Human Capital, Labour Supply and Tax Reform

Richard Blundell (UCL & IFS)
(based on joint work with Monica Costa-Dias (IFS), Costas Meghir (Yale & IFS) and Jonathan Shaw (IFS & UCL)).
Paper and references on my web page.

Dale Mortensen Lecture

SED, Warsaw, June 2015
The most wonderful economist......

- An economist who took theory and data seriously.
- Effortlessly moving between implications for micro and macro behaviour.
- Then there were the brunch-breakfasts in Evanstan, the walks and talks along the lakeshore, the folk-blues recollections and much more....
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Motivation - use this occasion to address some key questions...

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

2. Especially in the design of transfers to low wage families in the form of ‘in-work benefits’ or ‘earned income tax credits’.

3. To what extent do dynamic 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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And look forward to some key related developments...

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4. Human capital and the 'gender gap' in the earnings distribution: experience capital and the part-time 'penalty'.
Human Capital, Labour Supply and Tax Reform

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2. **Alternative forms of human capital (on the job)**: detailed measures of training spells and the 'direct' costs of training.

3. **Restrictions and Frictions**: layering in arrival rates, layoff rates and restricted choice sets with human capital investments.

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Focus here is on the labor supply, experience and education decisions of women:

- Labour supply of women has been found to 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.
- ... But what if education and work experience investments are complementary in the production of human capital?
- This research aims to unravel the way these two aspects of human capital interact with labour supply decisions at the extensive and intensive margin.
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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.
- A motivation for these policies is that incentivising women into work, even when they have young children, will preserve labour market attachment and reduces skill depreciation.
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Figure 1: Income Support and Tax credit award for lone parent with 1 child
Impact on married women in couples

Figure 2: The budget constraint for second-earner parents

Notes: See Figure 2.
Hours rules

- In a static Mirrlees setting, Blundell & Shephard (RESud, 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.

- Do the hours rules impact on observed behaviour?
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Do the hours rules impact on observed behaviour?
The Distribution of Weekly Hours of Work

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

After 16 Hour Rule (1993)
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 dynamic 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 quasi-experimental contrasts where possible.
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Data

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, and assets.

IFS taxben working on every wave:

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

Linked life histories capture choices at age 16: educational qualifications; and detailed 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

Richard Blundell (UCL), SED, Warsaw

Dale Mortensen Lecture 2015
Employment over the life-cycle

Richard Blundell (UCL), SED, Warsaw

Dale Mortensen Lecture 2015
Employment of mothers

Richard Blundell (UCL), SED, Warsaw

Dale Mortensen Lecture 2015
Family Composition by Age

Richard Blundell (UCL), SED, Warsaw
Dale Mortensen Lecture 2015
Key Model Features

- Labour supply and consumption choices are heterogeneous and are made in an uncertain environment with credit constraints.
- Wages depend on accumulated experience, with heterogeneity and persistent shocks.
- Experience is allowed to differ by education and by part-time/full time work.
- Education choices are made reflecting uncertainty, risk aversion and credit constraints, allowing for heterogeneity in the consumption value of education.
- Marriage/partner matching, partner income and children, while weakly exogenous are uncertain.
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What we find

- **Incentive effects**: labour supply elasticities are substantive and 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. We uncover strong complementarities.

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

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

- **Previous tax credit policy reform evaluations**: we can explain why previous models for low educated women provided an ‘accurate’ picture of policy reform.
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 (Fan/Sheshadri/Taber paper).
Model: female earnings

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

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

- \(\gamma_s\) varies with schooling \(s\) and background factors.
- Persistence of shocks - distinguish heterogeneity from state dependence (experience effects).
- \(\xi_{sit}\) is a transitory shock/measurement error.
- Correlation of initial permanent shock with preferences.
- Concave profile of experience effects that differ by schooling level and background factors.
- \(g_s(l_{sit})\) set to unity for full-time, part-time is estimated.
- \(\delta_s\) depreciation of human capital - cost of not working.
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Family formation dynamics

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(?)

\[
\text{Prob} \left[ t^k = 0 \mid t, s, k_{t-1}, t^k_{t-1}, m_{t-1} \right]
\]
Partner:

- Arrival rate depending on level of education and age,
  - characterised by education, employment status, prior marriage, children and earnings
  - arrival rate for male with given education depends on female age and education
  - departure probability depends on female age, presence of child and male education

$$\text{Prob} \left[ s^m_t \mid t, s, m_{t-1}, s^m_{t-1}, k_{t-1} \right]$$

- Fertility and marriage behavior are ‘weakly exogenous’,
  - however, there is feedback - individuals account for the implications of their choices on marriage and fertility.
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Taxes and Assets

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

- Taxes: income tax, NI, council tax
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- Allow for take-up to differ with generosity of tax credits.

