



# Health care utilisation in Europe: new evidence from the ECHP

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[www.york.ac.uk/res/herc/hedg.html](http://www.york.ac.uk/res/herc/hedg.html)

# Our Objectives...



- Motivation is research on inequality and horizontal inequity in health care use in Europe (EC-15)
- This paper concentrates on panel data estimation of utilisation
- Main differences compared to previous ECuity work (e.g., van Doorslaer, Koolman & Jones, 2004, HEc):
  - all waves of ECHP are used
  - analysis accounts for panel structure of data
  - control for unobserved heterogeneity (Latent class models)
  - applies Bago d'Uva's (2006, HEc) LC hurdle model
  - includes Finland (but not Germany, Luxembourg & UK)

# Background



- Most OECD countries have achieved close to universal public coverage
- Most EU countries subscribe to egalitarian goal of “equal treatment for equal need”, at least for public sector
- But pressure on public sector and growth of private insurance and delivery ‘complements’ or ‘supplements’ may affect equity performance
- Standard methodology now available for ‘broad-brush’ assessments and cross-country comparisons of inequality and inequity

# Equity-relevant system characteristics vary across countries



- Income-related variation in:
  - Provider remuneration
  - Degree and type of insurance coverage
  - Degree of cost sharing and exemptions
- Regional variation in:
  - Supply of medical care (both quality and quantity)
  - Coverage levels
  - Access costs

# Defining and describing horizontal equity



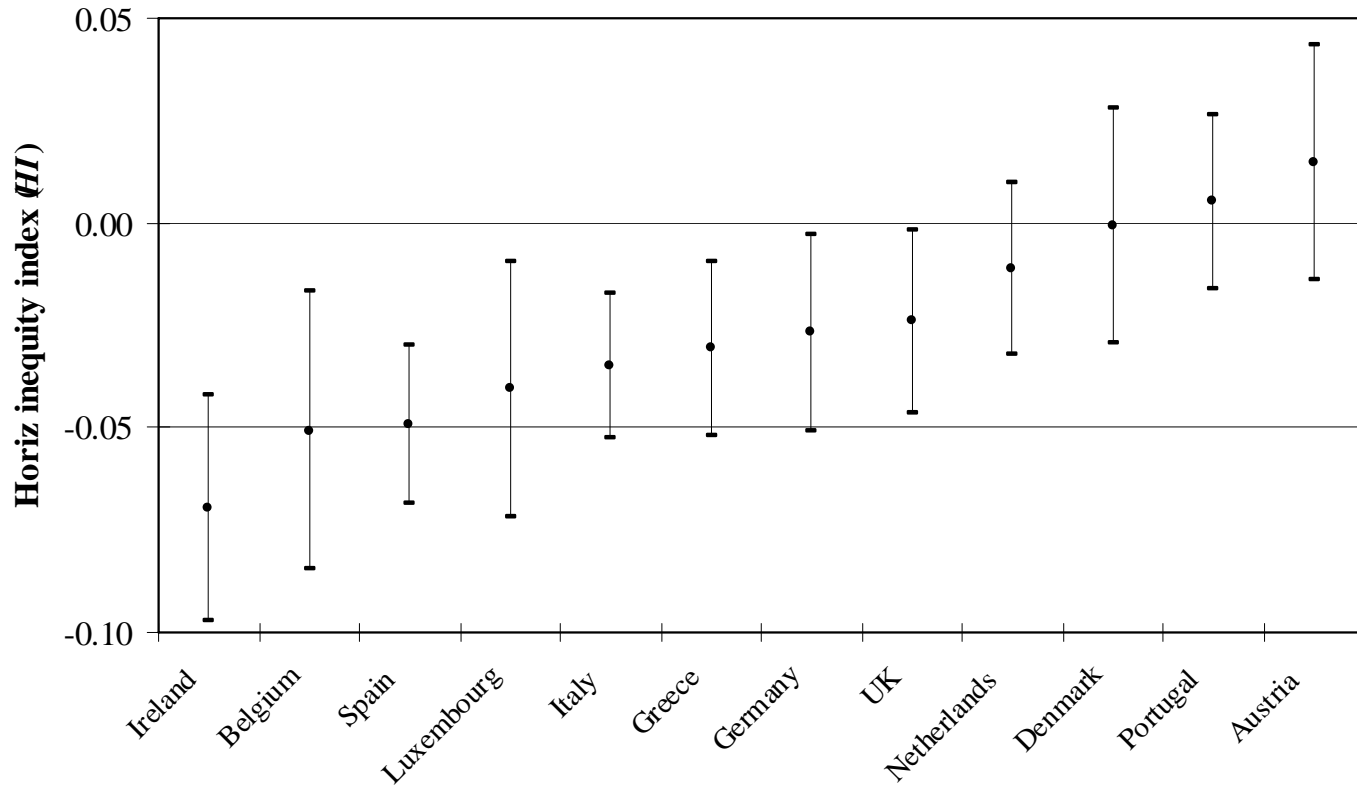
- Care is unequally distributed by income
- But also need is distributed unequally by income
- Income-related distribution of:
  - Actual use describes inequality
  - Need-standardized use describes inequity

# Inequality and inequity in GP visits, ECHP, 1996

(van Doorslaer, Koolman & Jones, 2004, HEc)

