Earned Income Tax Credit Policies: 
*Impact and Optimality*

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(based on joint work with Mike Brewer and Andrew Shephard)

- **The policy issue**: low labour market attachment and high incidence of poverty among certain groups
- **Aim**: to evaluate the impact and assess the optimality of employment tax-credit reforms
- Central position in EU labour market policy debate
  - Tax Credit expansions for lone parents
  - **WFTC expansion** in the UK, 1999/2000
- **Puzzle**: WFTC about twice as generous as EITC but with only half the impact
- focus on **lone mothers**
  - couples - targeting and collective labour supply
- examine the impact/design of further expansions
Layout of the presentation

- Policy Context
- Structure of the reforms/treatment
- Ex-post evaluation of historic reforms
- Ex-ante structural evaluation model
- Robustness of ex-ante model
- Optimality of reforms
- Impact on new tax credit policy in Britain

Pre-reform Employment Trends for Women in the UK (1978 – 1999)

Blundell and Hoynes (2004)
Blundell and Hoynes (2004)

Employment Trends for Women in the US

WFTC is in the class of ‘make work pay’ reforms
- Objective is to balance poverty reduction and employment incentives
- Focus on a ‘work condition’
- Highlight distinction between extensive and intensive margin in empirical labor and in optimal tax literature

Questions?
- How should we evaluate the impact of such a reform?
- Are such tax-credits and their expansion optimal?
- If yes, what is the optimal design?
Focus on WFTC reform (compare with EITC)

- WFTC reform has had a big impact on the policy debate in Europe
- influenced by EITC expansion in the US
- expanded the generosity of the UK in-work benefit system
  - the move from Family Credit to WFTC.
- ex-ante evaluation in 1999
- 2004 further expansion in generosity and extension of eligibility to individuals without children
  - raises important issues about design – time limits etc.

Three criteria for eligibility in WFTC:

- work eligibility
  - 16 or more hours per week
- family eligibility
  - children in full time education
- income eligibility
  - family net income below a certain threshold given by an adult credit plus age-dependent amounts for each child
  - once income is above the threshold then the amount of credit is tapered away at 55% per extra pound of net income – previously 70%
The US Earned Income Tax Credit and the UK WFTC compared

The Expansion in Generosity in the 2000 WFTC Reform
transfers per week for a min. wage lone parent
- unlike the US EITC the credit is based on net (rather than gross) family income

  – interaction with other benefits and taxes matter
    • differing size of the ‘treatment’ across eligibles
  – coincident reforms to family income support
    • different direction of these reforms to US
  – not all eligibles take-up credit
    • stigma/information

<table>
<thead>
<tr>
<th>Table 2.1: Adult and Child Elements of the WFTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
</tr>
<tr>
<td>Element</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>March 1999 (FC)</td>
</tr>
<tr>
<td>October 1999</td>
</tr>
<tr>
<td>March 2000</td>
</tr>
<tr>
<td>June 2001</td>
</tr>
<tr>
<td>June 2002</td>
</tr>
<tr>
<td>Real Increase (1999-2002)</td>
</tr>
</tbody>
</table>

*Note: All monetary amounts are expressed in April 2003 prices.*
Transfers and Taxes under Family Credit (lone parent, min wage)

Transfers and Taxes under the WFTC Expansion (lone parent, min wage)
### Table 2.2: Child Rates of Income Support and income-based JSA

<table>
<thead>
<tr>
<th>Child Element, Age</th>
<th>0 to 10</th>
<th>11 to 15</th>
<th>16 to 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1999</td>
<td>£21.90</td>
<td>£28.00</td>
<td>£33.50</td>
</tr>
<tr>
<td>October 1999</td>
<td>£27.00</td>
<td>£28.00</td>
<td>£33.50</td>
</tr>
<tr>
<td>March 2000</td>
<td>£28.40</td>
<td>£28.40</td>
<td>£33.80</td>
</tr>
<tr>
<td>March 2001</td>
<td>£33.00</td>
<td>£33.00</td>
<td>£33.80</td>
</tr>
<tr>
<td>October 2001</td>
<td>£34.50</td>
<td>£34.50</td>
<td>£35.40</td>
</tr>
<tr>
<td>March 2002</td>
<td>£34.50</td>
<td>£34.50</td>
<td>£35.40</td>
</tr>
<tr>
<td>October 2002</td>
<td>£38.10</td>
<td>£38.10</td>
<td>£39.00</td>
</tr>
<tr>
<td>April 2003</td>
<td>£38.50</td>
<td>£38.50</td>
<td>£38.50</td>
</tr>
<tr>
<td>Real Increase</td>
<td>76.2%</td>
<td>37.3%</td>
<td>14.9%</td>
</tr>
</tbody>
</table>

