costs and student loans
- Condition on family background variables at age 16
  - parental education and occupation, financial circumstances, siblings, region of birth
  - these may affect education and earnings capacity later in life
Data: British Household Panel Survey (BHPS)

Unbalanced panel of 5,200 working age females over 18 waves, 1991-2008

- Measures education, labour market outcomes, childcare, detailed demographics, (limited) assets information
- **Linked life histories** capture education choices at age 16: detailed family background measures include parental education, number of siblings, sibling order, whether lived with parents when aged 16, books at home as a child, etc
- Some women observed living with parents as children and followed into working life: parents are panel members themselves
- Different cohorts observed entering the labour market under different tax regimes
Employment over the life-cycle

All employment

Part–time employment

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Employment of mothers

All employment

Part-time employment

years to childbirth

years to childbirth

secondary

further

higher
Estimation

- Estimate processes for male earnings and employment, family dynamics and childcare costs, ‘outside’ the model

- **Method of Simulated Moments** for the remaining parameters
  - 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...

- Identification relies on rich longitudinal data for a long period with many and substantive tax and welfare reforms
  - Simulate individuals under the sequence of tax regimes faced by their cohort
  - Match quasi-experimental effects of reforms
  - Explore differential responses by background parental information and family circumstances
### Female wage equation estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Secondary</th>
<th>Further</th>
<th>Higher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage rate (0 experience)</td>
<td>4.5 (.01)</td>
<td>4.9 (.02)</td>
<td>6.3 (.03)</td>
</tr>
<tr>
<td>Returns to experience</td>
<td>.14 (.01)</td>
<td>.23 (.01)</td>
<td>.28 (.01)</td>
</tr>
<tr>
<td>Autocorrelation coef</td>
<td>.92 (.00)</td>
<td>.95 (.00)</td>
<td>.89 (.01)</td>
</tr>
<tr>
<td>Se innovation</td>
<td>.13 (.00)</td>
<td>.13 (.00)</td>
<td>.12 (.01)</td>
</tr>
<tr>
<td>Initial prod</td>
<td>.10 (.01)</td>
<td>.10 (.01)</td>
<td>.20 (.01)</td>
</tr>
<tr>
<td>Initial productivity: Se</td>
<td>.30 (.01)</td>
<td>.26 (.01)</td>
<td>.26 (.03)</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>.12 (.02)</td>
<td>.11 (.01)</td>
<td>.11 (.03)</td>
</tr>
<tr>
<td>Accumulation of HC in PTE</td>
<td>.15 (.01)</td>
<td>.12 (.01)</td>
<td>.10 (.01)</td>
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</tbody>
</table>
Part-time Experience Penalty

$-0.8 - 0.6 - 0.4 - 0.2 0$

experience gap (wage units)

20 30 40 50 60

age

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Model fit

Life-cycle profiles of wages

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Model fit

Distribution of female wage rates by age

Percentiles 10, 25, 50, 75 and 90
Employment over life-cycle

All employment

Part–time employment

- data, secondary
- data, further
- data, higher
- simulations, secondary
- simulations, further
- simulations, higher
Model fit

Employment of mothers

All employment

Part–time employment

data, secondary

simulations, secondary

data, further

simulations, further

data, higher

simulations, higher
Comparison with DiD

WFTC and IS Reforms for Lone Mothers

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

<table>
<thead>
<tr>
<th>1999 - 2002</th>
<th>Average Impact</th>
</tr>
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<tbody>
<tr>
<td>Structural estimate</td>
<td>+3.9</td>
</tr>
<tr>
<td>Matched Diff-in-diff</td>
<td>+3.6 (0.5)</td>
</tr>
</tbody>
</table>
### Overall Marshallian Labour Supply Elasticities

<table>
<thead>
<tr>
<th>Category</th>
<th>Extensive</th>
<th>Intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.50</td>
<td>0.38</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.93</td>
<td>0.63</td>
</tr>
<tr>
<td>Further</td>
<td>0.46</td>
<td>0.37</td>
</tr>
<tr>
<td>University</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Lone mother</td>
<td>1.93</td>
<td>0.78</td>
</tr>
<tr>
<td>Mothers in couples</td>
<td>0.51</td>
<td>0.50</td>
</tr>
<tr>
<td>Childless women</td>
<td>0.26</td>
<td>0.20</td>
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</tbody>
</table>
Marshallian Elasticities by Age: Extensive

by education, from the time of the shock onwards

Female Labour Supply, Human Capital and Tax Reform
Income Effects at Extensive Margin by Age

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Female Labour Supply, Human Capital and Tax Reform
Results: Impact of WFTC & Child IS Reform

Revenue Neutral Reform, basic tax rate adjustment

I. Impact on Employment of Mothers:

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<td>employment</td>
<td>3.8</td>
<td>3.5</td>
<td>1.5</td>
<td>-6.0</td>
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II. Impact on Education Shares:

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<td>30.4</td>
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Classified according to original education choice.
### Impact on Welfare and Income

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<th>WFTC and IS</th>
<th>pre education choice</th>
<th>post education choice</th>
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<tbody>
<tr>
<td>Welfare (△%)</td>
<td>2.06</td>
<td>.53</td>
</tr>
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<td>Lifetime Income (△%)</td>
<td>.63</td>
<td>-.85</td>
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Risk Aversion and the Value of Insurance
Willingness to pay in consumption

\[
\text{% change in consumption}
\]

\[
\text{variance of innovations in female wage rates}
\]

secondary  further  higher

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Female Labour Supply, Human Capital and Tax Reform
Risk Aversion and the Value of Insurance
Willingness to pay in consumption

![Graph showing the relationship between variance of innovations in female wage rates and percent change in consumption for different levels of education.]