GP visits	Probability of a visit		Conditional # of visits		Total # of visits	
	Inequality	Inequity	Inequality	Inequity	Inequality	Inequity
	( $C_M$ )	( $HI$ )	( $C_M$ )	( $HI$ )	( $C_M$ )	( $HI$ )
Ireland	<b>-0.0187</b>	0.0035	<b>-0.1136</b>	<b>-0.0657</b>	<b>-0.1323</b>	<b>-0.0696</b>
Belgium	0.0037	<b>0.0121</b>	<b>-0.1183</b>	<b>-0.0564</b>	<b>-0.1145</b>	<b>-0.0508</b>
Spain	<b>-0.0294</b>	<b>-0.0167</b>	<b>-0.0612</b>	<b>-0.0371</b>	<b>-0.0906</b>	<b>-0.0492</b>
Luxembourg	-0.0076	0.0002	<b>-0.0841</b>	<b>-0.0428</b>	<b>-0.0918</b>	<b>-0.0406</b>
Italy	-0.0055	-0.0002	<b>-0.0594</b>	<b>-0.0322</b>	<b>-0.0649</b>	<b>-0.0349</b>
Greece	<b>-0.0413</b>	-0.0041	<b>-0.0845</b>	<b>-0.0212</b>	<b>-0.1258</b>	<b>-0.0308</b>
Germany	<b>-0.0124</b>	<b>-0.0082</b>	<b>-0.0513</b>	-0.0173	<b>-0.0636</b>	<b>-0.0268</b>
UK	-0.0076	<b>0.0109</b>	<b>-0.0930</b>	<b>-0.0301</b>	<b>-0.1006</b>	<b>-0.0240</b>
Netherlands	-0.0019	<b>0.0103</b>	<b>-0.0517</b>	<b>-0.0201</b>	<b>-0.0535</b>	-0.0113
Denmark	<b>-0.0200</b>	0.0061	<b>-0.0631</b>	-0.0085	<b>-0.0831</b>	-0.0008
Portugal	<b>-0.0143</b>	0.0099	<b>-0.0549</b>	-0.0038	<b>-0.0692</b>	0.0051
Austria	<b>-0.0082</b>	-0.0018	<b>-0.0417</b>	0.0114	<b>-0.0499</b>	0.0146

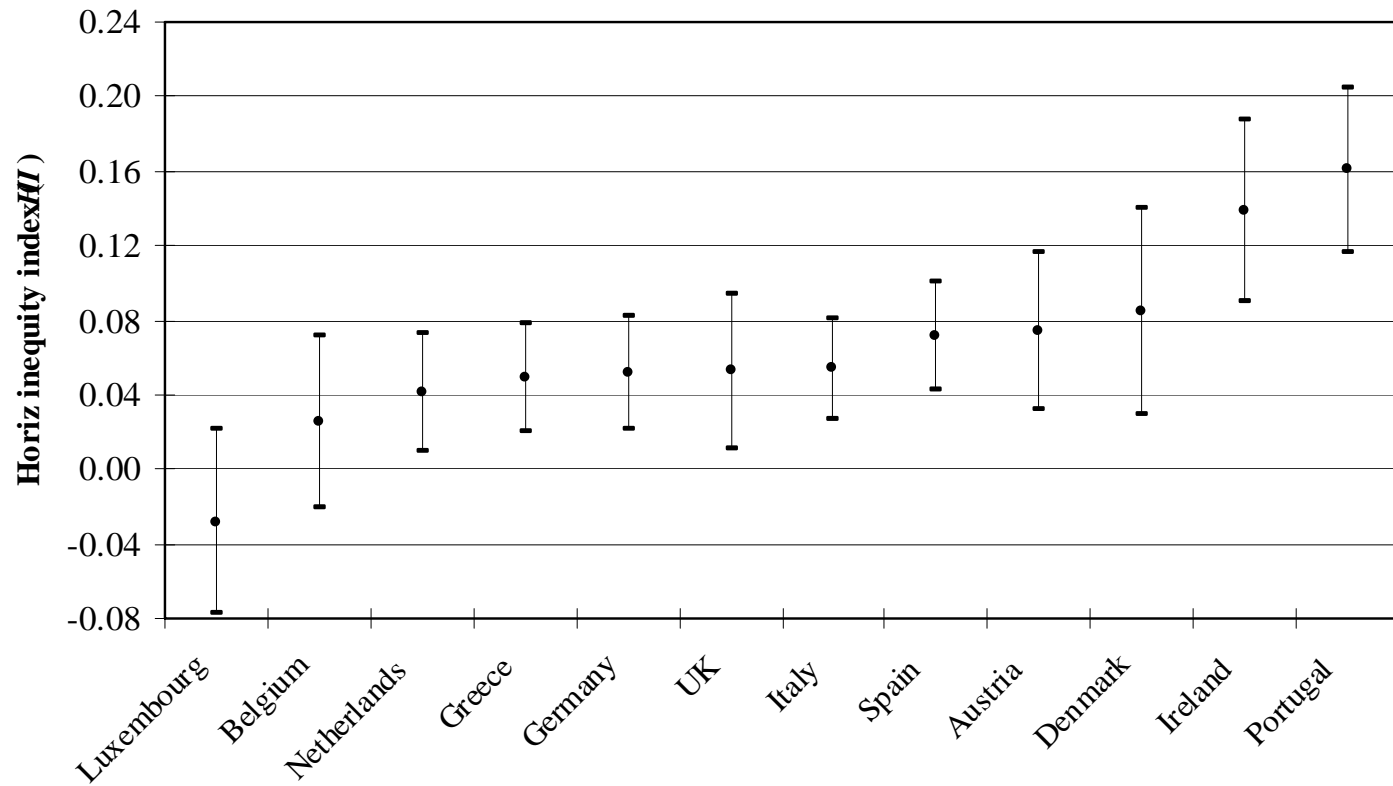
# Inequity indices for number of GP visits (with 95% confidence intervals)



# Inequality and inequity in specialist visits, ECHP, 1996

	Probability		Cond Number		Total	
	Inequality	Inequity	Inequality	Inequity	Inequality	Inequity
	( $C_M$ )	( $HI$ )	( $C_M$ )	( $HI$ )	( $C_M$ )	( $HI$ )
Luxembourg	0.0195	<b>0.0346</b>	<b>-0.0899</b>	<b>-0.0594</b>	<b>-0.0704</b>	-0.0282
Belgium	0.0125	<b>0.0344</b>	-0.0394	-0.0008	-0.0269	0.0255
Netherlands	-0.0041	<b>0.0307</b>	-0.0137	0.0197	-0.0178	<b>0.0413</b>
Greece	-0.0175	<b>0.0355</b>	-0.0242	0.0216	<b>-0.0418</b>	<b>0.0492</b>
Germany	<b>0.0130</b>	<b>0.0243</b>	0.0029	<b>0.0269</b>	0.0158	<b>0.0517</b>
UK	0.0163	<b>0.0723</b>	<b>-0.0397</b>	-0.0062	-0.0234	<b>0.0524</b>
Italy	<b>0.0416</b>	<b>0.0617</b>	-0.0237	-0.0035	0.0179	<b>0.0537</b>
Spain	<b>0.0439</b>	<b>0.0658</b>	-0.0171	0.0121	0.0267	<b>0.0714</b>
Austria	0.0108	<b>0.0214</b>	0.0237	<b>0.0554</b>	0.0345	<b>0.0740</b>
Denmark	-0.0074	0.0223	0.0297	<b>0.0581</b>	0.0223	<b>0.0844</b>
Ireland	<b>0.0621</b>	<b>0.1168</b>	0.0149	0.0299	<b>0.0770</b>	<b>0.1388</b>
Portugal	<b>0.0774</b>	<b>0.1103</b>	0.0197	<b>0.0549</b>	<b>0.0971</b>	<b>0.1604</b>

# Inequity indices for total number of specialist visits (with 95% confidence intervals)



# Data: The European Community Household Panel (ECHP)



- (Website info: <http://forum.europa.eu.int/Public/irc/dsis/echpanel/home>)
- Designed and coordinated by Eurostat
- A standardised multi-purpose annual longitudinal survey at the level of the (pre-enlargement) European Union (EC-15)
- Standardised questionnaire, annual interviewing of individuals aged >16 in a representative sample of households
- (Succeeded by EU-SILC)

# ECHP: sample



- 8 waves: 1994-2001
- total sample size: 129,000 adults (> 16 years), ranging from n=2,000 (Luxembourg) to n=17,000 (Italy).
- Austria (2-8), Belgium (1-8), Denmark (1-8), Finland (3-8), France (1-8), Germany (1-3), Greece (1-8), Ireland (1-8), Italy (1-8), Luxembourg (1-3), Netherland (1-8), Portugal (1-8), Spain (1-8), UK (1-3)
- Plus Swedish ULF and BHPS, GSOEP & PSELL
- We use: Austria (2-8), Belgium (1-8), Denmark (1-8), Finland (3-8), Greece (1-8), Ireland (1-8), Italy (1-8), Netherlands (1-8), Portugal (1-8), Spain (1-8)
- Considerable unit and item non-response (with Eurostat in imputations in UDB). See Peracchi (2002, EmpEc) and Jones, Koolman and Rice (2006, JRSSA) for discussion.

# ECHP: key variables



- Health care use over past 12 months (hospital in-patient, GP, specialist, dentist). We use:
  - “During the past 12 months, about how many times have you consulted a general practitioner (including home visits by the doctor)?”
  - “During the past 12 months, about how many times have you consulted a medical specialist (including out-patient consultations but excluding any consultation during hospitalisation)?”
- Self-assessed general health status (SAH): “How is your health in general” - very good, good, fair, poor, very poor
- “Do you have any chronic physical or mental health problem, illness or disability?”
- “Are you hampered in daily activities by this chronic.....?” (no, to some extent, severely)
- Income measured as disposable income per equivalent adult (modified OECD scale (1:05:0.3(<14)); Eurostat imputation) and deflated by CPI & PPPs
- Education: uses ISCED for highest level – tertiary, some secondary, less than second stage of secondary
- Regressors used for analysis of utilisation: age polynomials by gender, lagged health variables (SAH, hampered), income, education, economic activity, marital status, time dummies.

# Sample means for GP visits, by wave

	95	96	97	98	99	00	01
Austria		5.17	4.55	4.76	4.58	4.76	4.83
Belgium	4.95	4.95	4.80	5.04	4.99	4.95	4.85
Denmark	2.83	2.89	2.86	3.10	2.77	2.71	2.99
Finland			2.12	2.08	2.11	2.12	2.05
Greece	2.22	2.25	2.35	2.11	2.02	2.18	1.94
Ireland	3.53	3.44	3.58	3.69	3.65	3.54	3.58
Italy	3.93	4.29	4.63	4.49	4.67	4.65	4.68
Netherlands	2.86	2.75	2.77	2.91	2.86	2.85	2.83
Portugal	3.09	3.21	3.15	3.23	3.18	3.11	2.99
Spain	3.94	3.63	4.45	3.89	3.73	3.60	4.13