*Note: All monetary amounts are expressed in April 2003 prices.*

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**Weekly Hours Worked:**

**Low Education Single Mothers (aged 18-45)**

[Bar chart showing distribution of weekly hours worked with a lower hours limit marked]
How should we assess the impact of the expansion in tax-credit?

• Ex-post evaluation
  – Quasi-experimental evaluation strategy

• Ex-ante evaluation
  – ‘Structural’ evaluation model
    • ‘necessary’ for simulating further reforms
    • ‘necessary’ for assessing optimality

• use an appropriate mix of both strategies
To assess optimality

- Use Mirrlees optimal tax approach
- Suppose we wish to allocate £R to low income lone parents, how best should we do this?
- Need robust estimates of preferences
  - at least elasticities at extensive and intensive margins – Saez approximation/assumptions.
- Given elasticities, we can pose the question:
  - is the WFTC expansion ‘optimal’ for reasonable social welfare weights?
  - are there obvious aspects for improvement?

Robustness of the ex-ante evaluation model

- Compare structural evaluation model (simulated likelihood) estimated on pre-reform data to quasi-experimental ex-post evaluation
- The idea is to simulate the quasi-experimental estimate (moment)
  - we consider difference-in-differences
Ex-post evaluation: WFTC reform in 2000

- comparing outcomes of eligibles versus those who are not eligible
- identify impact of WFTC on eligibles assuming
  - common trends for eligible and non-eligible groups
  - invariance in group heterogeneity over time
  - conditional on a set of (matching) covariates X
- can structurally simulate this moment anyway!
Difference-in-Differences

suppose $F^{-1}$ is an inverse probability function, let $W=1$ denote eligibility and $t=1$ after the program, consider:

$$\alpha(X) = \{F^{-1}[E(Y|X,W=1,t=1)] - F^{-1}[E(Y|X,W=1,t=0)]\} - \{F^{-1}[E(Y|X,W=0,t=1)] - F^{-1}[E(Y|X,W=0,t=0)]\}$$

then use $F$ and the empirical distribution of $X$ for $W=1$ to recover the average impact on the eligibles.

• cubic polynomial for propensity scores for each of the comparison groups.
• estimate impact using predicted outcome for three non-treatment cases for each of the matched treated observations
Difference-in-Differences Results

<table>
<thead>
<tr>
<th>Single Women</th>
<th>Marginal Effect</th>
<th>Standard Error</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Resources Survey</td>
<td>3.5</td>
<td>1.55</td>
<td>25,163</td>
</tr>
<tr>
<td>Labour Force Survey</td>
<td>3.6</td>
<td>0.53</td>
<td>233,208</td>
</tr>
</tbody>
</table>

Drop: Summer 1999 – Spring 2000 inclusive; individuals aged over 45.
Outcome: employment. Average impact x 100, employment percentage.
Matching Covariates: age, education, region, ethnicity...

Robustness analysis

- Alternative groups
  - low education: 5.4 (0.61)
    - larger response on a lower base
  - Youngest child aged < 5: 3.13 (0.51)
  - Youngest child aged 5-10: 3.86 (0.54)

- Choice of pre-treatment years
  - results are robust to changing the pre-treatment time window
  - ‘hypothetical’ reform on pre-reform years
    - Spring 1997: treatment effect: .07 (.11)
**Structural analysis**

- Data from 1995-2003 - FRS
  - 1995-1999: pre-reform estimation data (ex-ante)
    - model does not reject provided ‘take-up’ is modelled
  - Use complete sample for ex-ante analysis of 2004 reforms