- Secondary
- Further
- Higher

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Female Labour Supply, Human Capital and Tax Reform
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<table>
<thead>
<tr>
<th>Pre-reform education choice by baseline educ</th>
<th>sec (1)</th>
<th>further (2)</th>
<th>higher (3)</th>
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<tr>
<td>Panel A: Adjustment in basic tax rate</td>
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<tr>
<td>(1) Pre-Tax Earnings</td>
<td>.29</td>
<td>.21</td>
<td>.09</td>
<td>.20</td>
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<td>(3) Welfare (post-ed)</td>
<td>.40</td>
<td>.94</td>
<td>.77</td>
<td>.71</td>
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<td>Panel B: Adjustment in tax credits maximum award</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(5) Pre-Tax Earnings</td>
<td>1.32</td>
<td>-.01</td>
<td>-.18</td>
<td>.37</td>
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<td>(7) Welfare (post-ed)</td>
<td>1.58</td>
<td>1.30</td>
<td>.21</td>
<td>1.03</td>
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<tr>
<td>Panel C: Adjustment in IS award</td>
<td></td>
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<tr>
<td>(9) Pre-Tax Earnings</td>
<td>-2.49</td>
<td>-1.34</td>
<td>-.38</td>
<td>-1.40</td>
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<tr>
<td>(11) Welfare (post-ed)</td>
<td>.90</td>
<td>.70</td>
<td>.09</td>
<td>.56</td>
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- **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

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<td>.81</td>
<td>.74</td>
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<td>(4) Welfare (pre-ed)</td>
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<td></td>
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<td>-1.04</td>
<td>-.07</td>
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<td>1.11</td>
<td>.91</td>
<td>.15</td>
<td>.72</td>
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<tr>
<td>(8) Welfare (pre-ed)</td>
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<td>Panel C: Adjustment in IS award</td>
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<td>(9) Earnings</td>
<td>-2.05</td>
<td>-1.16</td>
<td>-.89</td>
<td>-1.36</td>
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<tr>
<td>(11) Welfare (post-ed)</td>
<td>.72</td>
<td>.55</td>
<td>.07</td>
<td>.45</td>
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<td>(12) Welfare (pre-ed)</td>
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<td>.46</td>
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Notes: The values measure the impact of exogenously increasing public spending by 0.5% of total gross earnings and distribute it through a drop in the basic tax rate (panel A), an increase in the tax credits maximum award (panel B) and an increase in the IS award (panel C). All comparisons are against the 1999 tax and benefits system. Columns 1 to 4 display results if education is not allowed to respond, in which case the extra spending allows the basic tax rate to drop by 0.93pp, the IS award to increase by £4.2 per week, or the tax credits award to increase by £22.2 per week. Columns 5 to 8 display results when education choices can adjust the new system, in which case the extra spending allows the basic tax rate to drop by 0.97pp, the IS award to increase by £3.4 per week, or the tax credits award to increase by £16.6 per week. Rows 1 and 2 display effects on pre- and post-tax lifetime income, respectively. Rows 3 and 4 show effects on welfare measured by the willingness to pay in consumption terms to keep pre-reform wellbeing with post-reform family budget. These are measured at the beginning of working life (row 3) and at the start of life (row 4). See footnote to table ?? for more details.

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

R Blundell, M Costa Dias, C Meghir and J Shaw

Female Labour Supply, Human Capital and Tax Reform
Experience effects are lower for the lower educated and 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 the WFTC/IS, and similar, reforms.
Next steps:
- frictions
- sector choice and training
- health, cognition and human capital
- family dynamics
Training participation rates by age and education

Work–related training participation rates (50h+)

Low Ed

Medium Ed

High Ed

- Men
- Women

R Blundell, M Costa Dias, C Meghir and J Shaw
Female Labour Supply, Human Capital and Tax Reform
Descriptive wage regressions

Wage growth for continuously employed women

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<th>Higher</th>
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<td>.045 (.003)</td>
<td>.050 (.004)</td>
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<td>-.028 (.017)</td>
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Impact on Education Shares

Revenue Neutral Reform:

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<td>22.1</td>
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<td>2002</td>
<td>32.3</td>
<td>47.1</td>
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<tr>
<td></td>
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<tr>
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<td>intercept</td>
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