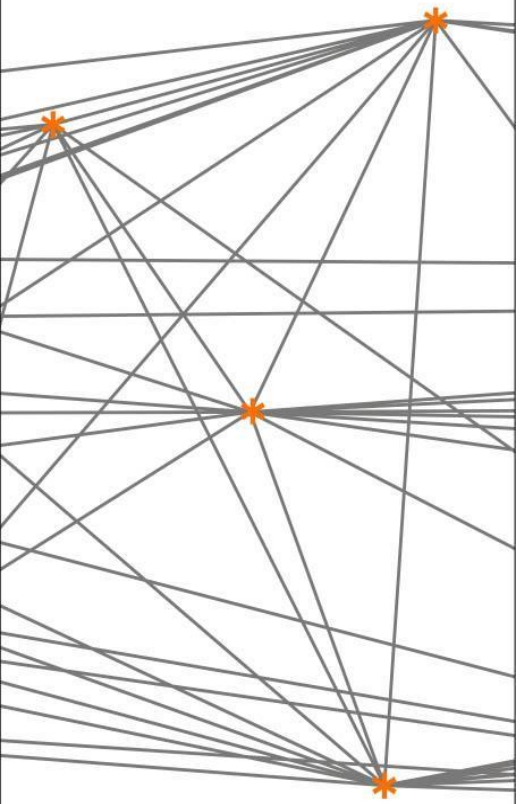
SHARE
Survey of Health, Ageing and Retirement in Europe



Centre for Statistical Methodology - LSHTM

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Cross-national differences in older adults physical functioning: results from HRS, ELSA and SHARE studies on ageing

Omar Paccagnella[1], Giovanna Boccuzzo[1], Paola Zaninotto[2]

[1] University of Padua (IT)

[2] University College London (UK)

SIXTH FRAMEWORK PROGRAMME

SEVENTH FRAMEWORK PROGRAMME

Introduction

Disability is a difficult concept to define and measure:

- it has a multidimensional structure
- its measurement in practice is quite complicated.

General measures of health status (i.e. diagnoses or medical conditions) are limited indicators of individual independence and functional capabilities.

The ADL (Activities of Daily Living) and IADL (Instrumental Activities of Daily Living) limitations are increasingly being used to measure disability, particularly for older people…

Introduction

There is a wide literature that documents a large cross-country heterogeneity in health and longevity at older ages

(e.g. National Research Council materials)

However, the reasons behind these observed divergent trends are only partly explained so far…

Aims of this work

This paper aims at:

- exploring and comparing the presence and severity of physical functioning among older adults living in England, United States and mainland Europe
- seeking to explain country differences

Approaches

How can we analyse cross-country differences ?

- The variable of interest
- The model of the analysis
- The set of variables

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How can we analyse cross-country differences ?

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  Presence and/or severity of ADLs?

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  Separated and/or joint analyses?

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Approaches

How can we analyse cross-country differences ?

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  Presence and/or severity of ADLs?

- The model of the analysis

  Separated and/or joint analyses?

- The set of variables

  Individual and/or contextual variables?

The data

Three “sister” studies on ageing (50+)…

- SHARE – Survey of Health and Retirement in Europe
- ELSA – English Longitudinal Study of Ageing
- HRS – Health and Retirement Study

For each study, data were collected in 2006

The data

A large set of information (harmonisation issues…)

- Outcome:

  ADLs – limitations with Activities of Daily Living

- Covariates:

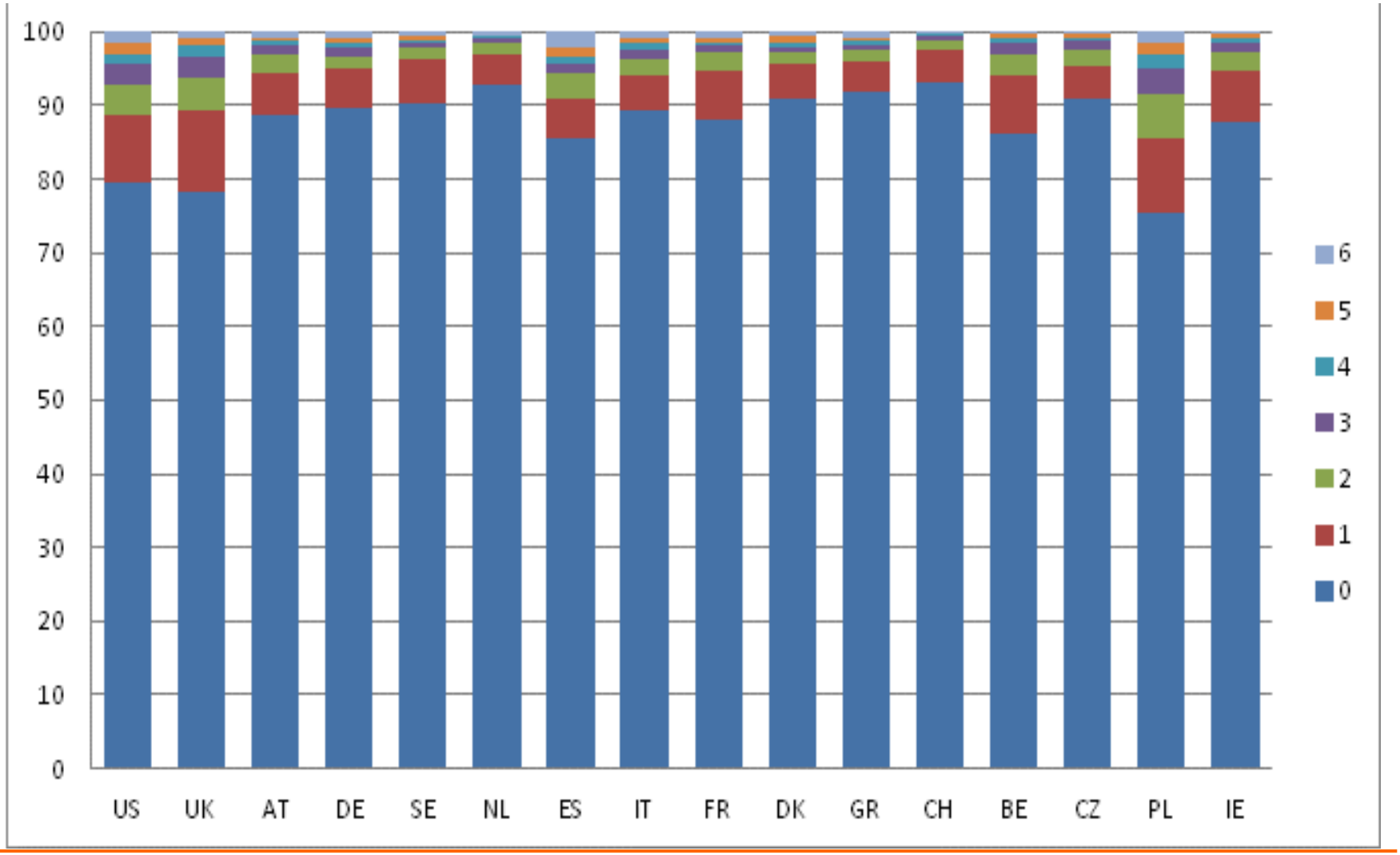
  Demographic: gender, age, household size

  Health status: BMI, chronic conditions (diabetes, high blood pressure, cancer, etc.), cognitive abilities (10 words test)

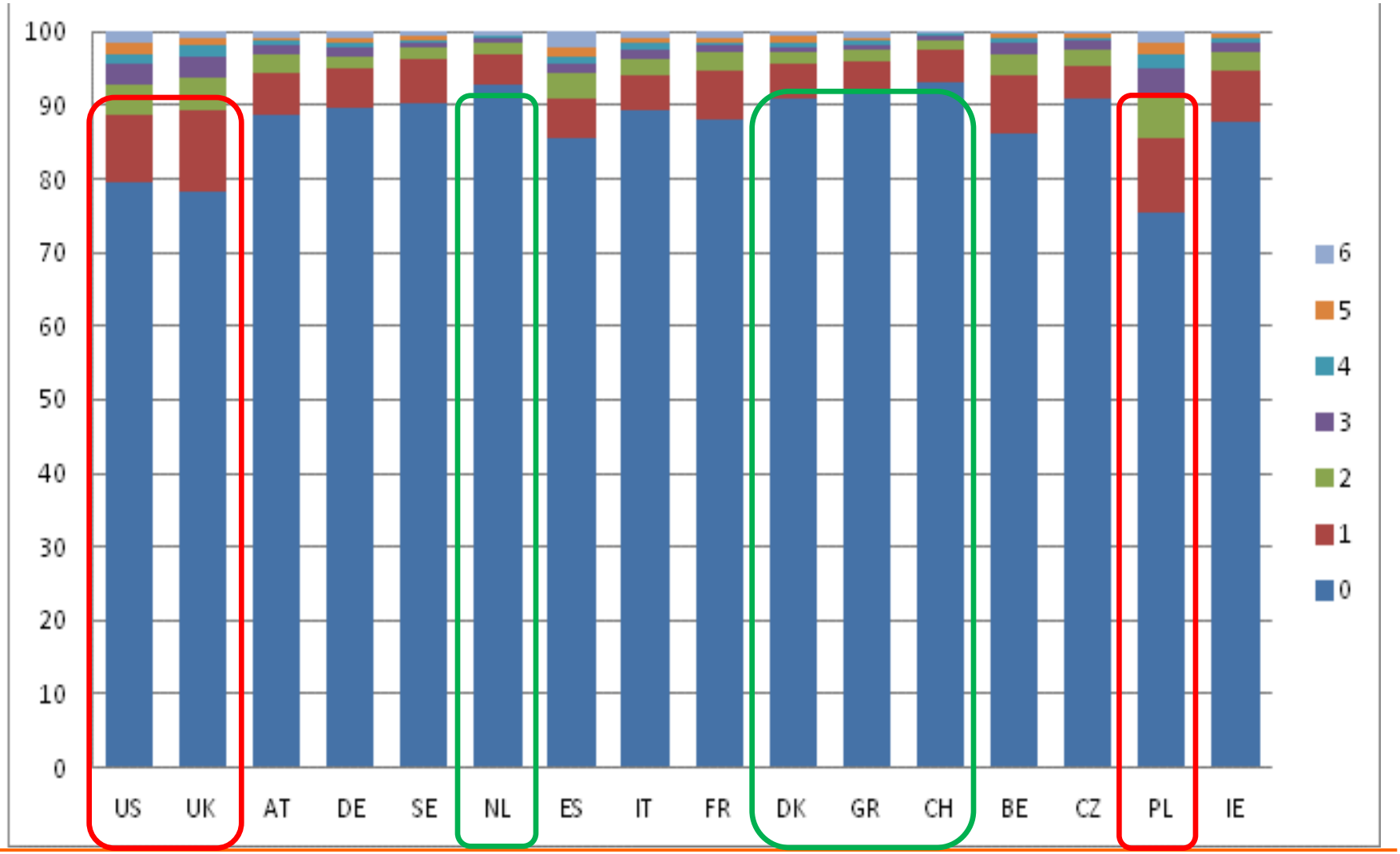
  Risk behaviour: alcohol, smoking

  SES: education, occupation, income, wealth, house ownership

The evidence – number of ADLs

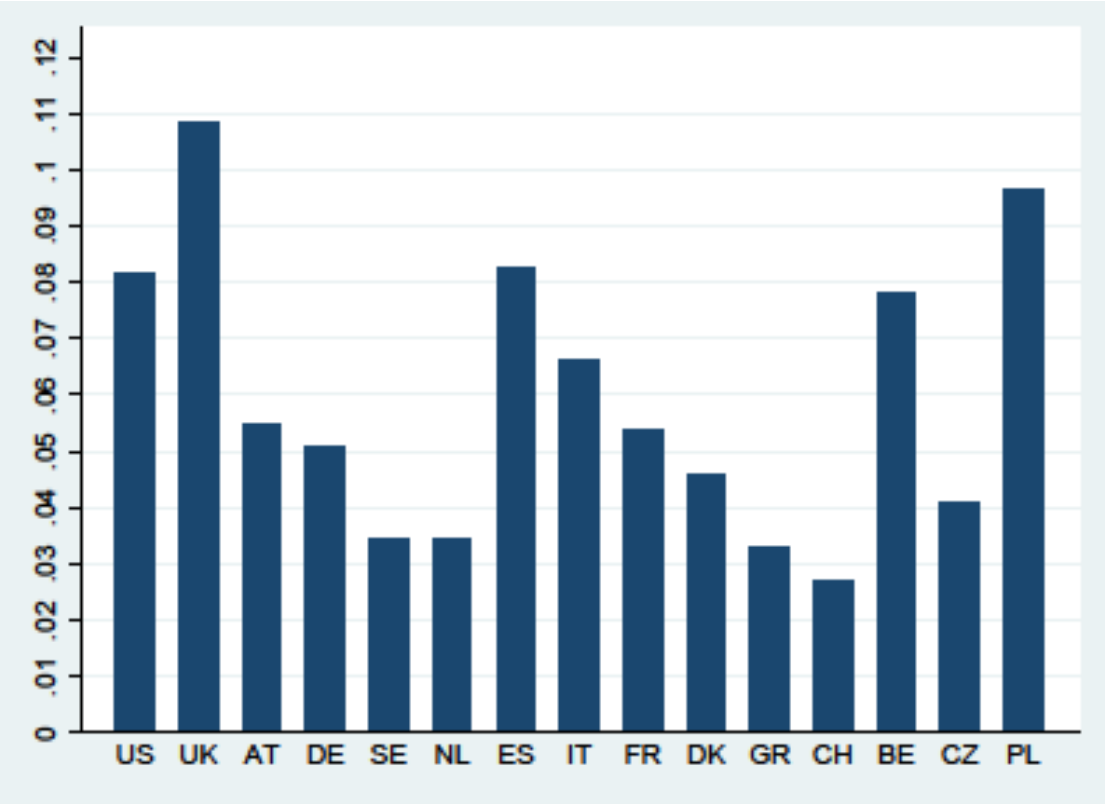


The evidence – number of ADLs

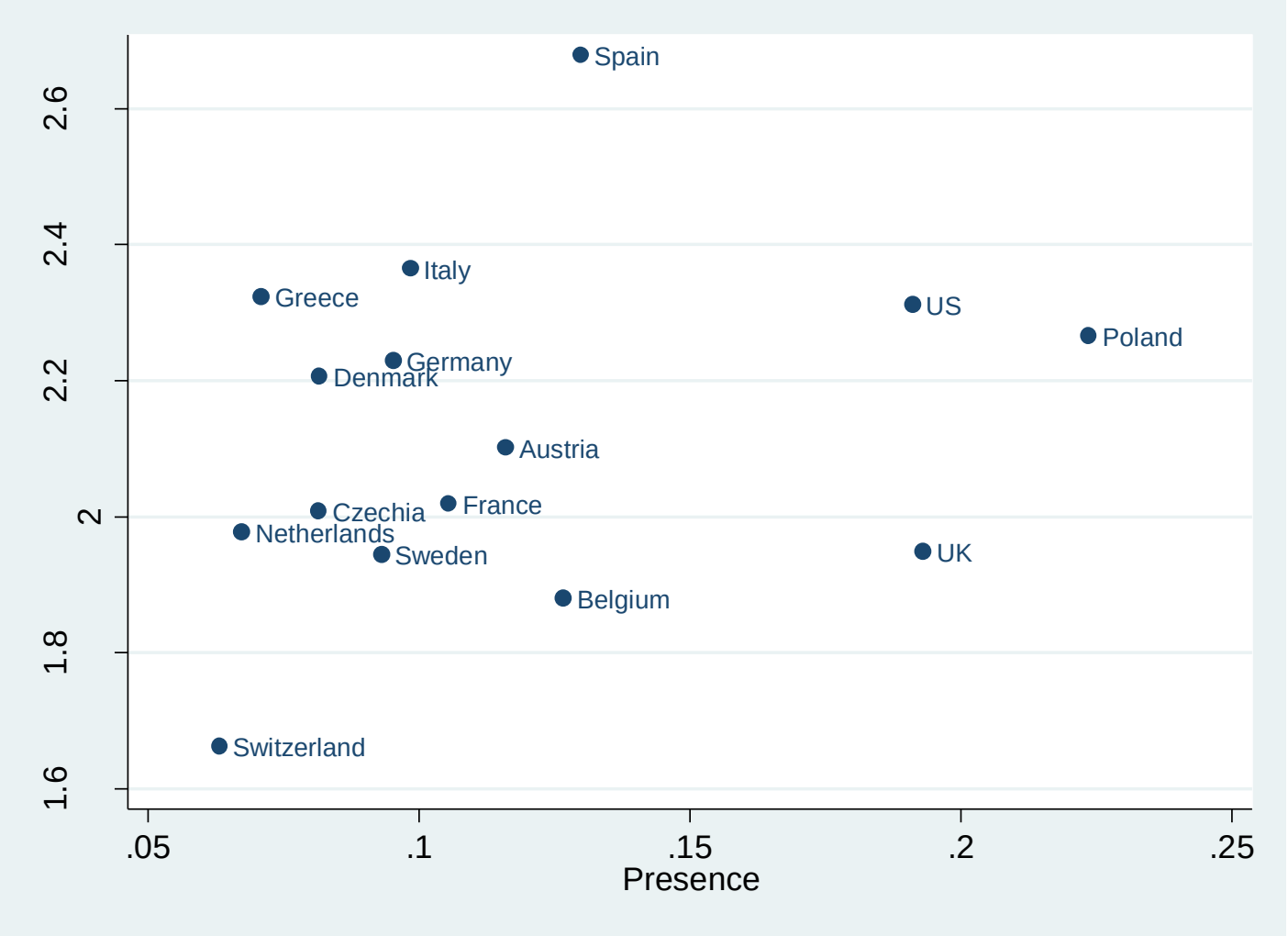


The evidence – number of ADLs

Distribution of 1 ADL ("difficulty dressing, including putting on shoes and socks") across countries



The evidence – number of ADLs



The evidence – number of ADLs

More than ¾ of the sample state no limitation, with %s even larger than 90% in some countries.

Analysing only those respondents who report at least 1 limitation could lead to biased results because **unobserved factors affecting** severity of limitation and presence/onset of any limitation in the whole sample may be correlated

Approaches

How can we analyse cross-country differences ?

- The variable of interest

  Presence AND severity of ADLs !

- The model of the analysis

- The set of variables

A different approach

In order to obtain consistent estimations, the statistical solution adopted for this analysis is based on the idea of Heckman's models for treating **sample selection bias**

The model can be written in terms of a system of equations for two latent responses:

- the first analyses the presence of at least 1 limitation through a probit model;
- the second investigates the severity of the limitations, among those respondents who are limited, by means of an ordinal probit model

A different approach

$$ADL_i^* = W_i\delta + \eta_i$$

$$ADL_i = \begin{cases} 1 & ADL_i^* > 0 \\ 0 & otherwise \end{cases}$$

$$\#ADL_i^* = X_i\beta + \varepsilon_i$$

$$\#ADL_i = \begin{cases} 1 & if \quad -\infty < \#ADL_i^* \leq \tau_1 \\ 2 & if \quad \tau_1 < \#ADL_i^* \leq \tau_2 \\ \vdots & \vdots \quad\quad\quad \vdots \\ H & if \quad \tau_{H-1} < \#ADL_i^* \leq \infty \end{cases}$$

A different approach

A bivariate normal distribution is assumed for η_i and ε_i. In order to induce dependence between these error terms, a shared random effect (ω_i) is introduced

$$\varepsilon_i = \lambda\omega_i + \nu_i$$
$$\eta_i = \omega_i + \zeta_i$$

$$\omega_i, \nu_i, \zeta_i \quad iid \; N(0,1)$$

and λ is a free parameter (a 'factor loading')

A different approach

The correlation between these two error terms is then

$$\rho = \frac{\lambda}{\sqrt{2\left(\lambda^2 + 1\right)}}$$

- A simple likelihood ratio test can be used to test the null hypothesis that correlation among these two components is null (i.e. $\rho = 0$)
- If $\rho = 0$, consistent estimates of the parameters of interest are obtained by estimating the severity of the limitation through a standard ordered model

A different approach

Computation complications due to the fact that the variable of interest is ordinal and not continuous.

The researcher needs to fit the data by a non-linear model.

Standard solutions (i.e. Heckman's two-steps methodology) are no longer applicable without assuming some forms of approximations and the estimator distributions are no longer available

A different approach

A Maximum Likelihood approach is therefore the suggested estimation method.

To this aim, a STATA ”wrapper” program (*ssm*) has been recently introduced by Miranda and Rabe-Hesketh (2006).

This wrapper program calls STATA *gllamm* (Generalized Linear Latent and Mixed Models) to fit the model, using the Adaptive Quadrature solution to approximate the likelihood

A different approach

Even if no exclusion restrictions are needed
to identify the model,
it is a good practice to specify at least
one exclusion restriction

In our model, we use as exclusion restriction
the variable “poor eye”, which is equal to 1
in the presence of poor eyesight reading either
closed or at distance

A different approach

This model may be estimated also by the *heckoprobit* STATA command, but:

- The *heckoprobit* command does not converge in some circumstances, while the *ssm* procedure does.
- The *heckoprobit* command is not able to calculate post-estimation residuals, while the “shared random effect” solution of the *ssm* procedure suggests a way to obtain estimates of the residuals from the severity equation

A different approach

Our model has been estimated sequentially adding one group of covariates (demo / health / risk behaviour / SES)

By means of the 'post-estimation' command *gllapred*, *gllamm* may calculate posterior means of the latent variable defined to introduce the shared random effect

Posterior means are then exploited to produce estimates of the residuals (from each equation) through standard calculations of residuals from probit and ordered probit modelling

A different approach

Residual estimates are then regressed on all country dummies (US as the reference category)

Country-specific and joint significance testing on the estimated coefficients are then performed

The same approach has been done after the estimation of a standard ordered probit model to compare results for the severity equation of our model

Approaches

How can we analyse cross-country differences ?

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  Presence AND severity of ADLs!

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  Joint analyses!

- The set of variables

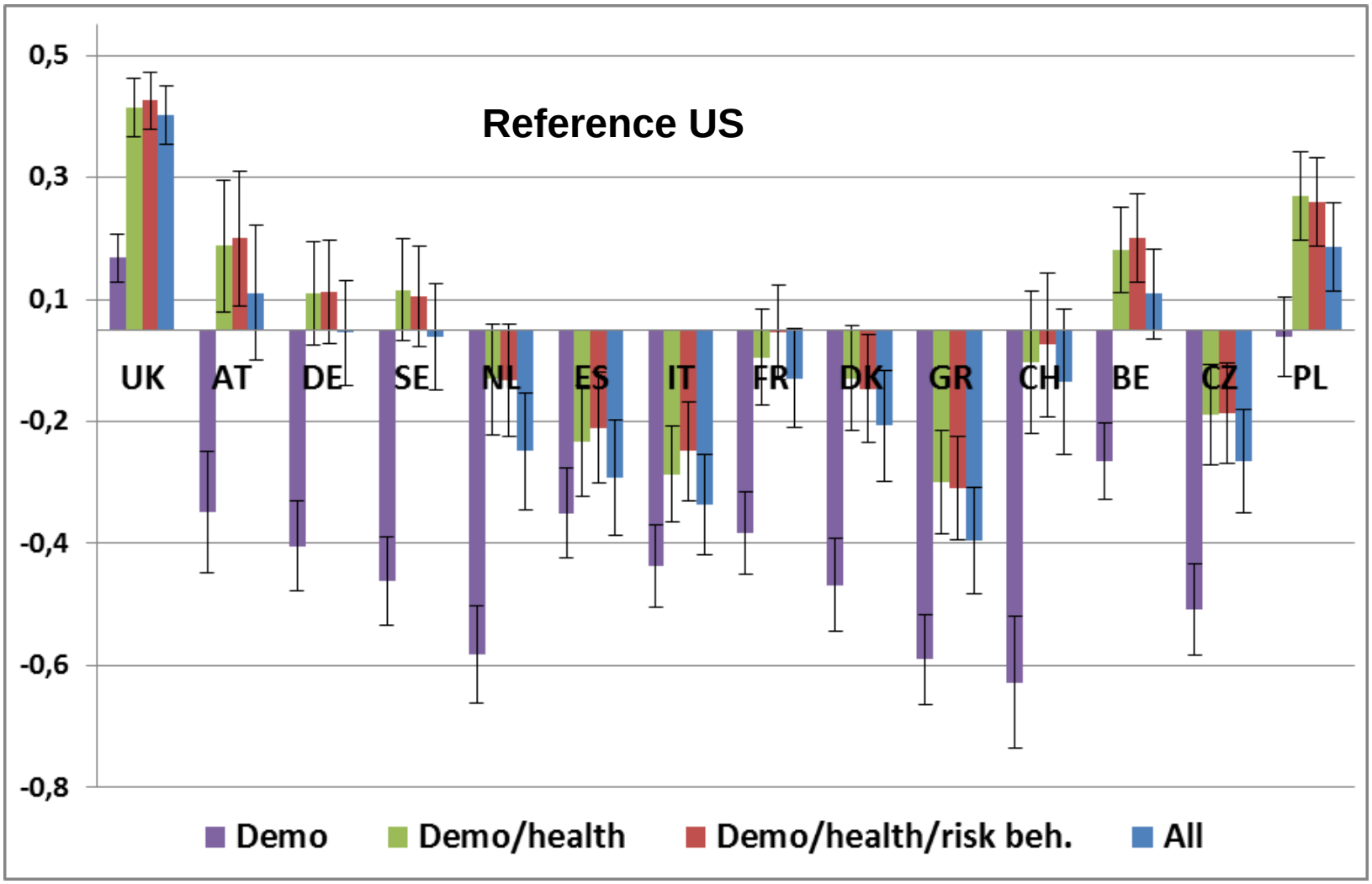
Main results

In our (full) model ALL conditions (except education and hh size) are important predictors of the presence or not of ADLs

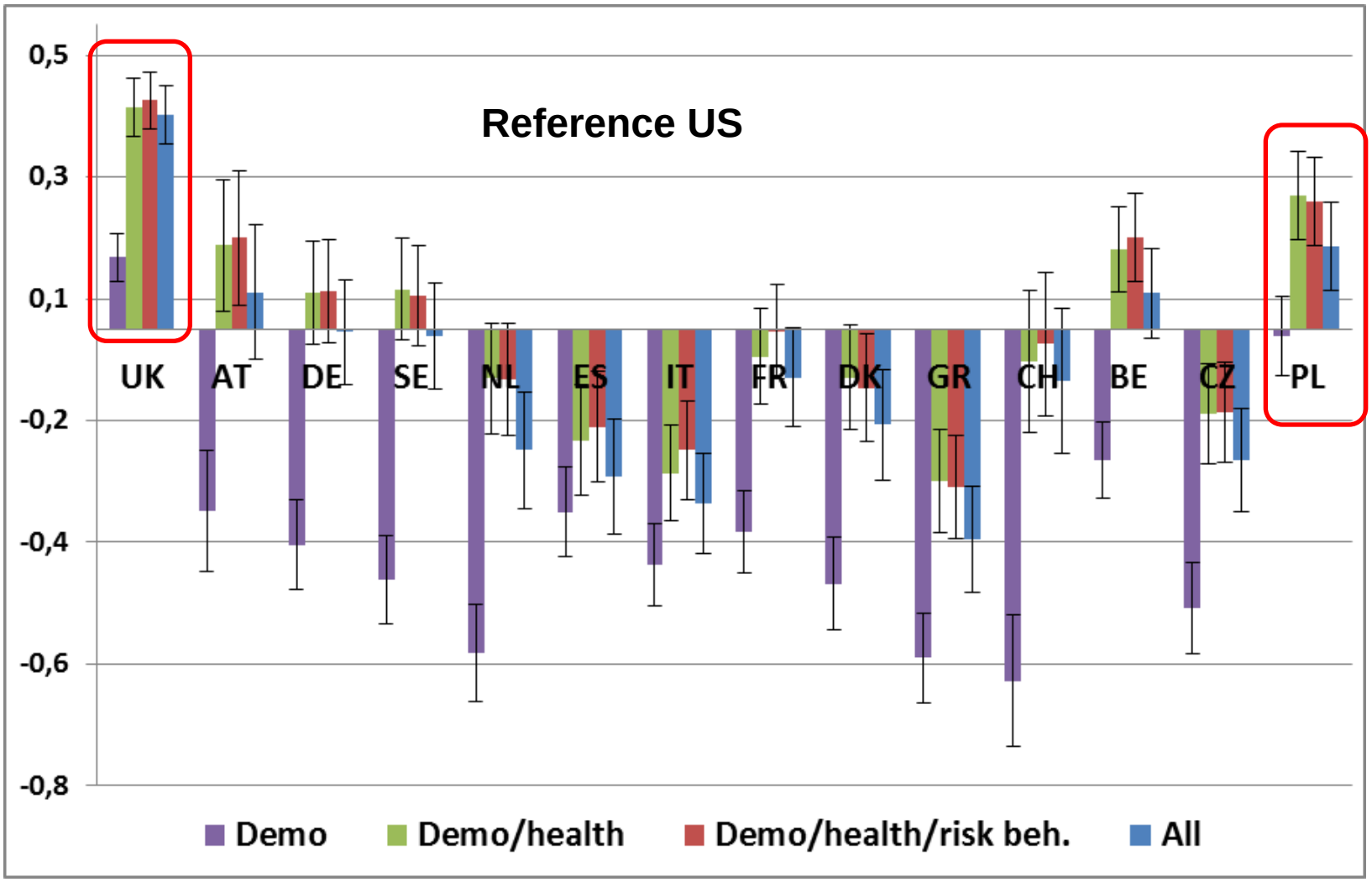
While, given the presence of ADLs, this is no longer true for the severity, in particular chronic conditions and demo variables.

In the standard ordered modelling, chronic conditions and demo variables are more important than in our approach.

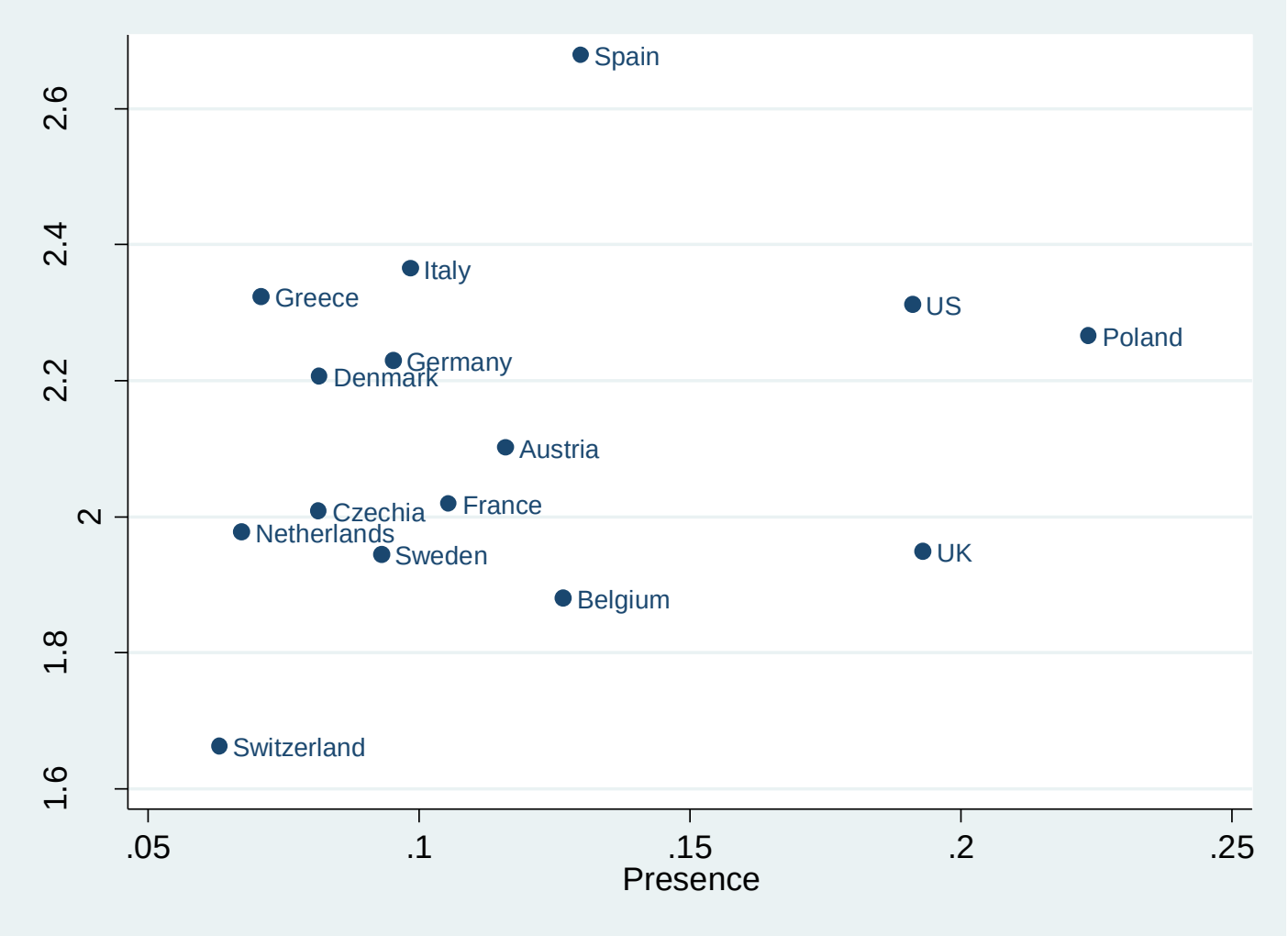
Main results: Presence of ADLs



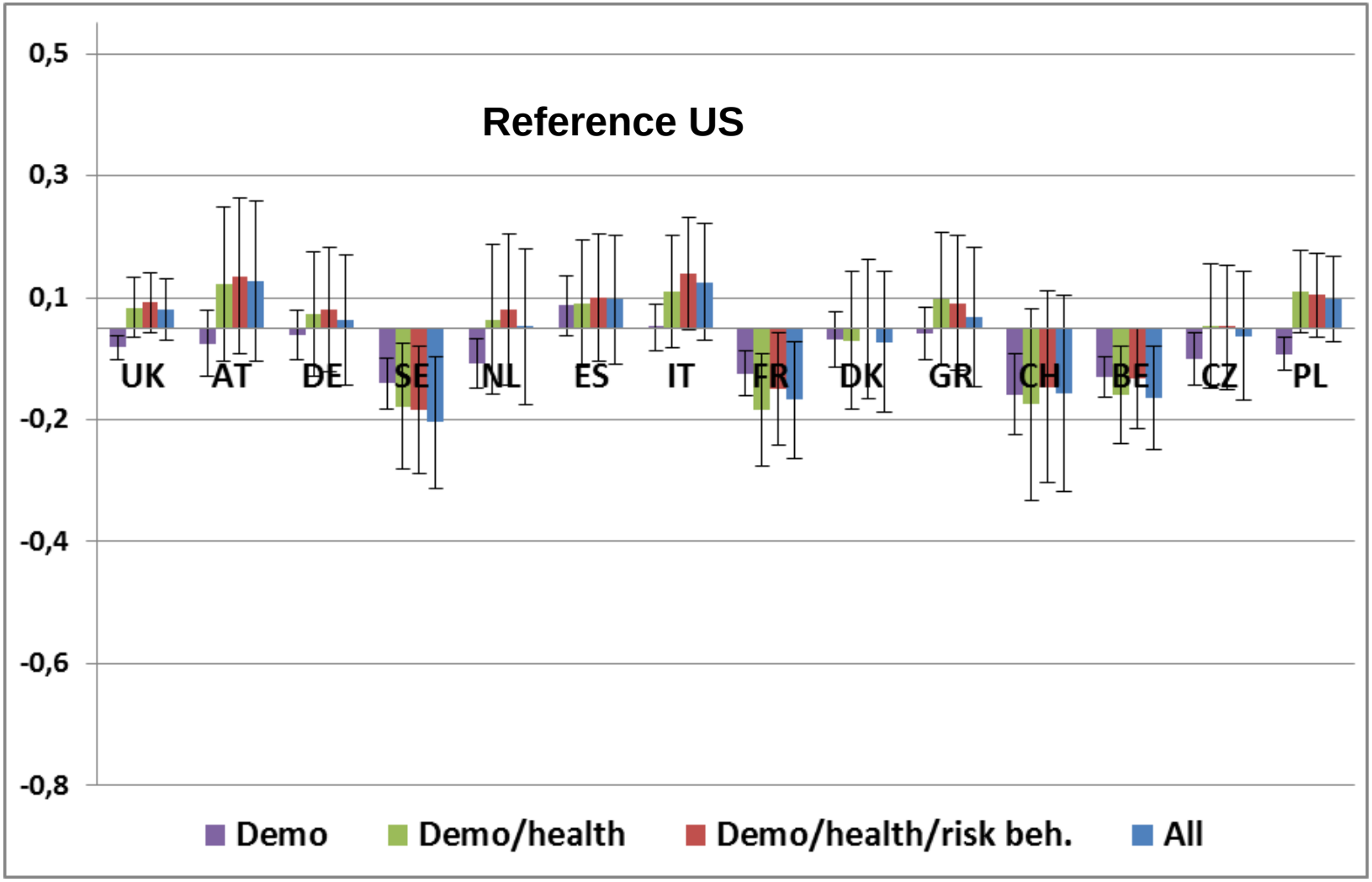
Main results: Presence of ADLs



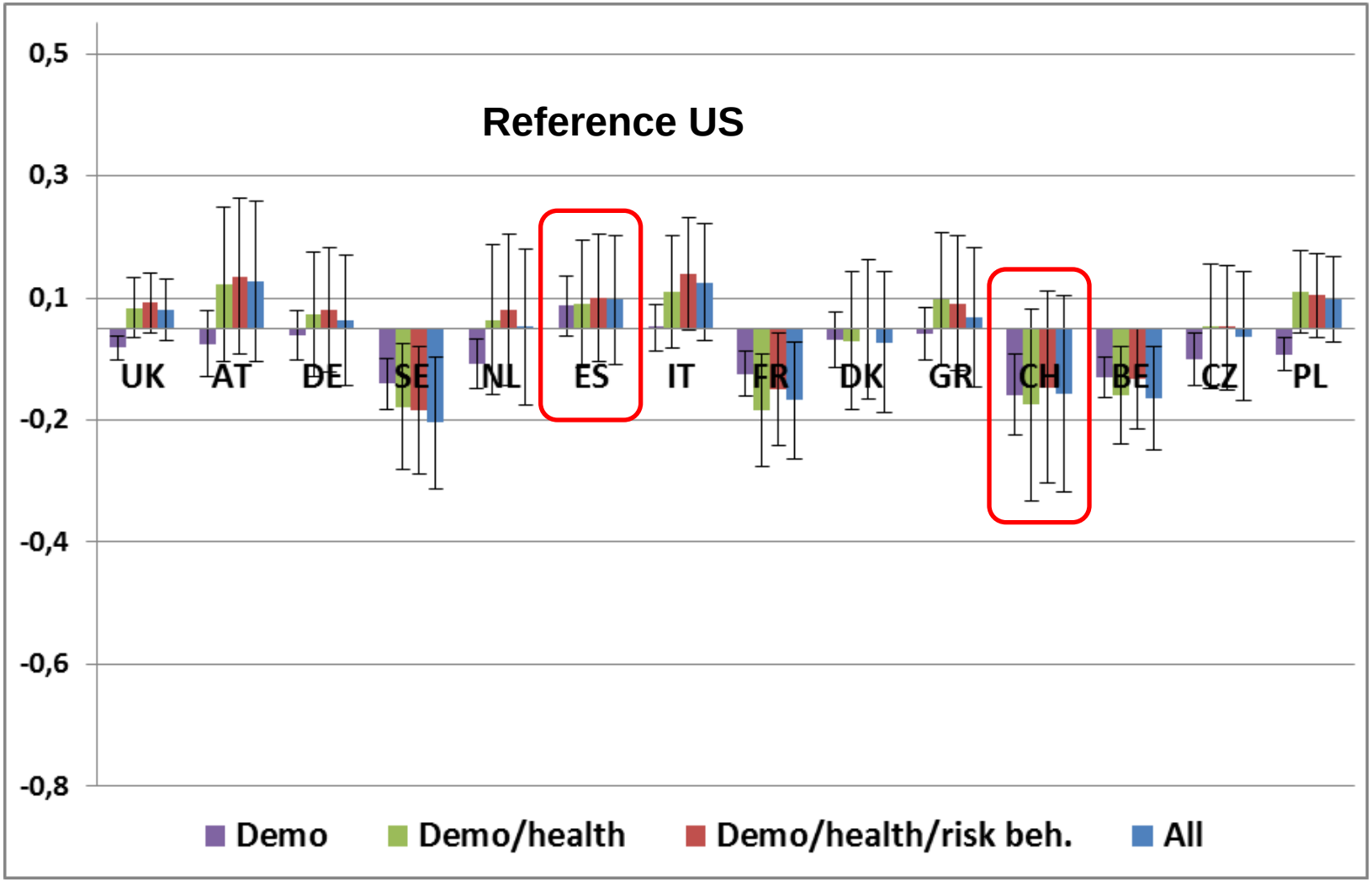
The evidence – number of ADLs



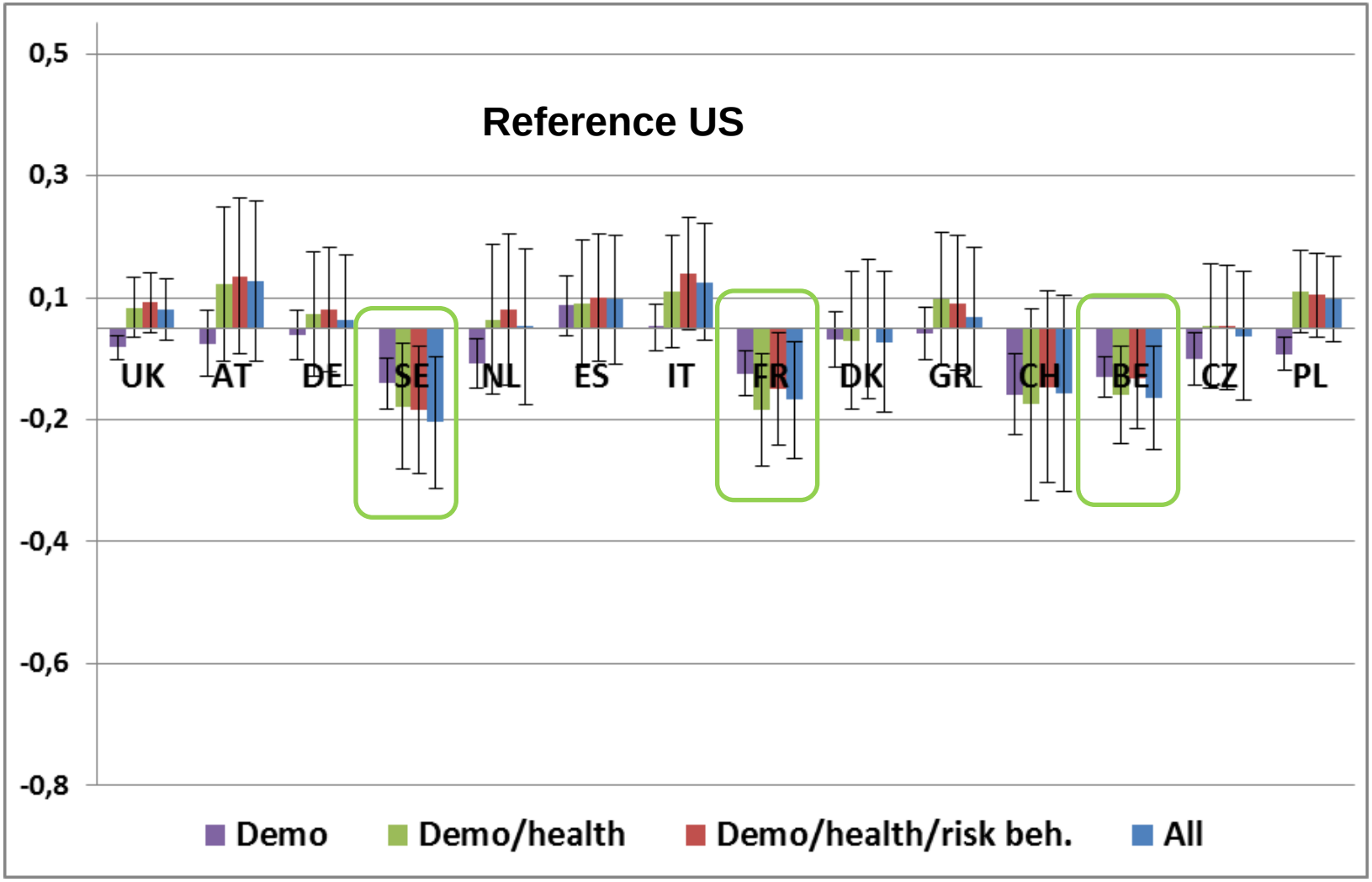
Main results: Severity of ADLs



Main results: Severity of ADLs



Main results: Severity of ADLs



Main results

Demographic

5% level

10% level

Does F-test reject joint significance?

Main results

Demographic
Ordered Probit
UK
AT
DE
SE
NL
ES
IT
FR
DK
GR
CH
BE
CZ
PL
Does F-test reject joint significance?
YES

5% level

10% level

Main results

Demographic	
Ordered Probit	Our approach
UK	UK
AT	AT
DE	DE
SE	SE
NL	NL
ES	ES
IT	IT
FR	FR
DK	DK
GR	GR
CH	CH
BE	BE
CZ	CZ
PL	PL
Does F-test reject joint significance?	
YES	YES

5% level

10% level

Main results

Demographic		Demo & health
Ordered Probit	Our approach	Ordered Probit
UK	UK	UK
AT	AT	AT
DE	DE	DE
SE	SE	SE
NL	NL	NL
ES	ES	ES
IT	IT	IT
FR	FR	FR
DK	DK	DK
GR	GR	GR
CH	CH	CH
BE	BE	BE
CZ	CZ	CZ
PL	PL	PL
Does F-test reject joint significance?		
YES	YES	YES

5% level

10% level

Main results

Demographic		Demo & health	
Ordered Probit	Our approach	Ordered Probit	Our approach
UK	UK	UK	UK
AT	AT	AT	AT
DE	DE	DE	DE
SE	SE	SE	SE
NL	NL	NL	NL
ES	ES	ES	ES
IT	IT	IT	IT
FR	FR	FR	FR
DK	DK	DK	DK
GR	GR	GR	GR
CH	CH	CH	CH
BE	BE	BE	BE
CZ	CZ	CZ	CZ
PL	PL	PL	PL
Does F-test reject joint significance?			
YES	YES	YES	YES

5% level

10% level

Main results

Demographic		Demo & health		Demo, health & risk behaviour
Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit
UK	UK	UK	UK	UK
AT	AT	AT	AT	AT
DE	DE	DE	DE	DE
SE	SE	SE	SE	SE
NL	NL	NL	NL	NL
ES	ES	ES	ES	ES
IT	IT	IT	IT	IT
FR	FR	FR	FR	FR
DK	DK	DK	DK	DK
GR	GR	GR	GR	GR
CH	CH	CH	CH	CH
BE	BE	BE	BE	BE
CZ	CZ	CZ	CZ	CZ
PL	PL	PL	PL	PL
Does F-test reject joint significance?				
YES	YES	YES	YES	YES

5% level

10% level

Main results

Demographic		Demo & health		Demo, health & risk behaviour	
Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit	Our approach
UK	UK	UK	UK	UK	UK
AT	AT	AT	AT	AT	AT
DE	DE	DE	DE	DE	DE
SE	SE	SE	SE	SE	SE
NL	NL	NL	NL	NL	NL
ES	ES	ES	ES	ES	ES
IT	IT	IT	IT	IT	IT
FR	FR	FR	FR	FR	FR
DK	DK	DK	DK	DK	DK
GR	GR	GR	GR	GR	GR
CH	CH	CH	CH	CH	CH
BE	BE	BE	BE	BE	BE
CZ	CZ	CZ	CZ	CZ	CZ
PL	PL	PL	PL	PL	PL
Does F-test reject joint significance?					
YES	YES	YES	YES	YES	YES

5% level

10% level

Main results

Demographic		Demo & health		Demo, health & risk behaviour		Demo, health, risk beh. & SES
Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit
UK	UK	UK	UK	UK	UK	UK
AT	AT	AT	AT	AT	AT	AT
DE	DE	DE	DE	DE	DE	DE
SE	SE	SE	SE	SE	SE	SE
NL	NL	NL	NL	NL	NL	NL
ES	ES	ES	ES	ES	ES	ES
IT	IT	IT	IT	IT	IT	IT
FR	FR	FR	FR	FR	FR	FR
DK	DK	DK	DK	DK	DK	DK
GR	GR	GR	GR	GR	GR	GR
CH	CH	CH	CH	CH	CH	CH
BE	BE	BE	BE	BE	BE	BE
CZ	CZ	CZ	CZ	CZ	CZ	CZ
PL	PL	PL	PL	PL	PL	PL
Does F-test reject joint significance?						
YES	YES	YES	YES	YES	YES	YES

5% level

10% level

Main results

Demographic		Demo & health		Demo, health & risk behaviour		Demo, health, risk beh. & SES	
Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit	Our approach	Ordered Probit	Our approach
UK	UK	UK	UK	UK	UK	UK	UK
AT	AT	AT	AT	AT	AT	AT	AT
DE	DE	DE	DE	DE	DE	DE	DE
SE	SE	SE	SE	SE	SE	SE	SE
NL	NL	NL	NL	NL	NL	NL	NL
ES	ES	ES	ES	ES	ES	ES	ES
IT	IT	IT	IT	IT	IT	IT	IT
FR	FR	FR	FR	FR	FR	FR	FR
DK	DK	DK	DK	DK	DK	DK	DK
GR	GR	GR	GR	GR	GR	GR	GR
CH	CH	CH	CH	CH	CH	CH	CH
BE	BE	BE	BE	BE	BE	BE	BE
CZ	CZ	CZ	CZ	CZ	CZ	CZ	CZ
PL	PL	PL	PL	PL	PL	PL	PL
Does F-test reject joint significance?							
YES	YES	YES	YES	YES	YES	YES	YES

5% level

10% level

Main results

Ordered probit or sample selection modelling ?

In all *ssm* models, the likelihood-ratio test on ρ strongly rejects the null hypothesis, meaning that:

- Unobservable components affecting the onset of a limitation are correlated with unobservable factors influencing the severity of such limitation
- All estimates of ρ are negative: cross-country heterogeneity in defining some disabilities?
- A model that accounts for sample selection is required to obtain consistent estimates of the parameters of interest

Main results

There are still some unexplained differences across a few countries

- Do we miss other important **individual** variables (social networks / life history information) ?

- Are country dummies not enough to capture all cross-country heterogeneity?

An improved model

Social policy contexts differ between US and Europe
and it has been hypothesized that
contextual factors may have causal effects
in producing the observed health discrepancies

Can these be included in the analysis?

An improved model

We improve the models that account for the presence of any ADL by excluding country dummies and including (country) contextual variables (source: OECD statistics database)

- Total expenditures on health (as % of GDP)
- Long-term interest rates
- Consumer Price Indices

  (% change from previous year)

An improved model

- Analysing the presence of any limitation, ALL contextual variables are statistically significant.
- Analysing the severity of the limitations, the role of the contextual variables is weaker.
- According to our approach, the interest rate variable is not significant and the country health expenditures is significant at 10% of level
- According to the standard ordered approach the interest rate is the only variable significant at 1% of level.

An improved model

In our model:

- The ρ estimate is still negative and statistically significant

- Overall, the larger the number of variables, the lower the ρ estimate (from -0.48 to -0.40 in this extended model)

An improved model

- For the severity of the ADL limitations, even if few country dummy estimates are still statistically significant at 5% of level, the F-test for the joint significance of all estimated dummies does not reject the null hypothesis (P-value > 10%)

- For the presence of any ADL, several country dummy estimates are still statistically and the F-test for the joint significance rejects the null hypothesis

Approaches

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  Joint analyses!

- The set of variables

  Individual AND contextual variables!

Concluding remarks

We proposed different approaches, in terms of the statistical method and the variables,
to investigate and explain cross-country heterogeneity in physical functioning at older ages,

Results are so far encouraging, showing some important improvements with respect to standard solutions, i.e. probit and ordered probit approaches.

Concluding remarks

Our findings show that it is important
to **jointly** analyse
the presence **and** the severity of the ADL limitations

Presence and Severity of ADLs have different meanings…

Concluding remarks

Using a large set of individual variables &
a reduced number of contextual variables,
our approach explains
the cross-country heterogeneity
in the severity of ADL limitations at older ages.

Using the same set of individual & contextual variables
the cross-country heterogeneity
in the presence of any ADL limitation is still present.

Open questions

- Are there other contextual variables that are able to explain cross-country heterogeneity investigating the presence of any ADL limitations?

- Are we able to quantify the “contribution” of each group of covariates in explaining the “variability” of the variable of interest ?

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Thank you !

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