- Variation: geographic, time, precise rules.
  - Tax and benefit system (accurate income/benefits)
  - Housing costs/benefits (local variation)
  - Local taxation

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**Key features of the structural model**

*main elements:*

- budget constraint – tax/benefit interactions and take-up
- preferences – discrete hours; flexible parametric utility
- heterogeneity – demographics, age and unobserved het.
- fixed costs of work
- stigma/hassle costs – take-up versus eligibility
- childcare costs
  - mixed-multinomial specification across discrete hours choices.
Net Income schedule for the program:

\[ y_{hP} = wh + I - \Gamma(wh, I|Z_{\Gamma}) + \Psi(w, h, I, P|Z_{\psi}) \]

the program payment function \( \Psi(w, h, I, P|Z_{\psi}) \) depends on:
- hours (through the hours condition of entitlement)
- investment income \( I \)
- participation \( P \) in the tax-credit program,
- and household characteristics \( Z_{\psi} \)

Net Income Schedule and Program Participation

\[ y_{hP} = wh + I - \Gamma(wh, I|Z_{\Gamma}) + \Psi_0(w, h, I|Z_{\psi}) + P \cdot \Psi_1(w, h, I|Z_{\psi}) \]

\[ = \overline{y}_h + P \cdot \Psi_1(w, h, I|Z_{\psi}), \]

let \( E_h = 1(\Psi_1 > 0) \)
be an indicator of entitlement at hours \( h \).
\[ P = 1 \] if participate in program

additional term: \( \eta = X_{hP}\beta_2 + u_{hP} \) ‘cost’ of receiving in-work support

\[ U_h = \alpha_{11}(\overline{y}_h + P \cdot \Psi_1 - C)^2 + \alpha_{22}h^2 + \alpha_{12}(\overline{y}_h + P \cdot \Psi_1 - C) \cdot h \]
\[ + \beta_1(\overline{y}_h + P \cdot \Psi_1 - C) + \beta_2h + \epsilon_{hP} - (P \cdot E_h) \cdot \eta \]
\[ = U_h(\overline{y}_h + P \cdot \Psi_1 - C) - (P \cdot E_h) \cdot \eta \]

important in structural simulation of increasing generosity
Stochastic specification and discrete hours

discrete hours alternatives: \( h \in \{h_1, \ldots, h_J\} \)

payoff ‘utility’ for each hours point:
\[
U(h, y_{hp}) \approx a_{11} y_{hp}^2 + a_{22} h^2 + a_{12} y_{hp} h + \beta_1 y_{hp} + \beta_2 h + \varepsilon_{hp}
\]

\[
\beta_1 = X_1 \beta_{1x} + u_y
\]
\[
\beta_2 = X_2 \beta_{2x} + u_h
\]
\[
a_{11} = X_{11} a_{11x}
\]
\[
a_{22} = X_{22} a_{22x}
\]
\[
a_{12} = X_{12} a_{12x}
\]

Program Participation

Utility ‘cost’ of receiving in-work support
\[
\eta = X_\eta \beta_\eta + u_\eta
\]

claim \( \Psi_1 \) in FC/WFTC at hours \( h_j \) if:
\[
U_p(h_j, \tilde{y}_{h_j} + \Psi_1 - C, P = 1) > U(h_j, \tilde{y}_{h_j} - C).
\]

utility cost among those who choose to claim WFTC must not exceed the utility gain from receipt of WFTC transfer income relative to non-receipt:
\[
\eta < U(h_j, \tilde{y}_{h_j} + \Psi_1 - C) - U(h_j, \tilde{y}_{h_j} - C) - X_\eta \beta_\eta
\]

\[
u_\eta < \Omega_U \quad \text{where} \quad \Omega_U = U(h_j, \tilde{y}_{h_j} + \Psi_1 - C) - U(h_j, \tilde{y}_{h_j} - C) - X_\eta \beta_\eta
\]
Probability specification and likelihood

\[
\log L = \sum \log \int \left[ \int_{u_{w0}} \prod_j \Pr(h = h_j, P = 1|X, u) \right. \\
+ \int_{u_{j0} \leq \Omega_j} \prod_j \Pr(h = h_j, P = 1|X, u) \left. \right] f(u_\eta) du_\eta \\
+ \int_{u_{j0} \leq \Omega_j} \prod_j \Pr(h = h_j, P = 0|X, u) \int f(u_\eta) du_\eta \\
+ \int_{u_{j0} \leq \Omega_j} \prod_j \Pr(h = h_j, P = 1|X, u, \eta = 0) \int f(u_\eta) du_\eta \\
\int f(u_\eta) du_\eta
\]

where \(u_\eta = (u_w, u_x, u_y, u_h)\)

Elasticities by ‘Earnings’ Class/Hours

<table>
<thead>
<tr>
<th>Earnings Class</th>
<th>1 (10)</th>
<th>2 (19)</th>
<th>3 (26)</th>
<th>4 (33)</th>
<th>5 (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive</td>
<td>0.376 (0.129)</td>
<td>0.425 (0.072)</td>
<td>0.460 (0.056)</td>
<td>0.649 (0.053)</td>
<td>0.555 (0.035)</td>
</tr>
<tr>
<td>Intensive</td>
<td>0.2403 (0.091)</td>
<td>0.1816 (0.072)</td>
<td>0.1485 (0.071)</td>
<td>0.0978 (0.054)</td>
<td></td>
</tr>
</tbody>
</table>

£4.80 per hour wage hours/earnings class
### Structural Evaluation Results: WFTC Expansion

#### Change in employment rate

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Age of Youngest Child</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.66</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td>(.25)</td>
<td>(.33)</td>
</tr>
</tbody>
</table>

#### Average change in hours:

- **Unconditional**
  - All: 1.63
  - 0-2: 0.75
  - 3-4: 0.75
  - 5-10: 0.70
  - 11+: 0.91
  - 11+: 0.65

- **Workers only**
  - All: 1.10
  - 0-2: 0.75
  - 3-4: 0.75
  - 5-10: 0.70
  - 11+: 0.91
  - 11+: 0.65

Estimated on pre-reform FRS data; 4.12 without change in take-up

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### Structural Evaluation Results: WFTC Expansion

#### Post-WFTC

<table>
<thead>
<tr>
<th></th>
<th>Not working</th>
<th>Part Time</th>
<th>Full Time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-WFTC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not working</td>
<td>51.90</td>
<td>1.95</td>
<td>2.71</td>
<td>56.56</td>
</tr>
<tr>
<td>Part Time</td>
<td>0.00</td>
<td>20.84</td>
<td>1.47</td>
<td>22.31</td>
</tr>
<tr>
<td>Full Time</td>
<td>0.00</td>
<td>0.93</td>
<td>20.20</td>
<td>21.13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>51.90</td>
<td>23.72</td>
<td>24.37</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Change in employment: 4.66 (.25)
### Structural Evaluation Results: All Reforms

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Age of Youngest Child</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-2</td>
</tr>
<tr>
<td>Change in employment rate</td>
<td>3.48</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td>(.23)</td>
<td>(.31)</td>
</tr>
<tr>
<td>Average change in hours:</td>
<td></td>
<td>Unconditional</td>
</tr>
<tr>
<td></td>
<td>1.22</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>0.57</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Estimated on pre-reform FRS data;
3.12 without change in take-up

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Remember! Transfers and Taxes under the WFTC Expansion (lone parent, min wage)

![Graph](Graph.png)

- **Net Income**
- **Increase in Child Allowance and IS**
- **Family Credit**
- **WFTC and IS reform**
Evaluation of the ex-ante model

• The *simulated* diff-in-diff parameter from the structural evaluation model does not differ significantly from the diff-in-diff estimate
  – Compare *simulated moment* with *diff-in-diff moment*
    \[ 3.48 (.23) - 3.6 (.55) \]
  – Chi-square test statistic p-value .42
  – Consider additional moments
    • education; youngest child interaction

Evaluation of the ex-ante model

• small average treatment on treated effect appears to be due to interaction of WFTC with other taxes/benefits and rise in IS.
• rather than ‘small’ response elasticities:
  – extensive elasticity \[ .81 (.13) \]
  – intensive elasticity \[ .31 (.09) \]
Is the design ‘optimal’?