# Sample means for specialists, by wave

	95	96	97	98	99	00	01
Austria		2.60	2.09	2.07	2.09	2.15	2.11
Belgium	1.90	1.92	1.93	2.07	1.99	2.02	2.05
Denmark	0.86	0.98	0.98	1.06	1.03	1.02	1.07
Finland			1.02	1.03	1.04	1.08	1.05
Greece	1.66	1.66	1.91	1.66	1.73	1.80	1.75
Ireland	0.67	0.62	0.68	0.66	0.67	0.66	0.68
Italy	1.09	1.21	1.41	1.29	1.31	1.29	1.33
Netherlands	1.76	1.66	1.51	1.67	1.62	1.69	1.66
Portugal	1.03	1.21	1.22	1.26	1.29	1.34	1.26
Spain	1.70	1.50	1.69	1.62	1.57	1.60	1.70

# Econometric analysis of health care use: hurdle model

- Two-part decision process: participation decision and subsequent number of visits are generated by two different decision processes (here both based on Negbin):

- 1<sup>st</sup> part distinguishes users and non-users:  $P[y_i > 0 | x_i, \theta_1]$

$$f(0 | x_i; \beta_1) = P[y_i = 0 | x_i, \beta_1] = (\lambda_{1,i}^{1-k} + 1)^{-\lambda_{1,i}^k}$$

- 2<sup>nd</sup> part models positive number of visits for users:  $E[y_i | y_i > 0, x_i, \theta_2]$

$$f(y_i | x_i; \alpha, \beta_2) = \frac{\Gamma\left(y_i + \frac{\lambda_{2,i}^k}{\alpha}\right) (\alpha \lambda_{2,i}^{1-k} + 1)^{-\frac{\lambda_{2,i}^k}{\alpha}} \left(1 + \frac{\lambda_{2,i}^{k-1}}{\alpha}\right)^{-y_i}}{\Gamma\left(\frac{\lambda_{2,i}^k}{\alpha}\right) \Gamma(y_i + 1) \left[1 - (\alpha \lambda_{2,i}^{1-k} + 1)^{-\frac{\lambda_{2,i}^k}{\alpha}}\right]}$$

# Econometric analysis of health care use: finite mixture/latent class model

- Latent class Negative Binomial proposed by Deb and Trivedi (1997)

where  $\sum_{j=1}^C \pi_j = 1$  and

$$g(y_i | x_i) = \sum_{j=1}^C \pi_j f_j(y_i | x_i; \theta_j)$$
$$f_j(y_i | x_i; \alpha_j, \beta_j) = \frac{\Gamma\left(y_i + \frac{\lambda_j^k}{\alpha_j}\right)}{\Gamma\left(\frac{\lambda_j^k}{\alpha_j}\right) \Gamma(y_i + 1)} (\alpha_j \lambda_{j,i}^{1-k} + 1)^{-\frac{\lambda_{j,i}^k}{\alpha_j}} \left(1 + \frac{\lambda_{j,i}^{k-1}}{\alpha_j}\right)^{-y_i}$$

- Unobserved heterogeneity represented by a discrete distribution with C mass points
- $\pi_j$  are unknown and estimated along with  $\alpha_j$  and  $\beta_j$
- Variation across classes: all parameters or just some (e.g., constant term)

# Econometric analysis of health care use: finite mixture/latent class model



- Number of points of support needed is low, usually two or three.
- Natural representation where each latent class can be seen as a 'type' of individual
- With two latent classes ( $C=2$ ), there is a distinction between low users and high users (instead of users and non-users as in hurdle model)
- Applications of Deb and Trivedi (1997, 2002) show a better performance of the LC NB compared to Hurdle.
- Jimenez-Martin et al (2002) show mixed evidence with ECHP: LC NB performs better for GP visits while hurdle is preferred for specialists.

# Econometric analysis of health care use: the LC hurdle model for panel data

- Panel data hurdle model (Bago d'Uva, 2006, HEc)
- Latent class approach to deal with unobserved heterogeneity:  $C$  latent classes
- Conditional on each latent class  $j$ , number of visits in period  $t$  follows a hurdle model:
  - 1<sup>st</sup> part:  $P[y_t > 0 | x_t, \theta_{1j}]$
  - 2<sup>nd</sup> part:  $E[y_t | y_t > 0, x_t, \theta_{2j}]$
  - Two-part decision process
- Conditional on each latent class  $j$ , joint density over  $T_i$  periods given by the product of hurdle densities

# Hurdle densities

- Conditional on each latent class  $j$ , joint density over  $T_i$  periods given by the product of hurdle densities

$$f_j(0 | x_{it}; \beta_{j1}) = P[y_{it} = 0 | x_{it}, \beta_{j1}] = (\lambda_{j1,it}^{1-k} + 1)^{-\lambda_{j1,it}^k}$$

$$f_j(y_{it} | x_{it}; \alpha_j, \beta_{j2}) = \frac{\Gamma\left(y_{it} + \frac{\lambda_{j2,it}^k}{\alpha_j}\right) (\alpha_j \lambda_{j2,it}^{1-k} + 1)^{-\frac{\lambda_{j2,it}^k}{\alpha_j}} \left(1 + \frac{\lambda_{j2,it}^{k-1}}{\alpha_j}\right)^{-y_{it}}}{\Gamma\left(\frac{\lambda_{j2,it}^k}{\alpha_j}\right) \Gamma(y_{it} + 1) \left[1 - (\alpha_j \lambda_{j2,it}^{1-k} + 1)^{-\frac{\lambda_{j2,it}^k}{\alpha_j}}\right]}$$

- We use  $k=0$  to give logit & NB2 (have estimated NB1 as well)

# Latent class specification

- Unconditional on latent class, joint density given by:

$$g(y_i | x_i; \pi_{i1}, \dots, \pi_{iC}; \theta_1, \dots, \theta_C) = \sum_{j=1}^C \pi_{ij} \prod_{t=1}^{T_i} f_j(y_{it} | x_{it}; \theta_j)$$

- Latent class framework represents time-invariant unobserved heterogeneity
- Unobserved heterogeneity: different groups of users (different slopes across users)
- Flexible specification for heterogeneity: no distribution assumed for individual effects

# Probability of class membership

- Class membership probabilities  $\pi_{ij}$  can be defined as:
  - Either, constants:  $\pi_{ij} = \pi_j, j=1, \dots, C$
  - Or, functions of time-invariant individual characteristics (eg: initial values, averages across the panel) as in, for example, Clark and Etilé, 2003; Clark et al, 2005:

$$\pi_{ij} = \frac{\exp(z'_i \gamma_j)}{\sum_{g=1}^C \exp(z'_i \gamma_g)}, \quad j = 1, \dots, C$$

# Posterior analysis



- Not to be confused with analysis of posterior probability of class membership:

$$P[i \in j] = \frac{\pi_{ij} \prod_{t=1}^{T_i} f_j(y_{it} | x_{it}; \theta_j)}{\sum_{j=1}^C \pi_{ij} \prod_{t=1}^{T_i} f_j(y_{it} | x_{it}; \theta_j)}$$

# Range of models to be estimated...



- Hurdle model: (degenerate) one component LC Hurdle, no account for panel structure of data
- LC NegBin with 2 latent classes, no account for two-part decision process within each class
- LC Hurdle with 2 latent classes
- In LC models, class membership is MNL function of time invariant characteristics

# Computational issues



- Estimation was done by maximum likelihood using TSP 4.5 (also implemented in Stata 9)
- Newton method used for the models with one component
- Broyden-Fletcher-Goldfarb-Shanno (BFGS) quasi-Newton algorithm used to estimate the latent class models (could use EM algorithm)
- Due to the possibility of convergence to local maxima in LC, the estimation was repeated using different sets of starting values
- These are obtained as combinations of the estimates of the one component version of the model
- Starting values can also be obtained from estimates of restricted versions of the model (for example, with constant slopes, or with constant class membership)

# GP visits: model comparison

Country	Hurdle		LC NegBin		LC Hurdle	
	LogL	BIC	LogL	BIC	LogL	BIC
Austria	-84610.0	169605.9	-81597.4	163733.3	-81280.9	<b>163477.2</b>
Belgium	-85071.9	170542.4	-81385.3	163319.8	-81051.9	<b>163042.7</b>
Denmark	-58803.6	117999.6	-56765.7	114072.0	-56529.9	<b>113914.3</b>
Finland	-52943.6	106256.9	-51287.1	103097.2	-51088.7	<b>103061.1</b>
Greece	-111658.0	223743.1	-110753.0	222094.4	-108677.0	<b>218360.0</b>
Ireland	-77216.5	154838.6	-74468.2	149495.3	-74200.9	<b>149357.3</b>
Italy	-245796.0	492037.6	-238287.0	477188.0	-237225.0	<b>475499.7</b>
Netherlands	-115387.0	231196.5	-111246.2	223074.5	-111000.0	<b>222995.1</b>
Portugal	-149261.0	298950.1	-144568.3	289726.4	-143235.1	<b>287478.6</b>
Spain	-200121.0	400684.5	-195404.5	391418.6	-194877.0	<b>390796.3</b>

# LC Hurdle for GPs: predicted utilisation

Country	Low users			High users		
	P(Y>0)	E(Y Y>0)	E(Y)	P(Y>0)	E(Y Y>0)	E(Y)
Austria	0.775	2.926	2.311	0.956	8.049	7.747
Belgium	0.768	2.841	2.248	0.965	7.681	7.432
Denmark	0.598	2.009	1.266	0.912	4.995	4.616
Finland	0.555	1.813	1.024	0.908	3.843	3.505
Greece	0.464	2.219	1.144	0.716	4.636	3.503
Ireland	0.607	2.328	1.489	0.891	6.403	5.808
Italy	0.683	3.112	2.315	0.908	7.714	7.184
Netherlands	0.568	2.066	1.217	0.906	4.881	4.482
Portugal	0.532	2.439	1.400	0.853	5.433	4.777
Spain	0.573	2.745	1.669	0.854	6.872	5.968

# LC Hurdle for GPs: income elasticities

Country		Low users	High users
Austria	$P(Y>0)$	-0.012	-0.005
	$E(Y Y>0)$	0.009	<b>0.035</b>
Belgium	$P(Y>0)$	0.008	<b>0.010</b>
	$E(Y Y>0)$	<b>-0.037</b>	<b>-0.050</b>
Denmark	$P(Y>0)$	0.033	<b>0.023</b>
	$E(Y Y>0)$	0.021	-0.024
Finland	$P(Y>0)$	0.024	-0.003
	$E(Y Y>0)$	0.004	-0.037
Greece	$P(Y>0)$	0.006	0.004
	$E(Y Y>0)$	-0.015	<b>0.020</b>
Ireland	$P(Y>0)$	<b>0.064</b>	0.003
	$E(Y Y>0)$	<b>-0.057</b>	<b>-0.043</b>
Italy	$P(Y>0)$	0.000	<b>0.011</b>
	$E(Y Y>0)$	<b>-0.031</b>	<b>-0.021</b>
Netherlands	$P(Y>0)$	<b>0.035</b>	0.009
	$E(Y Y>0)$	-0.019	<b>-0.068</b>
Portugal	$P(Y>0)$	<b>0.104</b>	<b>0.036</b>
	$E(Y Y>0)$	<b>0.018</b>	0.001
Spain	$P(Y>0)$	-0.006	0.005
	$E(Y Y>0)$	<b>-0.034</b>	<b>-0.021</b>

# Determinants of class membership

Variable	Portugal		Spain	
Constant	0.739	(1.442)	0.444	(0.776)
Age	<b>-0.111</b>	(-8.256)	<b>-0.051</b>	(-3.084)
Age2	<b>0.001</b>	(6.222)	<b>0.000</b>	(2.583)
Male	<b>-1.552</b>	(-3.571)	-0.310	(-0.600)
Male*Age	<b>0.046</b>	(2.478)	-0.012	(-0.533)
Male*Age2	0.000	(-1.751)	0.000	(1.109)
LSAHgood	-	-	<b>1.132</b>	(8.839)
LSAHfair	<b>1.819</b>	(17.306)	<b>3.256</b>	(21.121)
LSAHbad	<b>3.568</b>	(21.482)	<b>3.631</b>	(14.654)
LHamp	<b>0.663</b>	(5.127)	<b>1.340</b>	(7.245)
ISCED7	0.102	(0.666)	<b>0.270</b>	(2.654)
ISCED3	0.229	(2.087)	0.064	(0.656)
Self-employed	0.130	(1.239)	<b>-0.348</b>	(-2.809)
Not working	<b>-0.407</b>	(-4.683)	-0.125	(-1.404)
Not married	<b>-0.304</b>	(-4.042)	-0.071	(-0.863)
Log(Income)	<b>0.128</b>	(2.576)	<b>-0.126</b>	(-2.544)
$\bar{\pi}$	0.551		0.431	

# Income elasticities of GP use: comparison of models for 2 examples

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		Hurdle	LC NegBin		LC Hurdle	
			Low	High	Low	High
Portugal	$P(Y>0)$	<b>0.069</b>	<i>0.016</i>	<i>-0.002</i>	<b>0.104</b>	<b>0.036</b>
	$E(Y Y>0)$	-0.005	<i>0.020</i>	<i>-0.008</i>	<b>0.018</b>	0.001
	$E(Y)$	<b>0.063</b>	0.036	-0.010	<b>0.122</b>	<b>0.036</b>
Spain	$P(Y>0)$	<b>-0.010</b>	<i>-0.014</i>	<i>-0.004</i>	-0.006	0.005
	$E(Y Y>0)$	<b>-0.044</b>	<i>-0.019</i>	<i>-0.020</i>	<b>-0.034</b>	<b>-0.021</b>
	$E(Y)$	<b>-0.053</b>	<b>-0.033</b>	<b>-0.024</b>	<b>-0.041</b>	<b>-0.016</b>

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# Specialist visits: model comparison

Country	Hurdle		LC NegBin		LC Hurdle	
	LogL	BIC	LogL	BIC	LogL	BIC
Austria	-61254.1	122893.8	-59657.4	119852.8	-59006.9	<b>118928.4</b>
Belgium	-58583	117564.3	-56756.4	114061.6	-56215.5	<b>113369.2</b>
Denmark	-32293.7	64979.6	-31400.6	<b>63341.5</b>	-31247.5	69730.1
Finland	-35858.5	72086.7	-34951.2	70425.4	-34423.2	<b>69730.1</b>
Greece	-97487.9	195399.3	-95900.0	192383.5	-94567.4	<b>190132.5</b>
Ireland	-31141.1	62687.7	-30031.2	<b>60621.1</b>	-29876.0	60707.2
Italy	-139773.0	279991.6	-135648	271909.9	-134631.0	<b>270311.7</b>
Netherlands	-80407.1	161236.4	-77579.9	155741.5	-77117.9	<b>155230.3</b>
Portugal	-94797.3	190022.1	-91489.5	183568.0	-90620.8	<b>182248.6</b>
Spain	-134550.0	269542.5	-131339.8	263289.2	-130555.0	<b>262152.3</b>

# LC Hurdle for specialists: predicted utilisation

Country	Low users			High users		
	P(Y>0)	E(Y Y>0)	E(Y)	P(Y>0)	E(Y Y>0)	E(Y)
Austria	0.423	1.774	0.753	0.860	3.911	3.393
Belgium	0.330	2.261	0.766	0.820	4.223	3.501
Denmark	0.163	1.922	0.327	0.576	3.837	2.264
Finland	0.234	1.730	0.410	0.758	2.917	2.209
Greece	0.304	2.065	0.678	0.593	5.240	3.186
Ireland	0.120	1.917	0.238	0.539	3.404	1.856
Italy	0.228	1.830	0.440	0.665	3.552	2.402
Netherlands	0.225	2.424	0.571	0.706	4.806	3.445
Portugal	0.216	2.006	0.449	0.666	3.604	2.472
Spain	0.280	2.191	0.630	0.699	4.414	3.116

