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Background

• Population ageing

• Challenge: the growing per worker cost of providing a given age-vector of per capita benefits (Lee and Edwards, 2001)

• One of the Solutions: Increase Labor Supply
Some OECD Stats

For Sweden 2000-11

• Continuous Decline in Youth LFP

• 65+ remain constantly at 10%
Scientific Background

• Constant Elasticity of Substitution in Overlapping Generation Model

• Little consensus on estimated elasticity

• The equivalence: Estimated and calibrated parameters

• A vector of life-cycle parameter
Research Questions

• How have age-profiles of real wage and labor supply evolved overtime?

• How does the labor supply response to real wage vary over the life-cycle?
Theory predictions on wage differentials over age

- Efficiency wage hypothesis (Yellen, 1984)
- The shirking model (Calvo, 1979)

--> Wage-productivity discrepancy

- Uneven pay schedule between the young and old workers w.r.t productivity (Skirbekk, 2003).
- Such pay schedule is pareto efficient w/h mandatory retirement (Lazear, 1981)
- More time for senior to bid up wage (Harris and Bengt, 1982)
- Union attach great weight on old workers (Pissarides, 1989)
Theory predictions on Labor supply w.r.t wage

• Static Model

• Individual Labor Supply Curve

• Inter-temporal Substitution Hypothesis
A life-cycle labor supply function

• Max U in the form of

\[
\frac{1}{1 - 1/\gamma} \left( c_x^{1-1/\rho} + \alpha l_x^{1-1/\rho} \right)^{\frac{1-1/\gamma}{1-1/\rho}}
\]

s.t. \[ a_x r_x + w_x (1 - l_x) - c_x \]
A life-cycle labor supply function

• After ..., we get,

\[\ln(N_x) = \ln(N_{x-1}) - \left(1 - \frac{\bar{N}}{N}\right)\gamma \ln(1 + r_x) + \left(1 - \frac{\bar{N}}{N}\right)\gamma \left(\frac{\rho + \alpha \rho \gamma}{\gamma + \alpha \rho \gamma}\right) \ln \left(\frac{w_x}{w_{x-1}}\right)\]

\[\ln(N_x) = \ln(N_{x-1}) - \beta_1 \ln(1 + r_x) + \beta_2 \ln \left(\frac{w_x}{w_{x-1}}\right)\]

• Assuming \(\alpha=1\), we get,

\[\frac{\rho}{\gamma} = \frac{2\beta_2}{\beta_1} - 1\]
Hypothesis

Hypothesis 1: If $\frac{\beta_2}{\beta_1} > 1$, substitution effect dominates within period, and intratemporal elasticity outweighs intertemporal elasticity of labor supply w.r.t wage increase, i.e $\frac{\rho}{\gamma} > 1$.

Hypothesis 2: If $\frac{1}{2} < \frac{\beta_2}{\beta_1} < 1$, substitution effect dominates within period, but intratemporal elasticity is outweighed by intertemporal elasticity of labor supply w.r.t wage increase, i.e $0 < \frac{\rho}{\gamma} < 1$.

Hypothesis 3: If $0 < \frac{\beta_2}{\beta_1} < \frac{1}{2}$, income effect dominates within period, but intratemporal elasticity is outweighed by intertemporal elasticity of labor supply w.r.t wage increase, i.e $-1 < \frac{\rho}{\gamma} < 0$.

Hypothesis 4: If $\frac{\beta_2}{\beta_1} < 0$, income effect dominates within period, and intratemporal elasticity outweighs intertemporal elasticity of labor supply w.r.t wage increase, i.e $\frac{\rho}{\gamma} < -1$.

Hypothesis 5: If $\frac{\beta_2}{\beta_1} = 1$, i.e $\beta_2 = \beta_1$, intratemporal elasticity equals intertemporal elasticity of labor supply w.r.t wage increase, i.e $\frac{\rho}{\gamma} = 1$. 
Data

• Labor Income (YL) from National Transfer Accounts Sweden 1985-2003
• LFP and Employment Rate from SCB
• $\text{wage} = \frac{YL}{(LFP \times EMPL)}$
• Age groups: 16-19, 20-24, 25-34, 35-44, 45-54, 55-59, and 60-64
Method

• Lee-carter model: Describe the changing age profiles overtime

• Age-specific time series analysis: examine differences in labor supply responses to wage over life-cycle
Results: Changing age profiles
Result: Elasticity of labor supply w.r.t wage