• Assume we want to redistribute ‘£R’ to low ed. lone parents, what is the ‘optimal’ way to do this?
• Recover optimal tax/credit schedule in terms of earnings
  – use approximation in terms of extensive and intensive elasticities at different earnings
  – as ‘first step’ in a Mirrlees optimal tax problem
• Given elasticities at extensive and intensive margin, we can pose the question:
  – is the WFTC expansion ‘optimal’ for reasonable social welfare weights?

Optimal Structure

• Suppose we distinguish two groups
  – ‘low’ or ‘no’ earners: group 0
  – ‘higher’ earners: group 1
• Suppose the social welfare weight is higher for low earners, group 0
• Choose transfers and taxes $T$ to maximise welfare
Optimal design gives

\[ \frac{T_1 - T_0}{c_1 - c_0} = \frac{(g_0 - 1)}{\zeta_1} \]

\( \zeta_i \) is the labour supply elasticity

\( g_0 \) is the social welfare weight

\(-T\) is the subsidy given to that group

\( c \) is the net of tax income for that group

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**Optimal Structure**

Net Income

\('NIT' reform\)

Hours of Work = Earnings/Min Wage
Suppose we distinguish ‘non-employed’, ‘low earners’ and ‘higher’ earners, 0, 1, 2 .. etc

\[ \frac{T_i - T_{i-1}}{c_i - c_{i-1}} = \frac{1}{\zeta_i} \sum_{j=i}^I \left[ 1 - \hat{g}_j \right] \]

where

\[ \hat{g}_j = g_j + \eta_j k \]

\( \zeta \) is the intensive elasticity, \( \eta \) is the extensive elasticity

Note that a ‘large’ extensive elasticity can ‘turn around’ impact of social weights - implying an optimal tax credit structure – e.g. a higher transfer to lower skilled workers than to those out of work
### Implied Social Welfare Weights by ‘Earnings’ Class

<table>
<thead>
<tr>
<th>Earnings Class</th>
<th>0 (10)</th>
<th>1 (19)</th>
<th>2 (26)</th>
<th>3 (33)</th>
<th>4 (40)</th>
<th>5 (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WFTC with IS</td>
<td>1.27</td>
<td>.90</td>
<td>1.11</td>
<td>.93</td>
<td>1.02</td>
<td>.80</td>
</tr>
<tr>
<td>WFTC alone</td>
<td>1.10</td>
<td>.93</td>
<td>1.06</td>
<td>.92</td>
<td>1.02</td>
<td>.81</td>
</tr>
</tbody>
</table>

£5 per hour wage hours/earnings class
(minimum wage is £4.30)
Lone parent; child aged 4.

- ‘Almost’ monotonically declining social welfare weights make the reform optimal
  - non-monotonicities correspond to ‘peculiar’ hours conditions
- Weight $g_0$ higher than a pure tax-credit expansion
- Choose monotonic weights =>
The new tax credits in the UK

- **Child Tax Credit (CTC):** no work condition
  - increase in generosity and combined child elements in IS
- **Working Tax Credit (WTC):** work condition
  - increase the generosity relative to WFTC for workers with children
  - ex-ante prediction of further 3.8 increase in employment
- **WTC for childless single people and couples**
  - lower rate
  - only people aged 25 and over
  - working 30 hours or more per week
  - implicitly much lower social welfare weight for workers without children
- Opens debate on time limits – tax-credits may under insure by over providing static incentives
Summary

- Empirically robust elasticities and knowledge of the full tax and benefit system can easily reconcile EITC and WFTC ‘puzzle’.
- Can justify the WFTC expansion even with social welfare weights that decline monotonically with income – except for hours conditions.
- Contrast with implicit social welfare weights for the EITC expansions in the US.
- Contrast to the 2004 WTC/CTC expansions UK for individuals with and without children

Adequacy of the specification

- line-up structural model with quasi-experiment treatment effects
- work experience and wages?
  - Gladden and Tamer (2000)
  - Grogger (2005)
- program impact on gross wages?
- couples?
  - targeting in collective labour supply models with children - forthcoming JPE paper
- childcare? ; impact on fertility?
Some References:


