Labour Income Dynamics and the Insurance from Taxes, Transfers, and the Family

Richard Blundell\textsuperscript{1}  Michael Graber\textsuperscript{1,2}  Magne Mogstad\textsuperscript{1,2}

\textsuperscript{1}University College London and Institute for Fiscal Studies

\textsuperscript{2}Statistics Norway

AEA: January 2014
This paper:

▶ Explores the links between individual earnings dynamics, and individual/family disposable income dynamics over the life cycle.

▶ Examines the role of taxes and transfers, and spouse’s labour income to smooth/attenuate shocks.

We use rich population panel data from Norway.

▶ Follow many birth cohorts across their working life-time.

Full IFS working paper available on my webpage.

▶ Will also be used to model consumption and asset behaviour.
The literature (references in paper) has pointed out (at least) three key ingredients in models of earnings and income dynamics:

- persistence of shocks
- age and time dependence in the variance of shocks
- heterogeneous age profiles

The paper addresses three questions:

1. How do these factors vary over the life-cycle and differ across education groups and birth cohorts?
2. To what extent does the tax and transfer system attenuate shocks to earnings?
3. What happens when we add in income sources of other family members?
The nature of labour income dynamics vary systematically by age, education and their interaction

More specifically:

- Variance of shocks are strongly age-dependent
  - Highly educated: high variance early in the working life
  - Low educated: high variance later in working life

- Heterogeneous trends important for high skilled at early ages

- Pooling across education groups gives the appearance of an inverse U-shaped age profile in variance of permanent shocks

- Age-independence gives the impression of less persistence
  - Especially for the high educated
The impact of taxes and transfers in Norway

- Remarkable flattening of life-cycle inequality
- Reduces persistence of shocks
- Reduces the variance of transitory and permanent shocks

After taking taxes and transfers into account:

- Spouse’s income matters little for dynamics of inequality
For each birth cohort we write log-income of individual $i$ of age $a$ as

$$\log Y_{i,a} = \mathbf{X}'_{i,a} \varphi + \alpha_i + \beta_i(a) + v_{i,a} + \tau_{i,a}$$

$\mathbf{X}$ includes a polynomial in age and its interaction with education, dummies for region, marital status and family size and the interaction of the latter.

- $\beta_i(a)$ is an individual-specific experience profile (idiosyncratic trend)
  - Allow for correlation between $\alpha$ and $\beta$.
- $v_{i,a}$ is the persistent process,

$$v_{i,a} = \rho v_{i,a-1} + u_{i,a}$$

where $u_{i,a}$ is a mean-zero shock with variance $\sigma_a^2$.

- $\tau_{i,a}$ is the transitory component assumed to follow an MA(1) process,

$$\tau_{i,a} = \varepsilon_{i,a} + \theta \varepsilon_{i,a-1}$$

where $\varepsilon_{i,a}$ is a mean-zero shock with variance $\omega_a^2$.

- Variance components allowed to vary with age, time and education
- Allow $\rho$ to vary with birth cohort and education group.
Note the first order autocorrelation at age $a$

$$
\rho_a = \frac{\text{cov}(y_{i,a}, y_{i,a+1})}{\sqrt{\text{var}(y_{i,a})} \sqrt{\text{var}(y_{i,a+1})}}
$$

can be expressed as

$$
\rho_a \approx \frac{\text{var}(\alpha_i) + \rho \sum_{s=0}^{a} \rho^{2s} \text{var}(u_{i,a-s}) + \theta \text{var}(\varepsilon_{i,a})}{\text{var}(\alpha_i) + \sum_{s=0}^{a} \rho^{2s} \text{var}(u_{i,a-s}) + \text{var}(\varepsilon_{i,a}) + \theta^2 \text{var}(\varepsilon_{i,a-1})}.
$$

Therefore, by

- allowing the variances of each component to differ by age
  — we are in effect —

- allowing $\rho_a$ to vary quite unrestrictedly over the life cycle.
Panel data covering the entire Norwegian population, 1967-2006

▶ Several linked registry databases, which gives
  • **Individual demographic information** (including gender, date of birth, and marital status)
  • **Socioeconomic data** (including years of education, market income, cash transfers)

▶ Family identifiers allow us to match spouses and parents to children

Income variables:

▶ **individual market income**: annual pre-tax earnings
▶ **individual disposable income**: annual earnings and cash transfers net of taxes
▶ **family disposable income**: pooled disposable income of spouses

[Household Income by Source]
Transfer system (including DI benefits, child benefits, etc.)