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>All Age</th>
<th>16-19</th>
<th>20-24</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-59</th>
<th>60-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ln \left( \frac{w_{x,t}}{w_{x,t-1}} \right) )</td>
<td>0.667***</td>
<td>0.283*</td>
<td>0.350*</td>
<td>0.401***</td>
<td>0.310</td>
<td>-0.0313</td>
<td>-0.0541</td>
<td>-0.937*</td>
</tr>
<tr>
<td></td>
<td>(0.171)</td>
<td>(0.154)</td>
<td>(0.183)</td>
<td>(0.0971)</td>
<td>(0.234)</td>
<td>(0.0847)</td>
<td>(0.250)</td>
<td>(0.474)</td>
</tr>
<tr>
<td>( \ln(1 + r_t) )</td>
<td>-0.592***</td>
<td>-1.515*</td>
<td>-0.734***</td>
<td>-0.352***</td>
<td>-0.312*</td>
<td>-0.0315</td>
<td>-0.177</td>
<td>0.282</td>
</tr>
<tr>
<td></td>
<td>(0.106)</td>
<td>(0.712)</td>
<td>(0.211)</td>
<td>(0.0756)</td>
<td>(0.149)</td>
<td>(0.0608)</td>
<td>(0.158)</td>
<td>(0.641)</td>
</tr>
<tr>
<td>( \ln (N_{x,t-1}) )</td>
<td>1.183***</td>
<td>0.955***</td>
<td>1.033***</td>
<td>1.154***</td>
<td>1.162***</td>
<td>0.915***</td>
<td>0.848***</td>
<td>0.496*</td>
</tr>
<tr>
<td></td>
<td>(0.0713)</td>
<td>(0.0648)</td>
<td>(0.0574)</td>
<td>(0.0751)</td>
<td>(0.132)</td>
<td>(0.157)</td>
<td>(0.157)</td>
<td>(0.256)</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.785**</td>
<td>0.583</td>
<td>-0.409</td>
<td>-2.127*</td>
<td>-2.253</td>
<td>1.160</td>
<td>1.958</td>
<td>6.288*</td>
</tr>
<tr>
<td></td>
<td>(1.087)</td>
<td>(0.780)</td>
<td>(0.743)</td>
<td>(1.037)</td>
<td>(1.845)</td>
<td>(2.127)</td>
<td>(2.010)</td>
<td>(3.176)</td>
</tr>
<tr>
<td>Observations</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.967</td>
<td>0.941</td>
<td>0.965</td>
<td>0.962</td>
<td>0.934</td>
<td>0.777</td>
<td>0.787</td>
<td>0.768</td>
</tr>
<tr>
<td>F-test (p-value)</td>
<td>0.0995</td>
<td>0.864</td>
<td>0.752</td>
<td>0.674</td>
<td>0.650</td>
<td>0.0226</td>
<td>0.108</td>
<td>0.300</td>
</tr>
<tr>
<td>( \bar{\varepsilon} )</td>
<td>1.254</td>
<td>-0.627</td>
<td>-0.0476</td>
<td>1.277</td>
<td>0.989</td>
<td>-2.986</td>
<td>-1.611</td>
<td>-7.648</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>(0.369)</td>
<td>(0.327)</td>
<td>(0.588)</td>
<td>(0.532)</td>
<td>(0.923)</td>
<td>(7.646)</td>
<td>(3.264)</td>
<td>(12.31)</td>
</tr>
</tbody>
</table>
Result: Elasticity of labor supply w.r.t wage

Table 3: Estimation of Equation (14) by 2SLS (with Restriction: $\theta_{x,2} = \theta_{x,3} = \theta_{x,4}$)

<table>
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<th>45-54</th>
<th>55-59</th>
<th>60-64</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln \left( \left(1 + r_t \right)^{\frac{w_{x,t-1}}{w_{x,t}}} \right)$</td>
<td>-0.575***</td>
<td>-0.432***</td>
<td>-0.516***</td>
<td>-0.366***</td>
<td>-0.313***</td>
<td>-0.0153</td>
<td>-0.228</td>
<td>1.175**</td>
</tr>
<tr>
<td></td>
<td>(0.102)</td>
<td>(0.125)</td>
<td>(0.137)</td>
<td>(0.0699)</td>
<td>(0.138)</td>
<td>(0.0559)</td>
<td>(0.159)</td>
<td>(0.502)</td>
</tr>
<tr>
<td>$\ln (N_{x,t-1})$</td>
<td>1.160***</td>
<td>0.960***</td>
<td>1.047***</td>
<td>1.138***</td>
<td>1.162***</td>
<td>0.842***</td>
<td>0.947***</td>
<td>0.293</td>
</tr>
<tr>
<td></td>
<td>(0.0615)</td>
<td>(0.0676)</td>
<td>(0.0577)</td>
<td>(0.0672)</td>
<td>(0.108)</td>
<td>(0.120)</td>
<td>(0.146)</td>
<td>(0.258)</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.434**</td>
<td>0.472</td>
<td>-0.609</td>
<td>-1.901*</td>
<td>-2.264</td>
<td>2.145</td>
<td>0.679</td>
<td>8.775**</td>
</tr>
<tr>
<td></td>
<td>(0.938)</td>
<td>(0.812)</td>
<td>(0.745)</td>
<td>(0.927)</td>
<td>(1.511)</td>
<td>(1.635)</td>
<td>(1.863)</td>
<td>(3.200)</td>
</tr>
</tbody>
</table>

Observations 18 18 18 18 18 18 18 18
R-squared 0.966 0.931 0.960 0.961 0.934 0.768 0.756 0.702
F-test (p-value) 0.511 0.145 0.206 0.595 0.990 0.471 0.174 0.0656
Conclusion

• Youth labor supply: ISH dominates
• Old age labor supply: intra-temporal and income effect dominate
• Reconsidering the pay schedule w.r.t. labor supply, is it optimal?
• Policy implication: reforms of tax, social security as well as union policy should target on adjusting the pay schedule, i.e. increase net income for the young, lower it for the old
• Scientific implication: the array of life-cycle parameters is needed for OLG modeling