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Multi-layered perspective on the barriers to learning participation of disadvantaged adults

Sofie Cabus · Petya Ilieva-Trichkova · Miroslav Štefánik

Received: 18 February 2020 / Accepted: 23 June 2020 / Published online: 9 July 2020 @ The Author(s) 2020

Abstract We propose a multi-level explanatory model aimed at explaining the variability behind participation in adult learning. Our model focuses on the employed adults, narrowing down to vulnerable sub-groups of employed: low-skilled; young and low-skilled, and immigrants. Adult learning participation is explained identifying determinants at the level of the individual, household, job, employer as well as the system-level. The model is estimated using the European Union Labour Force Survey microdata for 28 European countries. Comparing the results across the vulnerable groups and types of determinants yields interesting insight in understanding the variability in adult learning participation across Europe.

Keywords Barriers to adult learning participation · Learning participation determinants · Multi-level modelling · Structural equation modelling

S. Cabus

P. Ilieva-Trichkova Bulgarian Academy of Sciences, Sofia, Bulgaria E-Mail: petya.ilievat@gmail.com

M. Štefánik () Slovak Academy of Sciences, Bratislava, Slovakia E-Mail: miroslav.stefanik@savba.sk

This research was undertaken within the ENLIVEN project and received funding from the European Union (EU), Horizon 2020 research and innovation programme under grant agreement No. 693989.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/ s40955-020-00162-3) contains supplementary material, which is available to authorized users.

Katholieke Universiteit Leuven, Leuven, Belgium E-Mail: sofie.cabus@kuleuven.be

Mehrebenen-Perspektive auf die Barriere für die Weiterbildungsteilnahme benachteiligter Erwachsener

Zusammenfassung Wir entwerfen ein mehrstufiges Erklärungsmodell, um die Variabilität der Partizipation an der Erwachsenenbildung zu erklären. Unser Modell konzentriert sich auf erwerbstätige Erwachsene und beschränkt sich auf gefährdete Untergruppen von Erwerbstätigen: Geringqualifizierte, Junge, geringqualifizierte Erwachsene sowie Immigranten. Die Partizipation an Erwachsenenbildung wird erklärt mit Determinanten auf der Ebene des Einzelnen, des Haushalts, des Arbeitsplatzes, des Arbeitgebers sowie auf der Systemebene. Das Modell wird anhand der Mikrodaten der Arbeitskräfteerhebung der Europäischen Union für 28 europäische Länder geschätzt. Der Vergleich der Ergebnisse zwischen den gefährdeten Gruppen und Determinantenarten liefert interessante Einblicke in die Variabilität der Partizipation an der Erwachsenenbildung in Europa.

Schlüsselwörter Lernwiderstände · Hürden · Weiterbildung · Erwachsenenbildung · Determinanten · Mehrebenenmodell · Strukturgleichungsmodellierung

1 Introduction

Adult learning (AL) is high on the Horizon 2020 Agenda, as indicated by one of the EU headline targets of minimal 15% of adults aged 25–64 enrolled in formal or non-formal learning activities. While many EU countries fail to reach the 15%-target, substantial differences in AL participation rates are observed between European countries, with less than 2.5% in Romania and Bulgaria in 2016, to more than 20% in Iceland, Finland, Denmark, Sweden and Switzerland (Eurostat [trng_lfs_01]; Extracted: January 2018). These differences are even more considerable across European regions from 0.7% in Sud-est and Sud-Vest Oltenia in Romania to 36.2% in Zurich in Switzerland (Eurostat [trng_lfs_04]; Extracted: July 2019).

Explaining the differences in participation in adult education remains a challenge for social researchers. Improvements in the availability of the data and advancements in the empirical methodologies open new alleys in this respect. Here we explore one of these alleys. Departing from available theoretical, as well as empirical research on barriers to participation in AL, we aim at exploring the barriers to participation in AL among disadvantaged adults across Europe. To do so, we use data from the European Union Labour Force Survey (EU-LFS) collected in 2016 and apply a multi-level modelling technique.¹ Our model combines variables based on characteristics of individuals, their households, jobs, employers' as well as the macrolevel characteristics of the environment where learning takes place.

We see our contribution to the literature mainly in the following five areas.

¹ This article uses data from Eurostat obtained for the needs of Research Project Proposal 124/2016-LF-S-AES-CVTS-CSIS. The responsibility for all conclusions drawn from the data lies entirely with the authors.

First, building upon previous frameworks in the field of adult education and economics, we propose a supra-individual comparative framework that covers the multiple layers of the complex problem of participation in AL to reveal those barriers that distinguish participants from nonparticipants in distinct societies. We look at these barriers from the perspective of individuals, while, at the same time, acknowledging that institutions and education and labour market policies may (structurally) impose barriers to individuals (Cross 1981; Chapman et al. 2006; Laal 2011; Boeren 2016; among others).

Second, we apply generalised structural equation modelling (GSEM), as to acknowledge the interdependency of identified system determinants. Doing so, we develop new indicators that up till now have not been fully covered in the analysis of barriers to participation in AL, such as over-education and care for family members.

Third, to the best of our knowledge, most of the previous research on the barriers explores the variability in AL participation at the level of countries, while ignoring the regional-differences (e.g. Rubenson and Desjardins 2009; Roosmaa and Saar 2016). Our modelling approach as well as data consider regional variability in AL participation.

Fourth, we consider participants in AL which belong to various disadvantaged groups, and which to this moment are in the focus of public policies (Tuparevska et al. 2019). It gives us a broader perspective on how barriers potentially differ across different disadvantaged groups of the population.

Fifth, in contrast to previous research on barriers, we take into account that AL is a heterogeneous good. Doing so, we explore the differences in the barriers to participation across two types of AL: formal learning and non-formal learning.

This paper proceeds as follows: In the following section, we frame our approach in the existing research on barriers to AL participation, resulting in a description of our explanatory model. Our empirical strategy is outlined in the second section. Further details on the data and definitions of explanatory variables are provided in the online annexe.² The third section lists the most interesting results from fitting the explanatory model to the EU-LFS data. We conclude in the final, fourth section.

2 Explaining adult learning participation

2.1 Theoretical models

There are many theoretical and empirical studies on the reasons why adults participate in education or training. They could be roughly divided into three groups:

- 1. those that focus on the individuals,
- 2. those that search the reasons in the macro-level, country context and
- 3. those that are based on individuals' interactions with different social contexts.

² http://ekonom.sav.sk/dokumenty/online_annex.htm.

The first group includes approaches from economics, sociology and psychology such as the human capital theory, rational choice theories, the theory of planned behaviour and the psychosocial interaction model. Most of them are based on the idea that the decisions to participate in further education are rational.

The human capital theory starts from the main idea that as people invest in educational activities, they increase their income, productivity, and skills (Schultz 1961; Becker 1993).

The choice-related explanations of the educational paths (Boudon 1974; Gambetta 1987) are also widely applied. According to the rational choice theory, if benefits outweigh costs, the individual is likely to continue receiving benefits. Thus, the decision to participate in AL can also be seen as being based on a cost-benefit calculus.

The theory of planned behaviour is developed with Fishbein and Ajzen's work on 'reasoned actions' (Fishbein and Ajzen 1980). According to them, there are three central predictors as to whether people will follow certain behaviour patterns: the attitude towards specific behaviour, the subjective norms attached to the behaviour and the perceived behavioural control.

The psychosocial interaction model is developed by Darkenwald and Merriam (1982). It focuses mainly on social environment factors and the socio-economic status of the individual.

The second body of research proves that different macro-level determinants further influence the participation in AL at country level. Macro-level determinants refer to broader structural factors situated and decided at the level of countries or regional level. