Fiscal policy, employment per age group and economic growth in OECD economies

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Outline

Context, aim and contribution of the paper

Model

Fiscal policy effects on employment and growth

Conclusions
Context

Large differences in per capita hours worked between the US and Europe and between European countries (core euro area versus Nordic countries).

Significant differences in potential per capita growth across countries.

Recent studies emphasize the key role of fiscal policy for employment and growth, i.e. the level and structure of taxes, the level and structure of government expenditure (e.g. Turnovsky, 2000; Prescott, 2004; Rogerson, 2007; Dhont and Heylen, 2008, 2009; Ohanian et al., 2008).

Main limitations of these studies:
- They neglect important employment differences across age groups of workers.
- They disregard the trade-off for young people between work and education, where education may be important for growth.
Context.... Key data, 17 OECD countries, 1995-2006/7

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>young</td>
<td>young</td>
<td>middle aged</td>
</tr>
<tr>
<td>Euro area 6</td>
<td>14.3</td>
<td>51.7</td>
<td>58.8</td>
</tr>
<tr>
<td>Nordic 4</td>
<td>20.2</td>
<td>54.3</td>
<td>65.6</td>
</tr>
<tr>
<td>US</td>
<td>12.8</td>
<td>65.6</td>
<td>74.2</td>
</tr>
<tr>
<td>UK</td>
<td>12.3</td>
<td>60.8</td>
<td>68.4</td>
</tr>
<tr>
<td>17 country average</td>
<td>15.3</td>
<td>55.9</td>
<td>63.4</td>
</tr>
</tbody>
</table>

Note: young: 20-34 years of age, middle aged: 35-49, older: 50-64
Aim and contribution of the paper

Develop a computable 4-period OLG model for an open economy which explains within one coherent framework

(i) employment rate (in hours) in three age groups
(ii) participation in (tertiary) education of the young
(iii) per capita potential GDP growth.

Special attention to the role of fiscal policy: three types of taxes, three types of government expenditures, balanced budget.

Test / show empirical relevance of the model (for 17 OECD countries)
Use it to study the effects of fiscal policy changes on key variables.
Derive policy implications…
Outline

Context, aim and contribution of the paper

Model
  * general set up
  * firms, households, government
  * optimization
  * parameterization
  * explanatory power

Fiscal policy effects on employment and growth

Conclusions
Model… general set up

Perfectly competitive open economy with perfect international mobility of physical capital, but immobile labour and human capital (Buiter and Kletzer, 1993, 1995; Nielsen and Sørenson, 1997).

4 overlapping generations of households:
- Young: work, study, or are “inactive”. Income is consumed or saved. Rate of return to savings is the (exogenous) world interest rate.
- Middle aged: work or are “inactive”. Income is consumed or saved.
- Older: work or are “inactive”. Income is consumed or saved.
- Retired: do not work anymore, consume all resources, leave no bequests

Firms employ (effective) labour and physical capital

Intergenerational education externality (Azariadis and Drazen, 1990)
Model

Firms

\[ Y_t = K_t^\alpha H_t^{1-\alpha}, \quad 0 < \alpha < 1 \]

- \( K \): physical capital, internationally mobile
- \( H \): effective labour, immobile

\[ H_t = n_1 h_1^t + n_2 h_2^{t-1} + n_3 h_3^{t-2}. \]

(sum of ‘effective’ hours worked by young, middle aged and older workers at \( t \))

- \( h_1^t \) Human capital of young worker in \( t \) (‘born’ in \( t \))
- \( h_2^{t-1} \) Human capital of middle aged worker in \( t \) (‘born’ at \( t-1 \))
- \( n_1 \) Hours worked by young worker (fraction of time)
Model

Households (‘workers’): Lifetime utility

\[ U = \ln C_1 + \gamma_1 \frac{(1 - n_1 - e)^{1 - \theta}}{1 - \theta} + \beta \left( \ln C_2 + \gamma_2 \frac{(1 - n_2)^{1 - \theta}}{1 - \theta} \right) \]
\[ + \beta^2 \left( \ln C_3 + \gamma_3 \frac{(1 - n_3)^{1 - \theta}}{1 - \theta} \right) + \beta^3 \ln C_4 \]

- \( C_j \): consumption when young (\( j=1 \)), middle aged (\( j=2 \)), older (\( j=3 \)) and retired (\( j=4 \))
- \( 1 - n_1 - e \): ‘leisure’ (fraction of time) when young
- \( e \): fraction of time spent studying (only when young)
- \( \gamma_j \): taste for ‘leisure’ (\( \gamma > 0 \)), \( 1/\theta \): intertemporal elasticity of substitution in leisure
Model

Households (‘workers’) : budget constraints

When :
- work: labour income (pay labour tax)
- study: no income, but build human capital → larger future income
- inactive: receive benefit from government (percent of after tax wage)

Allocation of income:
- Consumption (pay consumption tax)
- Savings → future income
Model

Households (‘workers’)

Production and intergenerational transfer of human capital

\[ h_1^t = h_2^{t-1} \] \quad \text{Intergenerational transfer, from middle aged born in } t-1 \text{ to young born in } t \quad \text{(Azariadis & Drazen, 1990)}

\[ h_2^t = [1 + \Psi(e, g, q)] h_1^t \] \quad \text{Accumulation of human capital from youth to middle age}

\[ e : \text{education time when young} \]
\[ g : \text{productive government expenditures} \]
\[ \text{(mainly education)} \]
\[ q : \text{indicator for quality of schooling} \]
\[ \text{We specify } \psi(.,.,.,) \text{ as a CES-function} \]

\[ h_3^t = h_2^t \] \quad \text{Evolution of human capital from middle age to older}
Model

Government

Balanced budget:

Revenues in $t$:
taxes on labour, taxes on consumption and capital tax,
from four generations living at time $t$

Expenditures in $t$:

non-employment benefits to three generations, productive expenditures $g$
(promoting accumulation of effective human capital), government
consumption, lump sum transfers
Model

Optimization

Firms:
- optimally choose $K, H$
  to the point where $r_t = (1 - \tau_k) \frac{\partial Y_t}{\partial K_t}$ and $w_t = \frac{\partial Y_t}{\partial H_t}$
- pay (source based) capital tax (Backus et al., 2008)

Households: optimally choose
- labour supply when young, middle aged and older ($n_1, n_2, n_3$)
- consumption/savings when young, middle aged, older and retired ($C_1, C_2, C_3, C_4$)
- education when young ($e$).
Model

Dynamic system of equations and endogenous variables → Dynare

Among other variables, the model explains within a coherent framework:
- employment among three age groups, aggregate employment
- education of the young
- per capita output growth

Key exogenous variables:
- Fiscal policy variables (labour, capital and consumption tax rates, non-employment benefit replacement rates, productive government spending)
- Other policy related variables: quality of education
Model

Parameterization

**Imposed parameters**

- physical capital share in output ($\alpha = 0.3$)
- real interest rate (3% per year)
- discount factor, annual rate of time preference (2% per year)
- intertemporal elasticity of substitution in leisure ($1/\theta = 0.5$)
- share parameters for the CES human capital production function
  ($v_1=0.25, v_2=0.20$)
- elasticity of substitution among factors ($e, g, q$) in human capital production
  ($\kappa = 0.7$)

$$
\Psi = \phi \left( v_1 g^{1-(1/\kappa)} + v_2 q^{1-(1/\kappa)} + (1-v_1-v_2) e^{1-(1/\kappa)} \right)^{\sigma \kappa / (\kappa-1)}
$$

Human capital production
Model

Parameterization

Calibrated parameters

calibrated such that model correctly predicts the average $n_1, n_2, n_3, e$ and growth rate of 9 European countries in 1995-2006/7.

taste for ‘leisure’ of the young \( (\gamma_1=0.041) \)
taste for ‘leisure’ of the middle aged \( (\gamma_2=0.092) \)
taste for ‘leisure’ of the older workers \( (\gamma_3=0.167) \)

\[
\Psi = \phi \left( v_1 g^{1-(1/\kappa)} + v_2 q^{1-(1/\kappa)} + (1-v_1-v_2) e^{1-(1/\kappa)} \right)^{\sigma \kappa / (\kappa-1)}
\]

Human capital production

efficiency parameter in human capital production \( (\phi = 6.0) \)
scale parameter in human capital production \( (\sigma = 1.31, \text{ increasing returns}) \)
Model

Explanatory power

Can the model explain cross-country and cross-age group variation in employment in hours?
Can it explain cross-country variation in education of the young?
Cross-country variation in per capita growth?

To do:

Introduce country specific fiscal policy data, and country specific quality of education

Compute the (steady state) predictions of the model for each country – Compare with the facts (1995-2006/7)

All preference and technology parameters are the same for each country (one exception: higher taste for leisure in Italy and Spain, see Blanchard, 2004)
# Fiscal policy differences


<table>
<thead>
<tr>
<th>Proxy for:</th>
<th>( \tau_1 )</th>
<th>( \tau_2 = \tau_3 )</th>
<th>( \tau_c )</th>
<th>( \tau_k )</th>
</tr>
</thead>
<tbody>
<tr>
<td>core euro area</td>
<td>56.0</td>
<td>57.0</td>
<td>13.6</td>
<td>23.3</td>
</tr>
<tr>
<td>Nordic countries</td>
<td>52.1</td>
<td>54.3</td>
<td>17.1</td>
<td>19.5</td>
</tr>
<tr>
<td>US</td>
<td>34.3</td>
<td>34.3</td>
<td>7.2</td>
<td>23.6</td>
</tr>
</tbody>
</table>

Note: Labour and capital tax rates are marginal rates.
## Fiscal policy differences


<table>
<thead>
<tr>
<th>Proxy for:</th>
<th>Productive government expenditures (% of GDP)</th>
<th>Net benefit replacement rate (% of net wage) when structurally inactive young</th>
<th>middle aged</th>
<th>older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core euro area</td>
<td>9.30</td>
<td>60.3</td>
<td>53.2</td>
<td>61.0</td>
</tr>
<tr>
<td>Nordic countries</td>
<td>12.50</td>
<td>56.8</td>
<td>48.8</td>
<td>50.3</td>
</tr>
<tr>
<td>US</td>
<td>9.32</td>
<td>19.7</td>
<td>18.7</td>
<td>18.7</td>
</tr>
</tbody>
</table>

Note: productive expenditures include education, active labour market policy, fixed capital investment, government financed R&D

Data sources: OECD; see also Dhont and Heylen, 2009.
<table>
<thead>
<tr>
<th>Proxy for:</th>
<th>$q \times 10000$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core euro area</td>
<td>504</td>
</tr>
<tr>
<td>Nordic countries</td>
<td>508</td>
</tr>
<tr>
<td>US</td>
<td>493</td>
</tr>
</tbody>
</table>
Model: explanatory power

(a) Correlation between the main endogenous variables in the actual data (1995-2007) versus correlation between these variables as predicted by the model (17 countries)

<table>
<thead>
<tr>
<th>Correlation between:</th>
<th>Actual data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>growth - education ($e$)</td>
<td>0.50</td>
<td>0.98</td>
</tr>
<tr>
<td>growth - empl_young ($n1$)</td>
<td>0.01</td>
<td>-0.12</td>
</tr>
<tr>
<td>growth - empl_midd ($n2$)</td>
<td>0.03</td>
<td>0.27</td>
</tr>
<tr>
<td>growth - empl_older ($n3$)</td>
<td>0.19</td>
<td>0.27</td>
</tr>
<tr>
<td>growth - aggregate empl ($n$)</td>
<td>0.10</td>
<td>0.15</td>
</tr>
<tr>
<td>productive gov. expenditures - education ($e$)</td>
<td>0.69</td>
<td>0.67</td>
</tr>
<tr>
<td>empl $n1$ - $n2$</td>
<td>0.80</td>
<td>0.86</td>
</tr>
<tr>
<td>empl $n1$ - $n3$</td>
<td>0.67</td>
<td>0.84</td>
</tr>
<tr>
<td>empl $n2$ - $n3$</td>
<td>0.80</td>
<td>0.97</td>
</tr>
<tr>
<td>empl_young ($n1$) - education</td>
<td>-0.31</td>
<td>-0.21</td>
</tr>
<tr>
<td>empl_midd ($n2$) - education</td>
<td>0.07</td>
<td>0.16</td>
</tr>
<tr>
<td>empl_older ($n3$) - education</td>
<td>0.17</td>
<td>0.17</td>
</tr>
</tbody>
</table>

(*) correlations which involve growth are without Ireland and Switzerland
Model: Explanatory power

Predictions (the model versus the facts for 17 OECD countries):

(b) Employment rate (in hours) of the young (%)

R = 0.57
Model : Explanatory power

Predictions (the model versus the facts for 17 OECD countries):

(c) Employment rate (hours) of the middle aged (%)

\[ R = 0.53 \]
Model: Explanatory power

Predictions (the model versus the facts for 17 OECD countries):

(d) Employment rate (hours) of the older (%)

\[ R = 0.85 \]
Model : Explanatory power

Predictions (the model versus the facts for 17 OECD countries) :
(e) Tertiary education rate of the young (%)
Model : Explanatory power

Predictions (the model versus the facts for 15 OECD countries) :

(f) Per capita growth (% per year)

\[ R = 0.57 \]

\((R=0.26 \text{ with Switz. and Ireland})\)
Outline

Context and contribution of the paper
Model
Fiscal policy effects on employment and growth
Conclusions
Fiscal policy effects on employment and growth:
- Size of shock: 3% of ex-ante output
- Compensated by change in lump sum transfers (to keep balanced budget)
- Data below are changes from benchmark (average of 9 European countries)

<table>
<thead>
<tr>
<th>Change in policy variable ( (a) )</th>
<th>( \Delta \tau_1 = \Delta \tau_2 )</th>
<th>( \Delta \tau_3 = \Delta \tau_4 = \Delta \tau_5 = )</th>
<th>( \Delta \tau_c = \Delta \tau_k = )</th>
<th>( \Delta b_1 = \Delta b_2 = )</th>
<th>( \Delta b_3 = \Delta b_4 = \Delta b_5 = )</th>
<th>( \Delta g_c = \Delta g_k = )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta n_1 )</td>
<td>0.62</td>
<td>7.98</td>
<td>-4.54</td>
<td>-5.23</td>
<td>0.43</td>
<td>0.51</td>
</tr>
<tr>
<td>( \Delta n_2 )</td>
<td>1.33</td>
<td>-1.48</td>
<td>3.90</td>
<td>0.31</td>
<td>0.77</td>
<td>0.89</td>
</tr>
<tr>
<td>( \Delta n_3 )</td>
<td>2.02</td>
<td>-2.25</td>
<td>0.51</td>
<td>9.42</td>
<td>1.17</td>
<td>1.36</td>
</tr>
<tr>
<td>( \Delta e )</td>
<td>0.33</td>
<td>-5.30</td>
<td>4.27</td>
<td>4.87</td>
<td>0.14</td>
<td>0.16</td>
</tr>
<tr>
<td>( \Delta n ) ( (b, c) )</td>
<td>1.29</td>
<td>1.49</td>
<td>0.05</td>
<td>1.11</td>
<td>0.77</td>
<td>0.90</td>
</tr>
<tr>
<td>( \Delta N/N ) ( (d))</td>
<td>2.45</td>
<td>2.83</td>
<td>0.09</td>
<td>2.10</td>
<td>1.46</td>
<td>1.70</td>
</tr>
<tr>
<td>( \Delta ) annual growth rate ( (b) )</td>
<td>0.02</td>
<td>-0.38</td>
<td>0.24</td>
<td>0.27</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>( \Delta z ) ex-post ( (e) )</td>
<td>-3.48</td>
<td>-3.13</td>
<td>-3.48</td>
<td>-3.87</td>
<td>-2.54</td>
<td>-2.94</td>
</tr>
</tbody>
</table>
Fiscal policy effects on employment and growth:
- Size of shock: 3% of ex-ante output
- Compensated by change in another fiscal policy variable (to keep balanced budget)

<table>
<thead>
<tr>
<th>Change in policy variable (a)</th>
<th>$\Delta \tau_1 = \Delta \tau_2 = \Delta \tau_3 = -4.3$</th>
<th>$\Delta b_1 = \Delta b_2 = \Delta b_3 = -7.6$</th>
<th>$\Delta g_v = +3.0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensating change (e)</td>
<td>$\Lambda \tau_c = 7.9$</td>
<td>$\Lambda b_c = 9.1$</td>
<td>$\Lambda g_c = -3.1$</td>
</tr>
<tr>
<td>Effect (b)</td>
<td>$\Delta n_1 = 0.06$</td>
<td>$\Delta n_2 = -5.88$</td>
<td>$\Delta n_3 = 3.25$</td>
</tr>
<tr>
<td></td>
<td>$\Delta n_8 = 0.35$</td>
<td>$\Delta n_9 = -0.83$</td>
<td>$\Delta n_{10} = 3.07$</td>
</tr>
<tr>
<td></td>
<td>$\Delta n_{15} = 0.53$</td>
<td>$\Delta n_{16} = 7.95$</td>
<td>$\Delta n_{17} = 5.04$</td>
</tr>
<tr>
<td></td>
<td>$\Delta e = 0.15$</td>
<td>$\Delta e = 4.64$</td>
<td>$\Delta e = -0.46$</td>
</tr>
<tr>
<td>$\Delta n$ (b, c)</td>
<td>$\Delta N/N$ (d)</td>
<td>$\Delta N/N$ (d)</td>
<td>$\Delta N/N$ (d)</td>
</tr>
<tr>
<td>$\Delta n_{b, c} = 0.30$</td>
<td>$\Delta N/N_{b, c} = 0.04$</td>
<td>$\Delta N/N_{b, c} = 3.71$</td>
<td>$\Delta N/N_{b, c} = 3.50$</td>
</tr>
<tr>
<td>$\Delta N/N_{b, c} = 0.58$</td>
<td>$\Delta N/N_{b, c} = 0.07$</td>
<td>$\Delta N/N_{b, c} = 7.03$</td>
<td>$\Delta N/N_{b, c} = 6.63$</td>
</tr>
<tr>
<td>$\Delta annual growth rate$ (b)</td>
<td>$\Delta annual growth rate$ (b)</td>
<td>$\Delta annual growth rate$ (b)</td>
<td>$\Delta annual growth rate$ (b)</td>
</tr>
<tr>
<td>$\Delta annual growth rate_{b} = 0.009$</td>
<td>$\Delta annual growth rate_{b} = 0.262$</td>
<td>$\Delta annual growth rate_{b} = -0.029$</td>
<td>$\Delta annual growth rate_{b} = 0.180$</td>
</tr>
</tbody>
</table>
Outline

Context and contribution of the paper

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Fiscal policy effects on employment and growth

Conclusions
Some conclusions

1. A simple perfectly competitive OLG model where the government sets three types of taxes to finance three types of expenditures is remarkably well able to explain the differences in employment per age group, education of the young and per capita growth in OECD countries.

2. The size of the effects of policy measures (e.g. tax changes) is in line with existing literature.
Some conclusions

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2. The size of the effects of policy measures (e.g. tax changes) is in line with existing literature.

3. Most effective measures to promote aggregate employment are changes in labour taxes and (especially) non-employment benefits. Overall changes in these policy variables have very little effect on long-run growth (they do affect output levels)
Some conclusions

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2. The size of the effects of policy measures (e.g. tax changes) is in line with existing literature.

3. Most effective measures to promote aggregate employment are changes in labour taxes and (especially) non-employment benefits. Overall changes in these policy variables have very little effect on long-run growth (they do affect output levels).

4. Growth is affected most by a change in productive government expenditures. This measure has only limited positive employment effects.
Some conclusions

5. In contrast to overall tax cuts, a tax cut targeted at older workers may also promote growth (it promotes education).

Tax cuts targeted at younger workers have the opposite effects.
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Tax cuts targeted at younger workers have the opposite effects.

6. Policy implication for core euro area countries (which strongly need higher long-run employment and growth):

- Cut benefits to structurally non-employment

- Use the money to finance lower labour taxes on older workers and higher productive government expenditures
Some conclusions

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Recent version of the paper, including level effects and welfare effects → renaat.vandekerckhove@ugent.be