- Since 1967, key program parameters are fairly stable over time

Tax system (2006): Progressive through deductions and surtaxes

- 7.8% social security contribution on labour income
- (taxable income - deductions) is taxed at a flat rate of 28%
  - single persons/dual earner couples: 50% of standard deductions
  - two surtax brackets adding an additional 9 and 12 percent to the marginal tax rates

Over time, the Norwegian tax system has become less progressive through a series of policy changes
We study income dynamics for the period 1967-2006. In each year we select males born between 1925 and 1964, who are

- between the ages of 25 and 60, and link them to their family members at any point during their working life
- non-immigrants and non-self-employed
- with non-zero earnings in at least four consecutive periods

Applying these restrictions gives us an unbalanced panel with

- 40 time periods
- 934,704 individuals (23,368 individuals on average per cohort)

This sample is then partitioned into three mutually exclusive groups according to educational levels

- low-skilled (32%): not having completed high school
- medium-skilled (48%): high school degree
- high - skilled (20%): attended college
AGE PROFILES: LOG INCOME

Low-Skilled

- Concave profile over the life-cycle
- Very flat for the low-skilled, very steep for the high-skilled early in life
- Progressive nature of the tax and transfer system dampens the income differentials between high skilled and low skilled after age 35.

Medium-Skilled

High-Skilled
remarkable flattening of the increase in the variance of log-income due to the tax and transfer system especially for the low-skilled at the end of the life-cycle.
<table>
<thead>
<tr>
<th></th>
<th>Individual Market Income</th>
<th>Individual Disposable Income</th>
<th>Family Disposable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>$\rho$</td>
<td>1.00</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>(0.000000)</td>
<td>(0.000000)</td>
<td>(0.014782)</td>
</tr>
<tr>
<td>$\sigma^2_\alpha$</td>
<td>-</td>
<td>-</td>
<td>0.000152</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>(0.000053)</td>
</tr>
<tr>
<td>$\theta$</td>
<td>0.238500</td>
<td>0.258840</td>
<td>0.294650</td>
</tr>
<tr>
<td></td>
<td>(0.003749)</td>
<td>(0.002352)</td>
<td>(0.005684)</td>
</tr>
</tbody>
</table>

1. **Unit root but with strong MA(1) for lower education groups** - will be shown to be sensitive to restricting age-dependence in variances.

2. **Taxes and transfers reduce the persistence of shocks** - persistence only changes significantly for the high-skilled when move from individual disposable income to family disposable income.

3. **Only find significant heterogenous profiles in labour market income for the high-skilled.**
## Heterogeneous Profiles

<table>
<thead>
<tr>
<th></th>
<th>Low-Skilled</th>
<th>Medium-Skilled</th>
<th>High-Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\rho)</td>
<td>1.00</td>
<td>1.00</td>
<td>0.90</td>
</tr>
<tr>
<td>(\sigma^2_{\alpha})</td>
<td>-</td>
<td>-</td>
<td>0.026887</td>
</tr>
<tr>
<td>(\sigma^2_{\beta})</td>
<td>0.000000</td>
<td>0.000000</td>
<td>0.0002773</td>
</tr>
<tr>
<td>(\rho_{\alpha\beta})</td>
<td>-</td>
<td>-</td>
<td>-0.998930</td>
</tr>
<tr>
<td>(\theta)</td>
<td>0.238500</td>
<td>0.258830</td>
<td>0.293430</td>
</tr>
</tbody>
</table>

### Standard Errors

- \(\rho\): (0.000000) (0.000000) (0.047717)
- \(\sigma^2_{\alpha}\): - (0.049236)
- \(\sigma^2_{\beta}\): (0.000000) (0.000000) (0.000102)
- \(\rho_{\alpha\beta}\): - (0.005172)
- \(\theta\): (0.003749) (0.002353) (0.005608)
VARIANCE OF PERMANENT SHOCKS

Robustness

Low-Skill

Medium-Skill

High-Skill

Market Income
Disposable Income
Family Disposable Income
VARIANCE OF TRANSITORY SHOCKS

Robustness

Low-Skill

Market Income
Disposable Income
Family Disposable Income

Medium-Skill

Market Income
Disposable Income
Family Disposable Income

High-Skill

Market Income
Disposable Income
Family Disposable Income
BIAS: VARIANCE OF PERMANENT SHOCKS

Low-Skill

Medium-Skill

High-Skill

<table>
<thead>
<tr>
<th>Homogeneous Profiles</th>
<th>Age-invariant Variances</th>
<th>No MA</th>
</tr>
</thead>
</table>

Bias in $\sigma_a^2$ vs age

Homogeneous Profiles | Age-invariant Variances | No MA
BUSINESS CYCLES AND AGE PROFILES

The diagram shows two line graphs with age on the x-axis and various metrics on the y-axis. The upper graph represents \( \sigma^2 \) with values ranging from 0 to 0.15, and the lower graph represents the gap in log-GDP with values ranging from -1 to 1.