Assets:

- Initial period assets from the survey.
- Deal with the initial conditions problem by simulating from the start of life.
- Transfers implicit through funding of education.
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Model: post education optimisation problem

\{ c_{it}, l_{it} \}_{t=t,\ldots,\bar{t}} \text{ are chosen over the life-cycle to maximise }

\begin{align*}
V_t(X_{it}) &= E \left[ \sum_{t=t}^{\bar{t}} \beta^{t-t} \left( \frac{c_{it}}{n_{it}} \right)^{\eta} \exp \left( f(l_{it}, l^m_{it}, X_{it}) + \theta_i l_{it} \right) \right] \\
\text{subject to the budget constraint}
\end{align*}

\begin{align*}
a_{it+1} &= (1 + r)a_{it} + l_{it} w_{sit} + d^m_{it} l^m_{it} w^m_{it} - T(X_{it}, l_{it}, l^m_{it}) - CC_t \left( t^k_{it}, l_{it}, l^m_{it}, X_{it} \right) - c_{it}
\end{align*}

- net worth liquidity constraint: \( a > a_s \).
- uncertain environment: earnings (own and partner’s) and family composition.
- \( f(l_{it}, l^m_{it}, X_{it}) \) is a function of family composition, education, partner, partner labour supply, background factors, and unobserved heterogeneity, see equation (2).
- \( \theta_i \): unobserved types.
- childcare costs and housing rents vary by location and time.
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Model: education decisions

- Sequential discrete choice model.
  - 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, region of birth, books in the home, whether lived with parents at 16, etc.
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  - parental education/occupation, financial circumstances, siblings, region of birth, books in the home, whether lived with parents at 16, etc.
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.... see paper appendix.
### Female wage equation estimates

<table>
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<th>Parameter</th>
<th>Secondary</th>
<th>Further</th>
<th>Higher</th>
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<tbody>
<tr>
<td>baseline at age 25</td>
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<td>5.55 (.045)</td>
<td>6.94 (.11)</td>
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<td>.15 (.01)</td>
<td>.23 (.01)</td>
<td>.31 (.02)</td>
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<td>.92 (.01)</td>
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<td>.15 (.01)</td>
<td>.14 (.01)</td>
</tr>
<tr>
<td>initial prod</td>
<td>.15 (.01)</td>
<td>.13 (.01)</td>
<td>.31 (.03)</td>
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<tr>
<td>initial productivity: se</td>
<td>.30 (.02)</td>
<td>.26 (.02)</td>
<td>.26 (.03)</td>
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<td>depreciation rate</td>
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<td>accumulation of HC in PTE</td>
<td>.17 (.02)</td>
<td>.10 (.02)</td>
<td>.12 (.02)</td>
</tr>
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Notes: Interactions with background factors. See Table 5.
<table>
<thead>
<tr>
<th></th>
<th>all employment</th>
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<th>part-time employment</th>
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<td>further</td>
<td>university</td>
<td>secondary</td>
<td>further</td>
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<td>intercept</td>
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<td>-0.06 (.01)</td>
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<tr>
<td>child aged 0-2</td>
<td></td>
<td>0.15 (.01)</td>
<td></td>
<td></td>
<td>-0.05 (.01)</td>
<td></td>
</tr>
<tr>
<td>child aged 3-5</td>
<td></td>
<td>0.07 (.01)</td>
<td></td>
<td></td>
<td>-0.06 (.01)</td>
<td></td>
</tr>
<tr>
<td>child aged 6-10</td>
<td></td>
<td>-0.02 (.01)</td>
<td></td>
<td></td>
<td>0.03 (.01)</td>
<td></td>
</tr>
<tr>
<td>child aged 11-18</td>
<td></td>
<td>-0.07 (.01)</td>
<td></td>
<td></td>
<td>0.06 (.01)</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td></td>
<td>-0.06 (.01)</td>
<td></td>
<td></td>
<td>-0.02 (.02)</td>
<td></td>
</tr>
<tr>
<td>male working</td>
<td></td>
<td>-0.17 (.01)</td>
<td></td>
<td></td>
<td>0.09 (.01)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Full interactions in Table 6.
Model fit

