

Asset ownership of the elderly across Europe: A multilevel latent class analysis to segment country and households

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Abstract Wealth is an useful measure of the socio-economic status of the elderly, because it might reflect both accumulated socio-economic position and potential for current consumption. A growing number of papers have studied household portfolio in old age, both from a financial point of view (i.e. in the framework of the life-cycle model) and from a marketing perspective. In this paper, we aim at providing new evidence on this issue both at the household and country level, by investigating similarities and differences in the ownership patterns of several financial and real assets among elderly in Europe. To do so, we exploit the richness of information provided by SHARE (Survey of Health, Ageing and Retirement in Europe), an international survey on ageing that collects detailed information on several aspects of the socio-economic condition of the European elderly. Given the hierarchical structure of the data, the econometric solution we adopt is a multilevel latent class analysis, which allows to obtain simultaneously country and household segments.

Key words: Ageing, latent class analysis, multilevel data analysis, segmentation

1 Introduction

International segmentation aims at structuring heterogeneity that exists among countries and units (individuals, firms, etc.) in order to identify relatively homogeneous groups of countries and/or units ([14]). The ongoing political process of European unification, the introduction of the Euro currency and new developments in infor-

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mation and communication technology have contributed to create a potential large single market, the European Union. By treating the different member states as a unique market can lead to plan some attractive (because of economies of scale) unified marketing strategies. Nevertheless, the identification of substantial differences among countries (because of differences in economic structures, cultural identities or regulations) might support the use of multi-domestic or multi-regional policies.

The segmentation of the European market has been widely investigated over the last decade. An interesting review is provided by [9]. Mixed evidence arises from these studies, in terms of presence (or not) of cross-country segments, and the number and composition of such segments. However, most of these works investigate country and consumer segmentation sequentially, that is countries are screened at a first stage and grouping is usually based on macro characteristic analyses. Few studies determine country segments and cross-national segments simultaneously ([1]).

The identification of homogenous segments can be helpful under different points of view. On the one hand, the revealed structure helps companies to develop and implement international marketing strategies ([12]); on the other hand, the findings can support the researches on the household life-cycle effects within the financial market ([5]). In this framework, it is of particular interest the study of portfolio holdings of the elderly. The elderly control, as a group, a substantial fraction of the household wealth, therefore their choices in investments or savings might affect the future course of the markets. However, despite their substantial wealth, the majority of elderly has restricted portfolio holdings and does not invest in risky financial assets ([7]). Furthermore, there is evidence of a large heterogeneity in household portfolio ownership within and across European countries ([3], [4]). The study of the portfolio choice made by old people is therefore important for policymakers, scientific researchers and marketing managers.

This paper aims at shedding more light on the behaviour of households across Europe by investigating similarities and differences in the ownership patterns of many financial and real assets. To this aim, we use data from SHARE (Survey of Health, Ageing and Retirement in Europe). This is an international survey on ageing, that collects detailed information on several aspects that characterize the socio-economic condition of the European elderly ([2]). Our approach is the multilevel Latent Class (LC) analysis introduced by [13], that allows to obtain simultaneously country and household segments. As all multilevel models, this approach takes into account the dependencies between lower-level units resulting from the hierarchical data structure (households nested into countries). As a LC model, one of its typical application is clustering or constructing typologies with observed variables. Hence, applications of multilevel LC models typically aim at simultaneously clustering individuals and groups: lower-level units are assumed to belong to lower-level LCs differing in the distribution of the observed responses; higher-level units are assumed to belong to higher-level LCs differing in the distribution of the lower-level LCs.

The remainder of the paper is organized as follows. Section 2 briefly introduces the data used in this work, while Section 3 describes our econometric approach. Results of the empirical applications are reported and commented in Section 4. Section 5 ends the paper, drawing some comments on the basis of our findings.

2 Data

In this paper we use data from the 2006-2007 wave of the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is an interdisciplinary survey on ageing that is run every two years and collects extensive information on health, socio-economic status and family interactions of individuals aged 50 and over in a host of European countries. Even though data are collected at the individual level, for the purposes of our analysis we consider data at the household level. Within couples, the eligible reference person (“head”) is chosen as the elder partner, or the female when partners have the same age.

Overall, our sample contains 23238 households living in 14 countries (Sweden, Denmark, Ireland, Germany, The Netherlands, Belgium, France, Switzerland, Austria, Spain, Italy, Greece, Poland and Czech Republic). Heads are prevalently females (55%) and 65 years old on average. Almost half of them have low or no education and about 65% of them lives with a partner. More than 50% are retired from work. The financial and real asset information available in the dataset is the ownership of the following set of products: bank or postal accounts; bonds; stocks; mutual funds; individual retirement accounts (IRAs); life insurance; house; mortgage; other real estate. There is evidence of large variations in the ownership across products and across countries. On the one hand, almost 3/4 of the overall households own bank and postal accounts or the house; on the other hand, bonds and mutual funds are held by less than 15% of the households. In Poland and Czech Republic more than 10% of the households has none of the listed products, while in Sweden, France and Belgium this percentage falls to less than 2%.

3 The Multilevel Latent Class analysis

As introduced in the previous section, data are available for an international sample of households, $(i = 1, 2, \dots, n_j)$, belonging to a set of European countries $(j = 1, 2, \dots, 14)$. According to the hierarchical nature of the data, households represent lower-level units and countries higher-level units.

The multilevel Latent Class (LC) model assumes that households belong to one of K LCs (unobserved subpopulations) at the lower-level and countries to one of T LCs at the higher-level. The aim of the model is to classify, at the same time, households and countries in groups with some typical profile on the basis of the observed ownership of financial and real assets of the households.

The multilevel LC model proposed by [13] consists of two basic equations, one representing the mixture model at the household level, and the other the mixture model at the country level. For each household i in country j , let y_{hij} denote the observed ownership of product h of household i in country j , where $y_{hij} = 1$ if household i from country j owns the financial product h , and $y_{hij} = 0$ otherwise. Vectors $\mathbf{y}_{ij}$ and $\mathbf{y}_j$ denote, respectively, the full vector of responses of household i of country j and the full set of responses of country j . At the household level, the

model specifies the conditional probabilities of product ownership for household i of country j , given that country j belongs to LC t :

$$P(\mathbf{y}_{ij}|w_j = t) = \sum_{k=1}^K P(x_{ij} = k|w_j = t)P(\mathbf{y}_{ij}|x_{ij} = k) \quad (1)$$

$$= \sum_{k=1}^K P(x_{ij} = k|w_j = t) \prod_{h=1}^H P(y_{hij} = 1|x_{ij} = k), \quad (2)$$

where x_{ij} and z_j denote the variables representing the lower- and higher-level latent class memberships, and k ($k = 1, \dots, K$) and t ($t = 1, \dots, T$) denote a particular lower- and higher-level latent class.

As underlined by [1], this represents a traditional mixture model, with the exception that the relative sizes of first-level LC, $P(x_{ij} = l|w_j = t)$, depend on higher-level LC membership. Within each LC at the household level, the ownership of different products is assumed to be independent, which is the basic assumption of most LC models and usually referred to as the local independence assumption ([6]).

The mixture model at the country level specifies the marginal probabilities of product ownership for a country j :

$$P(\mathbf{y}_j) = \sum_{t=1}^T P(w_j = t)P(\mathbf{y}_j|w_j = t) = \sum_{t=1}^T P(w_j = t) \prod_{j=1}^{n_j} P(\mathbf{y}_{ij}|w_j = t). \quad (3)$$

As typical in multilevel analysis, the observations of the n_j households in each country j are assumed to be independent of each other given the country LC membership.

Combining equations 2 and 3, the final model is:

$$P(\mathbf{y}_j) = \sum_{t=1}^T [P(w_j = t) \prod_{j=1}^{n_j} [\sum_{k=1}^K P(x_{ij} = k|w_j = t) \prod_{h=1}^H P(y_{hij} = 1|x_{ij} = k)]] \quad (4)$$

The probability of observing a particular response pattern for a country, $P(\mathbf{y}_j)$, is expressed by three components: (i) the probability that country j belongs to higher-level LC t , (ii) the probability that household i belongs to first-level LC k , given the country latent class membership, (iii) the probability that household i of country j owns the financial product h , given the household latent class membership [10].

Components (i) and (ii) are modelled through multinomial logit equations:

$$P(w_j = t) = \frac{\exp(\gamma_t)}{\sum_{r=1}^T \exp(\gamma_r)} \quad (5)$$

$$P(x_{ij} = k|w_j = t) = \frac{\exp(\gamma_{kt})}{\sum_{r=1}^K \exp(\gamma_{rt})}. \quad (6)$$

The third component is modelled through a logit equation:

$$P(y_{hij} = 1|x_{ij} = k) = \frac{\exp(\beta_{hk})}{1 + \exp(\beta_{hk})}. \quad (7)$$

Models with covariates affecting the class membership probability and/or the product ownership probability are obtained by adding the relevant covariate effects to the intercept term γ_i , γ_{ki} and β_{hk} in the linear predictor of the logit models.

4 Empirical application

We run the multilevel LC model defined in equation (4) to the SHARE dataset described in Section 2 in order to classify countries and households in latent classes with some typical profiles. To choose the number of latent classes at the two levels of the analysis, we used the three step procedure proposed by [10]. First, we determined the number of lower-level LCs ignoring the multilevel structure (that is, assuming that $T = 1$); second, we fixed the number of lower-level LCs to the value of step 1 and determine the number of higher-level LCs; third, we fixed the number of higher-level LCs to the value of step 2 and re-determine the number of lower-level LCs. In particular, we used the BIC value computed with the number of lower level units to decide about the number of LCs at the household level and we used the BIC value computed with the number of higher level units to decide about the number of LCs at the country level. The final model classifies the households in eight latent classes and the countries in six latent classes. Results at lower- and higher-level are reported in Table 1 and Table 2, respectively.

Table 1 shows that LC8 is the largest lower-level latent class and is characterized by households with a high probability of owning bank accounts and the house, confirming the results obtained from the descriptive statistics in Section 2. The largest LCs (number 5, 7 and 8, with the probability that household i belongs to one of them greater than 50%) are characterized by people with a low probability of holding any risky assets, such as stocks or mutual funds. Households with very large and diversified portfolios (in terms of probability of owning different financial and real assets) are in LC4. This LC is quite similar to LC3, where the probability of having the primary house and a mortgage is less important than LC4. This difference between the two classes might be related to the choice of long-time investments.

LCs 1 (the smallest class) and 6 are interesting because of the role of two specific products: low probability of having bank accounts and high probability of having IRAs, respectively. Since bank accounts are common in all countries, while IRAs are typical in a few countries (for instance, Nordic countries, Czech Republic, France, etc.), this finding might suggest the presence of country-specific features, probably related to national regulations to incentive the ownership of some specific assets.

In the end, LC2 is characterized by households with a high probability of owning a primary accommodation, a mortgage and bank accounts: the “oldest old” people typically do not have mortgages, so this class might include “younger” households (i.e. individuals who are still at work).

Table 2 shows the model results relative to the higher-level of the analysis: size ($P(z_j = t)$) and household segments probabilities ($P(x_{ij} = k | z_j = t)$) of the country latent classes. Using the empirical Bayes modal prediction [11], the countries have

been assigned to one of the six latent classes. As represented in Figure 1, we can segment the countries according to a geographical order.

Table 1 Household segments: LC size ($P(x_{ij} = k)$) and asset ownership probabilities ($P(Y_{hij} = 1|x_{ij} = k)$).

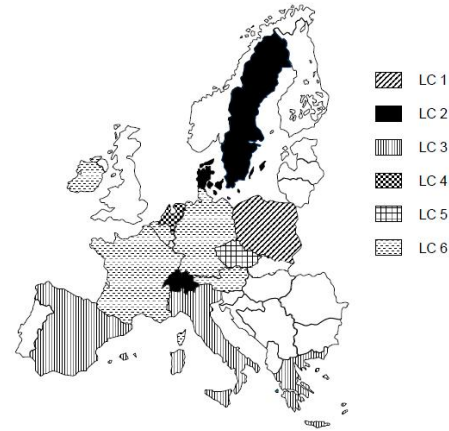
k :	1	2	3	4	5	6	7	8
$P(x_{ij} = k)$:	0.031	0.104	0.137	0.086	0.179	0.108	0.150	0.206
$P(Y_{hij} = 1 x_{ij} = k)$:								
account	0.735	0.938	0.992	0.974	0.887	0.213	1	0.588
bonds	0.020	0.037	0.313	0.244	0.031	0.001	0.053	0.03
stocks	0.064	0.134	0.554	0.601	0.035	0.003	0.070	0.009
mutual funds	0.049	0.089	0.434	0.44	0.041	0.001	0.052	0.003
ira	0.996	0.159	0.443	0.664	0.065	0.004	0.154	0
life insurance	0.337	0.381	0.383	0.526	0.149	0.266	0.199	0.018
house own	0.788	1	0.712	1	0.194	0.692	0.963	0.824
other real estate	0.295	0.101	0.379	0.39	0.033	0.044	0.184	0.262
mortgage	0.066	0.999	0	1	0	0.010	0	0.049

Table 2 Country segments: LC size ($P(z_j = t)$) and household segments probabilities ($P(x_{ij} = k|z_j = t)$).

t :	1	2	3	4	5	6
$P(z_j = t)$:	0.078	0.211	0.211	0.078	0.078	0.344
$P(x_{ij} = k z_j = t)$:						
$k=1$	0.008	0.002	0.008	0	0.343	0.005
$k=2$	0.005	0.134	0.028	0.455	0.003	0.098
$k=3$	0.015	0.284	0.048	0.047	0.015	0.177
$k=4$	0	0.336	0.002	0.042	0.002	0.032
$k=5$	0	0.228	0	0.434	0.022	0.276
$k=6$	0.945	0	0	0	0.284	0.036
$k=7$	0.026	0	0.096	0.022	0.025	0.359
$k=8$	0	0.016	0.818	0	0.305	0.018

Central Europe countries (plus Ireland) have the highest probability to be grouped together (higher-level LC6), and they are characterized by an interesting mix of household segments with non-risky (lower-level LC5 and LC7) and risky asset portfolio (lower-level LC3). According to the model, the richest countries (Sweden, Denmark and Switzerland) belong to the higher-level LC2, where the probability that households belong to lower-level LCs with risky asset portfolio (LC3 and LC4) is the highest; then, Mediterranean countries (higher-level LC3) are mainly characterized by household segments with a low probability of risky asset portfolio (lower-level LC8). Each of the remaining three LCs are composed by a single country:

Fig. 1 Empirical Bayes modal prediction: country segments posterior membership.



the Netherlands (higher-level LC4), Poland (higher-level LC1) and Czech Republic (higher-level LC5). At a first sight, this is a surprising result, in particular for the Eastern Europe countries. However, we should note that in each of these LCs, the conditional probability of the household segments is the highest for the lower-level LCs 2, 6 and 1 respectively, that are just the three household segments described above as having some peculiar profiles.

Our results confirm the evidence of a substantial heterogeneity of portfolio holdings of the elderly within and across Europe ([3], [4]). However, the innovative features of our approach (compared for instance to the probit modelling used in the aforementioned literature) allow us to highlight two other important findings: first, in each country we can recognize some groups of holders whose portfolio characteristics are similar to those in other European countries (e.g. the richest households); second, when analysing household portfolios of the elderly in Europe, some countries are characterized by so similar patterns of asset ownership that can be grouped together (instead of specifying a full set of country-specific effects).

5 Conclusions

[8] argue that wealth is a particularly useful measure of the socio-economic status of the elderly, because it might reflect both accumulated socio-economic position and potential for current consumption (which can be indeed supported by spending down financial or real assets). However, there is evidence from SHARE (Survey of Health, Ageing and Retirement in Europe) of a huge cross-country variability on the number and the type (risky vs non-risky) of the asset ownership among the elderly.

For investigating similarities and differences in the ownership patterns of several financial and real assets among European elderly, we adopt a multilevel latent class solution, that allows to use the information collected from households to make inference both at the household and country level.

The overall result is that treating the different European member states as a unique market is difficult to support and most countries can be grouped in classes that follow a geographical division. Moreover, households can be divided in well-defined classes, where the largest have low probability of holding risky assets.

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