Disability and Labour Force Participation in Greece
A microeconometric analysis

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Outline

1 Motivation - Research Questions
2 Data
3 Labour force participation - Health
   - Definitions
   - Profile
4 Econometric Models
   - Dynamic Random Effects Probit
   - Initial conditions
   - Interpretation of models
5 Results
6 More
   - Conclusions
   - End page
   - References
   - Heckman (1981) method
   - Orme (1996) method
   - Wooldridge (2002) method
   - Unobserved Heterogeneity
Motivation

Labour market integration promotes social cohesion, improves aggregate labour market indices & reduces national budget expenditure.

All these issues are rather relevant for Greece (relatively low participation & employment rates, perennial public deficits).

Change of policy: instead of providing services & benefits; the provision of equality & full participation is promoted.

Helpful for government officials to know the exact impact of disability upon LFP.
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Research Questions

Explore the determinants of LFP & correctly measure the effect of disability.

Distinguish between (un)observed heterogeneity and true state dependence.

True state dependence: causal relation between previous and current LFP ⇒ an individual who is participating now will behave differently in the future than an individual out of the labour market.
European Community Household Panel (ECHP)

- Harmonised cross-national longitudinal survey focussing on income and living conditions.
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Sample:

- Working age males & females aged 16 to 65.
- After sampling criteria are applied we have 44,755 person-year observations for 8,959 individuals.
An individual participates when (s)he is working or (s)he is unemployed.
An individual participates when (s)he is working or (s)he is unemployed.

Q1: Do you have any chronic physical or mental health problem, illness or disability?
Q2: Are you hampered in your daily activities by this physical or mental health problem, illness or disability?
An individual participates when (s)he is working or (s)he is unemployed.

**Q1:** Do you have any chronic physical or mental health problem, illness or disability?

**Q2:** Are you hampered in your daily activities by this physical or mental health problem, illness or disability?

**Four health groups:**

1. No chronic health problems - Reference category.
2. Chronic health problems but no limitations.
3. Chronic health problems with some limitations.
4. Chronic health problems with severe limitations.
## Table 1: Labour force participation rates

|                  | \( \Pr(LFP_t = 1) \) | \( \Pr(LFP_t = 1 | LFP_{t-1} = 1) \) | Entry | Exit |
|------------------|------------------------|---------------------------------|-------|------|
| **All**          |                        |                                 |       |      |
| No health problems | 69.17                  | 93.27                           | 14.10 | 6.73 |
| No limitations   | 59.20                  | 93.20                           | 11.01 | 6.80 |
| Some limitations | 44.43                  | 85.63                           | 6.80  | 14.37|
| Severe limitations | 21.58                 | 67.11                           | 3.52  | 32.89|
| **Men**          | 82.55                  | 95.69                           | 15.12 | 4.31 |
| No health problems | 88.16                 | 96.94                           | 20.99 | 3.06 |
| No limitations   | 74.66                  | 96.33                           | 14.10 | 3.67 |
| Some limitations | 63.38                  | 89.91                           | 7.59  | 10.09|
| Severe limitations | 27.66                 | 67.61                           | 2.98  | 32.39|
| **Women**        | 48.85                  | 86.81                           | 11.33 | 13.19|
| No health problems | 51.84                 | 87.61                           | 12.57 | 12.39|
| No limitations   | 39.39                  | 85.71                           | 9.29  | 14.29|
| Some limitations | 30.88                  | 79.42                           | 6.52  | 20.58|
| Severe limitations | 15.62                 | 66.10                           | 3.93  | 33.90|
### Table 2: Health Status Transition Probabilities, $t-1$ to $t$

<table>
<thead>
<tr>
<th>Initial ($t-1$) status</th>
<th>Destination ($t$) probabilities (%)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>1. No health problems</td>
<td>95.12</td>
<td>0.63</td>
<td>2.95</td>
<td>1.31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(70.29)</td>
<td>(64.14)</td>
<td>(49.09)</td>
<td>(32.61)</td>
<td></td>
</tr>
<tr>
<td>2. No limitations</td>
<td>55.40</td>
<td>17.84</td>
<td>19.95</td>
<td>6.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(63.56)</td>
<td>(65.79)</td>
<td>(51.76)</td>
<td>(41.38)</td>
<td></td>
</tr>
<tr>
<td>3. Some limitations</td>
<td>37.57</td>
<td>3.81</td>
<td>44.37</td>
<td>14.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(49.51)</td>
<td>(57.83)</td>
<td>(43.79)</td>
<td>(20.00)</td>
<td></td>
</tr>
<tr>
<td>4. Severe limitations</td>
<td>23.48</td>
<td>1.56</td>
<td>21.22</td>
<td>53.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(38.86)</td>
<td>(40.91)</td>
<td>(25.33)</td>
<td>(14.21)</td>
<td></td>
</tr>
</tbody>
</table>

*Number in parentheses is the probability of participating given present and past health status*
We estimate a dynamic random effects probit model:

$$LFP^*_{it} = x_{it}'\beta + \psi h_{it} + \gamma LFP_{it-1} + \epsilon_i + u_{it}$$

(1)

for $i=1,\ldots,N$ and $t=2,\ldots,T$
We estimate a dynamic random effects probit model:

\[ LFP^*_{it} = x_{it}'\beta + \psi h_{it} + \gamma LFP_{it-1} + \epsilon_i + u_{it} \]  

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for \( i=1,...,N \) and \( t=2,...,T \)

Chamberlain (1984) suggests:

\[ \epsilon_i = \alpha_0 + \delta_1 \bar{x}_i + \alpha_i \]  

(2)
We estimate a dynamic random effects probit model:

$$LFP^*_it = x_{it}'\beta + \psi h_{it} + \gamma LFP_{it-1} + \epsilon_i + u_{it}$$  \hspace{1cm} (1)$$

for \(i=1,\ldots,N\) and \(t=2,\ldots,T\)

Chamberlain (1984) suggests:

$$\epsilon_i = \alpha_0 + \delta_1 \bar{x}_i + \alpha_i$$  \hspace{1cm} (2)$$

if we now plug (2) in (1) we get:

$$LFP^*_it = x_{it}'\beta + \psi h_{it} + \gamma LFP_{it-1} + \delta_1 \bar{x}_i + \alpha_i + u_{it}$$  \hspace{1cm} (3)$$
Dynamic Random Effects Probit - Initial conditions

Initial conditions problem

\[ LFP_{i1}^* = Z_i \delta + \eta_i + e_{it} \text{ for } t=1 \]

If \( \eta_i \) and \( \alpha_i \) are correlated then \( LFP_{i1} \) is correlated with \( \alpha_i \) in \( LFP_{i2}^* = \gamma LFP_{i1}^* + x_{i2} \beta + \epsilon_i + u_{i2} \) thus we cannot estimate consistently \( \gamma \) and \( \beta \).

**General Solution:** Estimate jointly equation (3) and the initial conditions allowing for correlation between \( \alpha_i \) and \( \eta_i \).
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**Solutions:**

1. **Heckman (1981):** Approximate the initial observation with a simple probit model and allow free correlation between \( LFP_{i1} \) and \( LFP_{it} \).

   ![Details](https://example.com/details)
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2. **Orme(1996):** Two-step estimation method; in the first step estimate a probit for \( LFP_{i1} \) & in the second estimate (3) adding \( E[\eta_i|LFP_{i1}] \) from the first step.
**Dynamic Random Effects Probit - Initial conditions**

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   - Details

3. **Wooldridge (2002):** Parametric method; models the unobserved heterogeneity conditional on the value of the initial period and the other exogenous variables.
   - Details
Unlike linear models the coefficients are not equal to the change in the conditional mean of the dependent variable when regressors change by one unit. Thus, we need to estimate the partial effect of $LFP_{it-1}$ on the $\Pr(LFP_{it} = 1)$.
Dynamic Random Effects Probit - Interpretation

- Unlike linear models the coefficients are not equal to the change in the conditional mean of the dependent variable when regressors change by one unit. Thus, we need to estimate the partial effect of $LFP_{it-1}$ on the $Pr(LFP_{it} = 1)$.

- We estimate predicted probabilities using the coefficients & taking the lagged dependent variable fixed at 1 and 0 while the rest of the regressors are kept in their sample mean value. Their difference is the marginal effect.

\[
\text{Marginal Effect of } LFP_{it-1} =
\hat{P}r(LFP_{it} = 1 | LFP_{it-1} = 1, \bar{x}_{it}, \bar{h}_{it}) - \hat{P}r(LFP_{it} = 1 | LFP_{it-1} = 0, \bar{x}_{it}, \bar{h}_{it})
\equiv
\Phi \left\{ \left( \gamma + \bar{x}_{it}\hat{\beta} + \bar{h}_{it}\hat{\psi} \right) (1 - \hat{\rho})^{0.5} \right\} - \Phi \left\{ \left( \bar{x}_{it}\hat{\beta} + \bar{h}_{it}\hat{\psi} \right) (1 - \hat{\rho})^{0.5} \right\}
\]

Standard errors were estimated using the delta method.
### Table 3: Marginal effects of labour force participation

<table>
<thead>
<tr>
<th></th>
<th>Probit</th>
<th>D.Probit</th>
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<td>LFP&lt;sub&gt;t-1&lt;/sub&gt;</td>
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<td>-0.062</td>
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<td>-0.062</td>
<td>-0.058</td>
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<tr>
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<td>0.013</td>
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<td>0.025</td>
</tr>
<tr>
<td>Female</td>
<td>-0.386</td>
<td>-0.210</td>
<td>-0.234</td>
<td>-0.305</td>
<td>-0.225</td>
<td>-0.232</td>
</tr>
<tr>
<td>University</td>
<td>0.196</td>
<td>0.098</td>
<td>0.114</td>
<td>0.157</td>
<td>0.116</td>
<td>0.167</td>
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<tr>
<td>High school</td>
<td>0.025</td>
<td>0.009</td>
<td>0.016</td>
<td>0.032</td>
<td>0.025</td>
<td>0.027</td>
</tr>
<tr>
<td>Age 17-25</td>
<td>0.196</td>
<td>0.173</td>
<td>0.183</td>
<td>0.213</td>
<td>0.201</td>
<td>0.152</td>
</tr>
<tr>
<td>Age 26-35</td>
<td>0.311</td>
<td>0.211</td>
<td>0.236</td>
<td>0.281</td>
<td>0.247</td>
<td>0.193</td>
</tr>
<tr>
<td>Age 36-45</td>
<td>0.334</td>
<td>0.225</td>
<td>0.248</td>
<td>0.302</td>
<td>0.256</td>
<td>0.204</td>
</tr>
<tr>
<td>Age 46-55</td>
<td>0.267</td>
<td>0.174</td>
<td>0.193</td>
<td>0.241</td>
<td>0.201</td>
<td>0.163</td>
</tr>
<tr>
<td>Married</td>
<td>-0.061</td>
<td>-0.050</td>
<td>-0.107</td>
<td>-0.105</td>
<td>-0.100</td>
<td>-0.111</td>
</tr>
<tr>
<td>Attica</td>
<td>-0.064</td>
<td>-0.031</td>
<td>-0.034</td>
<td>-0.051</td>
<td>-0.037</td>
<td>-0.041</td>
</tr>
<tr>
<td>Child&lt;12</td>
<td>-0.034</td>
<td>0.008</td>
<td>0.021</td>
<td>0.010</td>
<td>0.007</td>
<td>0.008</td>
</tr>
<tr>
<td>Income</td>
<td>-0.002</td>
<td>-0.001</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Red indicates insignificant M.E.
Conclusions

- Health problems have a significant adverse effect on the probability of participating;
  This is overestimated when unobserved characteristics are ignored.
- The negative health effect is higher for more severe health problems.
- Health problems influence LFP directly (incidence of a health problem) & indirectly (unobserved heterogeneity).
- There is true state dependence in LFP, between 36.5% to 41.7%; but is heavily overestimated when (un)observed characteristics and I.C are ignored.
- I.C. are always positive and significant; can’t reject endogenous I.C.
- Being a woman, being married, living in Attica ⇒ significant negative effect on LFP.
- Higher education increases the probability of participating;
  Age has an inverse U-shape.
- Children & unearned income affect unobserved heterogeneity in a way that decreases LFP.
Thank you for your attention!!! 😊

Here’s a link to the paper


Heckman suggests to approximate the initial observation with a simple probit model and to allow free correlation between $LFP_{i1}$ and $LFP_{it}$.

\[
LFP_{i1}^* = Z_i \lambda + \eta_i \quad (4)
\]

\[
\eta_i = \theta \alpha_i + u_{i1} \quad (5)
\]

Substitute (5) in to (4) and estimate jointly with (3):

\[
LFP_{i1}^* = Z_i \lambda + \theta \alpha_i + u_{i1} \quad (6)
\]

\[
LFP_{it}^* = x_{it} \beta + \gamma LFP_{it-1} + \delta_1 \bar{x}_i + \alpha_i + u_{it} \quad (7)
\]
Orme suggests a two-step estimation method that provides adequate inferences for the parameters of interest. Following Heckman (1979) he suggests a reduced form equation for the initial observation:

\[ LFP_{i1}^* = Z_i \lambda + \eta_i \]  

(8)

Correlation between \(\alpha_i\) and \(L_{i,1}\) can be removed by:

\[ \alpha_i = \kappa \eta_i + w_i \]  

(9)

Substitute (9) in to (3) and get:

\[ LFP_{it}^* = x_{it} \beta + \gamma LFP_{it-1} + \delta_1 \bar{x}_i + \kappa E[\eta_i | LFP_{i1}] + w_i + u_{it} \]  

(10)
Wooldridge proposes a parametric method of estimation which models the unobserved heterogeneity conditional on the value of the initial period and the other exogenous variables.

\[
\epsilon_i | LFP_{i1}, x_i \sim \text{Normal} \left( \alpha_0 + \alpha_1 LFP_{i1} + \bar{x}_i \alpha_2, \sigma^2_\alpha \right)
\]

\[
LFP^*_it = \dot{x}_{it} \beta + \gamma LFP_{it-1} + \alpha_0 + \alpha_1 LFP_{i1} + \bar{x}_i \alpha_2 + \alpha_i + u_{it} \tag{11}
\]
### Table 4: Marginal effects of labour force participation;
**Time-Averaged Characteristics**

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Severe lim.</td>
<td>-0.319</td>
<td>-0.405</td>
<td>-0.443</td>
<td>-0.306</td>
</tr>
<tr>
<td>Some lim.</td>
<td>-0.028</td>
<td>-0.025</td>
<td>-0.028</td>
<td>-0.013</td>
</tr>
<tr>
<td>No lim.</td>
<td>-0.189</td>
<td>-0.203</td>
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<tr>
<td>Married</td>
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<tr>
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<tr>
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<td>-0.002</td>
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