Life-cycle profiles of wages

Richard Blundell (UCL), SED, Warsaw  
Dale Mortensen Lecture 2015
Model fit

Distribution of female wage rates by age

Wage distribution: perc 10, 25, 50, 75, 90

education = 1

education = 2

education = 3

Wage distribution: perc 10, 25, 50, 75, 90
data simulations

Richard Blundell(UCL), SED, Warsaw
Dale Mortensen Lecture 2015
Model fit

Employment over life-cycle

All employment

Part–time employment

Richard Blundell (UCL), SED, Warsaw  Dale Mortensen Lecture 2015
Model fit

Employment of mothers

All employment

Part–time employment

Richard Blundell (UCL), SED, Warsaw
Dale Mortensen Lecture 2015
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>
</thead>
<tbody>
<tr>
<td>Simulations</td>
<td>+4.4 (0.15)</td>
</tr>
<tr>
<td>Matched Diff-in-diff</td>
<td>+4.2 (0.31)</td>
</tr>
</tbody>
</table>
Frisch Labour Supply Elasticities

<table>
<thead>
<tr>
<th></th>
<th>extensive</th>
<th>intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.64</td>
<td>0.26</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.89</td>
<td>0.38</td>
</tr>
<tr>
<td>High School</td>
<td>0.61</td>
<td>0.23</td>
</tr>
<tr>
<td>University</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Lone mother</td>
<td>1.87</td>
<td>0.56</td>
</tr>
<tr>
<td>Mothers in couples</td>
<td>0.75</td>
<td>0.33</td>
</tr>
<tr>
<td>Childless women</td>
<td>0.43</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Notes: Distinct age patterns. See Figure 7 and Table 9.
## Marshallian Labour Supply Elasticities

<table>
<thead>
<tr>
<th></th>
<th>extensive</th>
<th>intensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.47</td>
<td>0.22</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.67</td>
<td>0.31</td>
</tr>
<tr>
<td>High School</td>
<td>0.43</td>
<td>0.20</td>
</tr>
<tr>
<td>University</td>
<td>0.30</td>
<td>0.17</td>
</tr>
<tr>
<td>Lone mother</td>
<td>1.07</td>
<td>0.44</td>
</tr>
<tr>
<td>Mothers in couples</td>
<td>0.58</td>
<td>0.31</td>
</tr>
<tr>
<td>Childless women</td>
<td>0.29</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Notes: Distinct age patterns. See Figure 7 and Table 9.
Revenue Neutral Reform, basic tax rate adjustment

I. Impact on Employment of Younger Women (Table 11):

<table>
<thead>
<tr>
<th>No Education Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Single Mother</td>
</tr>
<tr>
<td>Sec.</td>
</tr>
<tr>
<td>2.4</td>
</tr>
<tr>
<td>Couple with Kids</td>
</tr>
<tr>
<td>Sec.</td>
</tr>
<tr>
<td>-0.46</td>
</tr>
</tbody>
</table>

II. Impact on Education Shares (Table 12):

<table>
<thead>
<tr>
<th></th>
<th>Sec.</th>
<th>Fur.</th>
<th>Uni.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>31.1</td>
<td>45.6</td>
<td>23.2</td>
</tr>
<tr>
<td>2002</td>
<td>31.8</td>
<td>45.4</td>
<td>22.8</td>
</tr>
</tbody>
</table>
Results: Impact of WFTC & Child IS Reform

Revenue Neutral Reform, basic tax rate adjustment

I. Impact on Employment of Younger Women (Table 11):

<table>
<thead>
<tr>
<th>No Education Choice</th>
<th>Single Mother</th>
<th>Couple with Kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>employment</td>
<td>2.4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

II. Impact on Education Shares (Table 12):

<table>
<thead>
<tr>
<th></th>
<th>Sec.</th>
<th>Fur.</th>
<th>Uni.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>31.1</td>
<td>45.6</td>
<td>23.2</td>
</tr>
<tr>
<td>2002</td>
<td>31.8</td>
<td>45.4</td>
<td>22.8</td>
</tr>
</tbody>
</table>
Results: Employment Impact of WFTC & Child IS Reform

Revenue Neutral Reform, basic tax rate adjustment

<table>
<thead>
<tr>
<th>No Education Choice</th>
<th>Single Mother</th>
<th>Couple with Kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>employment</td>
<td>2.4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Education Choice</th>
<th>Single Mother</th>
<th>Couple with Kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>employment</td>
<td>2.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Notes: Classified according to original education choice.
Impact on Welfare and Income

<table>
<thead>
<tr>
<th>WFTC and IS</th>
<th>pre ed. choice</th>
<th>post ed. choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare (△%)</td>
<td>1.49</td>
<td>.55</td>
</tr>
<tr>
<td>Lifetime Inc. (△%)</td>
<td>.18</td>
<td>-.26</td>
</tr>
</tbody>
</table>

Richard Blundell (UCL), SED, Warsaw

Dale Mortensen Lecture 2015
Risk Aversion and the Value of Insurance
Willingness to pay in consumption

Notes: See Figure 8.

Richard Blundell (UCL), SED, Warsaw
Dale Mortensen Lecture 2015
## Alternative policies

<table>
<thead>
<tr>
<th></th>
<th>Sec</th>
<th>HS</th>
<th>Uni</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tax Rate Adjustment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Disp. Income</td>
<td>.14</td>
<td>.16</td>
<td>.18</td>
<td>.16</td>
</tr>
<tr>
<td>Welfare</td>
<td>.64</td>
<td>.79</td>
<td>.90</td>
<td>.55</td>
</tr>
<tr>
<td><strong>Tax Credit Adjustment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Disp. Income</td>
<td>1.18</td>
<td>.54</td>
<td>-.01</td>
<td>.61</td>
</tr>
<tr>
<td>Welfare</td>
<td>1.94</td>
<td>1.11</td>
<td>.18</td>
<td>1.15</td>
</tr>
<tr>
<td><strong>Income Support Adjustment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Disp. Income</td>
<td>-.18</td>
<td>-.56</td>
<td>-.69</td>
<td>-.42</td>
</tr>
<tr>
<td>Welfare</td>
<td>.72</td>
<td>.44</td>
<td>.14</td>
<td>.46</td>
</tr>
</tbody>
</table>

- Notes: See Table 14
- 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 Income Support increases by 4.2 pounds
Experience effects imply strong complementarity between formal education and human capital on-the-job.

Lower experience effects for those in part-time work.

Lower education women with children have more elastic labour supply and larger income effects.

There is a key effect of tax credit/welfare reform on education choice, attenuating some of 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 tax-credit type reforms.

This work, and related work, provides a structural framework for tax and welfare policy and aligns with a new agenda:
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The results can explain previous structural and quasi-experimental results for tax-credit type reforms.
This work, and related work, provides a structural framework for tax and welfare policy and aligns with a new agenda:
1 Human capital and the 'gender gap': experience capital and the part-time 'penalty'.
   - These features can largely explain the earnings gap.

2 Tax design with human capital dynamics: Mirrlees models with persistent wage shocks, human capital and credit constraints.
   - Blundell and Shephard (2015) find an enhanced role for a progressive age-based tax schedule even with savings taxation.
   - Important new papers at this SED - Stantcheva, Kapicka, DeCosta/Santos, Krueger/Ludwig...

3 Alternative forms of human capital on the job: detailed measures of training spells by gender.
   - Key new papers, also at this SED, on the contrast LbD and LoD, Blandin, for example.

4 Restrictions and Frictions: incorporating arrival rates, layoff rates with human capital investment.
   - Enhances complementarity but overall results remain.
The agenda....

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Offer and Layoff Probabilities

<table>
<thead>
<tr>
<th>Working status at $t-1$</th>
<th>working</th>
<th>not working</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) secondary</td>
<td>0.982</td>
<td>0.995</td>
</tr>
<tr>
<td>(2) high school</td>
<td>0.977</td>
<td>0.952</td>
</tr>
<tr>
<td>(3) university</td>
<td>0.981</td>
<td>0.930</td>
</tr>
</tbody>
</table>

Impact on model:

- Overall behaviour of the low educated group remains.
- An increase in the returns to experience for the higher educated and an enhanced degree of complementarity.
- Sorting with (multiple dimensions of) skill accumulation, Lise and Postel-Vinay (2015) at this SED.....
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Strong complementarity with education.
Training related to the return to work for educated women.
Summary of main results:

- Experience effects imply strong complementarity.
- Lower experience effects for those in part-time work.
- Lower educationl women with children have more elastic labour supply and larger income effects.
- There is a key effect of tax credit/welfare reform on education choice, attenuating some of the employment gains.
- The insurance value of the tax/welfare system is substantial.
- The results explain previous structural and quasi-experimental results.
Human Capital, Labour Supply and Tax Reform
SED, Warsaw, June 2015