The line graphs are labeled for years 1956 and 1962.
The nature of labour income dynamics vary systematically by age, education and their interaction

More specifically:

► Variance of shocks are strongly age-dependent
  • Highly educated: high variance early in the working life
  • Low educated: high variance later in working life

► Heterogeneous trends important for high skilled at early ages

► Pooling across education groups gives the appearance of an inverse U-shaped age profile in variance of permanent shocks

► Age-independence gives the impression of less persistence
  • Especially for the high educated
The impact of taxes and transfers in Norway

- Remarkable flattening of life-cycle inequality
- Reduces persistence of shocks
- Reduces the variance of transitory and permanent shocks

After taking taxes and transfers into account:

- Spouse’s income matters little for dynamics of inequality
The quasi-difference $\Delta^\rho y_{i,a} \equiv y_{i,a} - \rho y_{i,a-1}$ of our baseline specification (with $\beta_i = 0$) can be written as

$$\Delta^\rho y_{i,a} = \alpha_i (1 - \rho) + u_{i,a} + \Delta^\rho \varepsilon_{i,a} + \theta \Delta^\rho \varepsilon_{i,a-1}, \quad a = a_{\text{min}} + 1, \ldots, a_{\text{max}},$$

so that the autocovariance $\text{cov}(\Delta^\rho y_{i,a}, \Delta^\rho y_{i,a+s})$ is

$$= (1 - \rho)^2 \text{var}(\alpha_i) \begin{cases} + \sigma_a^2 + \omega_a^2 + (\theta - \rho)^2 \omega_{a-1}^2 + \theta^2 \rho^2 \omega_{a-2}^2 & \text{if } s = 0 \\ + (\theta - \rho) \left( \omega_a^2 - \theta \rho \omega_{a-1}^2 \right) & \text{if } s = 1 \\ - \theta \rho \omega_a^2 & \text{if } s = 2 \\ + 0 & \text{if } s > 2 \end{cases}.$$
### Market Income Disposable Income

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>0</th>
<th>0.05</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium-Skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Age Distribution

- **Low-Skill**
  - Market Income
  - Disposable Income
  - Family Disposable Income

- **Medium-Skill**
  - Market Income
  - Disposable Income
  - Family Disposable Income

- **High-Skill**
  - Market Income
  - Disposable Income
  - Family Disposable Income
PARTICIPATION

Participation Rate

20 30 40 50 60 70

age

Total Low−Skilled

Medium−Skilled High−Skilled

Participation Rate

.4 .5 .6 .7 .8 .9 1

age

Total Low−Skilled

Medium−Skilled High−Skilled

- - - - Total

- - - - Low−Skilled

- - - - Medium−Skilled

- - High−Skilled
PARTICIPATION RATES Spouse

Low-Skilled

Medium-Skilled

High-Skilled
Marriage Rates

Low-Skilled

Medium-Skilled

High-Skilled
Average Tax Rates

Average tax rate (%) vs. Income (2001 NOK) for different years:
- Single person, 2006
- Single person, 2004
- Single person, 2001
- Single person, 1994
- Single person, 1979
Marginal Tax Rates

- Single person, 2006
- Single earner couple, 2006
Total household income by income source for each decile:

<table>
<thead>
<tr>
<th>Decile</th>
<th>Labour income</th>
<th>Self-employment</th>
<th>Capital income</th>
<th>Cash Transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42%</td>
<td>4%</td>
<td>-5%</td>
<td>59%</td>
</tr>
<tr>
<td>2</td>
<td>45%</td>
<td>5%</td>
<td>1%</td>
<td>49%</td>
</tr>
<tr>
<td>3</td>
<td>58%</td>
<td>5%</td>
<td>1%</td>
<td>36%</td>
</tr>
<tr>
<td>4</td>
<td>68%</td>
<td>4%</td>
<td>1%</td>
<td>26%</td>
</tr>
<tr>
<td>5</td>
<td>74%</td>
<td>4%</td>
<td>1%</td>
<td>21%</td>
</tr>
<tr>
<td>6</td>
<td>77%</td>
<td>4%</td>
<td>2%</td>
<td>17%</td>
</tr>
<tr>
<td>7</td>
<td>79%</td>
<td>5%</td>
<td>2%</td>
<td>14%</td>
</tr>
<tr>
<td>8</td>
<td>81%</td>
<td>5%</td>
<td>2%</td>
<td>12%</td>
</tr>
<tr>
<td>9</td>
<td>82%</td>
<td>6%</td>
<td>3%</td>
<td>9%</td>
</tr>
<tr>
<td>10</td>
<td>69%</td>
<td>11%</td>
<td>15%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Time Effects

- 0.025
- 0.05
- 0.075
- 0.1
- 0.125

ω^2

- 2.5
- 3.0
- 3.5
- 4.0
- 4.5
- 5.0
- 5.5

Age

- 1944
- 1949
- 1954
- 1959
- 1964