# LC Hurdle for specialists: income elasticities

Country		Low users	High users
Austria	$P(Y>0)$	<b>0.110</b>	<b>0.030</b>
	$E(Y Y>0)$	0.006	<b>0.070</b>
Belgium	$P(Y>0)$	0.036	0.014
	$E(Y Y>0)$	-0.052	-0.035
Denmark	$P(Y>0)$	0.045	0.034
	$E(Y Y>0)$	-0.022	-0.050
Finland	$P(Y>0)$	<b>0.155</b>	0.041
	$E(Y Y>0)$	<b>-0.090</b>	0.014
Greece	$P(Y>0)$	<b>0.128</b>	<b>0.060</b>
	$E(Y Y>0)$	0.010	<b>0.055</b>
Ireland	$P(Y>0)$	<b>0.152</b>	<b>0.144</b>
	$E(Y Y>0)$	0.027	-0.057
Italy	$P(Y>0)$	<b>0.105</b>	<b>0.063</b>
	$E(Y Y>0)$	<b>-0.035</b>	0.000
Netherlands	$P(Y>0)$	<b>0.055</b>	-0.016
	$E(Y Y>0)$	<b>-0.129</b>	-0.006
Portugal	$P(Y>0)$	<b>0.198</b>	<b>0.099</b>
	$E(Y Y>0)$	<b>-0.045</b>	<b>0.028</b>
Spain	$P(Y>0)$	<b>0.080</b>	<b>0.042</b>
	$E(Y Y>0)$	<b>-0.033</b>	0.012

# Determinants of class membership

Variable	Portugal		Spain	
Constant	<b>-7.254</b>	(-11.328)	<b>-6.902</b>	(-9.975)
Age	<b>-0.037</b>	(-2.287)	0.004	(0.208)
Age2	0.000	(0.177)	0.000	(-2.110)
Male	<b>-1.556</b>	(-3.089)	<b>-1.586</b>	(-2.471)
Male*Age	0.021	(1.005)	0.028	(1.020)
Male*Age2	0.000	(0.038)	0.000	(-0.277)
LSAHgood			<b>0.707</b>	(4.784)
LSAHfair	<b>1.439</b>	(13.019)	<b>3.056</b>	(17.614)
LSAHbad	<b>1.787</b>	(10.444)	<b>3.721</b>	(16.300)
LHamp	<b>1.193</b>	(8.579)	<b>1.224</b>	(7.756)
ISCED7	-0.196	(-1.031)	<b>0.471</b>	(4.288)
ISCED3	<b>0.270</b>	(2.187)	<b>0.367</b>	(3.290)
Self-employed	0.098	(0.863)	-0.195	(-1.357)
Not working	<b>-0.279</b>	(-2.858)	-0.049	(-0.508)
Not married	<b>-0.348</b>	(-3.948)	<b>-0.357</b>	(-3.876)
Log(Income)	<b>0.870</b>	(14.152)	<b>0.620</b>	(9.675)
$\bar{\pi}$	0.338		0.346	

# Income elasticities of specialist use: comparison of models for 2 examples

		Hurdle	LC NegBin		LC Hurdle	
			Low	High	Low	High
Portugal	P( $Y > 0$ )	<b>0.299</b>	<i>0.041</i>	<i>0.035</i>	<b>0.198</b>	<b>0.099</b>
	E( $Y   Y > 0$ )	<b>0.055</b>	<i>0.036</i>	<i>0.075</i>	<b>-0.045</b>	<b>0.028</b>
	E( $Y$ )	<b>0.354</b>	<b>0.077</b>	<b>0.110</b>	<b>0.152</b>	<b>0.127</b>
Spain	P( $Y > 0$ )	<b>0.125</b>	<i>0.018</i>	<i>0.008</i>	<b>0.080</b>	<b>0.042</b>
	E( $Y   Y > 0$ )	<b>0.029</b>	<i>0.017</i>	<i>0.025</i>	<b>-0.033</b>	0.012
	E( $Y$ )	<b>0.155</b>	<b>0.035</b>	<b>0.033</b>	<b>0.047</b>	<b>0.054</b>

# Conclusions



- LC hurdle model outperforms hurdle and LC Negbin model on statistical criteria in most cases
- Different income effects on probability of use and conditional number of visits, especially for specialists:
  - low users are more income elastic than high users
  - probability of using health care more income elastic than conditional number of visits
  - For low users, income elasticity of conditional number of visits is often negative
  - For high users, the elasticities are nearly all positive but smaller in magnitude.

# APPENDIX



# Ongoing and possible further work



- Comparison of LC hurdle with 2 and 3 latent classes
- Possibility for future research:
  - Compute predictions of HCU according to 3 options
  - Compute HI indices using different predictions obtained
  - Assess impact of different options for predictions (i.e., of different assumptions regarding nature of individual heterogeneity)
  - Ultimately, assess whether panel data provides a different picture of inequity in health care use in Europe

# Appendix: Measurement of horizontal inequity in health care use

- Two-step approach to compute horizontal inequity:
- 1 - Predict need-expected utilisation using LCM models (setting non-need variables at their sample means):

$$\hat{y}_{it} = E[y | x_{it}^N, \bar{x}_t^{NN}] = G(x_{it}^N, \bar{x}_t^{NN})$$

- 2 – HI index computed as the difference between CI of actual utilisation and CI of predicted utilisation  $\hat{y}$
- Non-linear model: HI index depends on values used for non-need variables  
=> non-need effects not completely neutralised
- Additionally, prediction using LCM is not straightforward

# Measurement of horizontal inequity in health care use: prediction of use with LCM



- 3 options:
  - 1&2 within model with constant class membership probabilities
  - Option 3 within model with  $\pi_{ij}$  defined as functions of covariates
- Different assumptions regarding *need/non-need* nature of unobserved individual heterogeneity
- Key assumption: predicted use varies only with need factors → equal treatment for equal need

# Measurement of horizontal inequity in health care use: prediction of use with LCM

- **Option 1** ( $\pi_{jj} = \pi_j, j = 1, \dots, C$ ):

$$\hat{y}_{it} = \sum_j^C \pi_j E_j [y_{it} | x_{it}^N, \bar{x}_t^{NN}]$$

- Same observed need  $x_{it}^N \Rightarrow$  same pred. use (regardless of latent class)
- Individual heterogeneity treated as *non-need* (similarly to Van Ourti, 2004)

- **Option 2** ( $\pi_{jj} = \pi_j, j = 1, \dots, C$ ) - predict latent class  $j^*$ , then:

$$\hat{y}_{it} = E_{j^*} [y_{it} | x_{it}^N, \bar{x}_t^{NN}]$$

- Same observed need  $x_{it}^N \Rightarrow$  dif. pred. use for dif. pred. latent classes
- Individual heterogeneity treated as *need*

# Measurement of horizontal inequity in health care use: prediction of use with LCM

- **Option 3** – class membership depends on covariates (need & non-need):

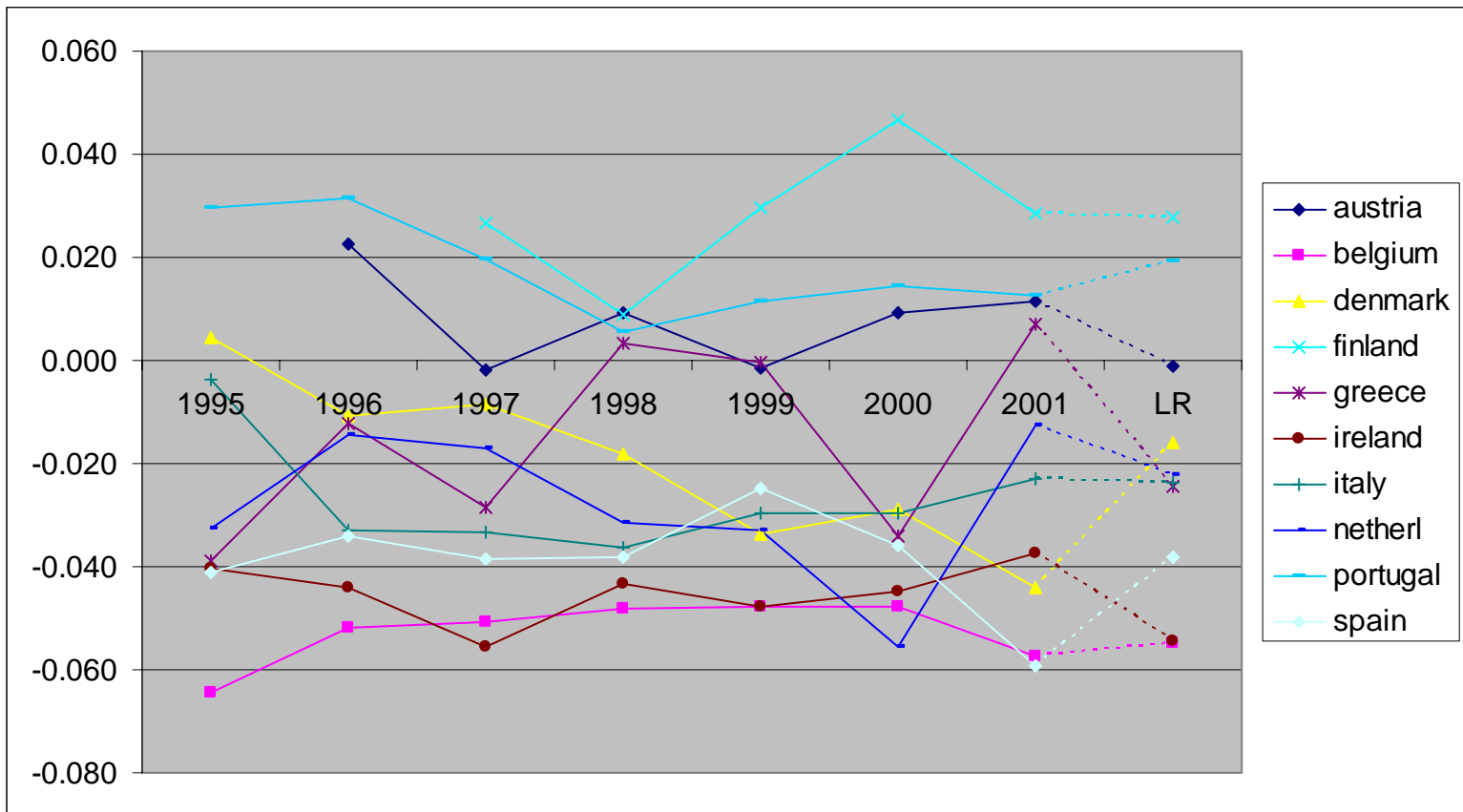
$$\pi_j(z_i) = \pi_j(z_i^N, \bar{z}_i^{NN})$$

- Individual heterogeneity can be related to *need* and *non-need* factors
- Predict use:

$$\hat{y}_{it} = \sum_j^C \hat{\pi}_j(z_i^N, \bar{z}_i^{NN}) E_j[y_{it} | x_{it}^N, \bar{x}_t^{NN}]$$

- Variation in  $\pi_{ij}$  - legitimate only if related to need
- Same obs. need => same pred.  $\pi_{ij}$  & same pred. use conditional on class
- Thus, same obs. need => same pred. use
- Some unexplained variation: treated as *non-need*

# HI for GPs



# HI for Specialists

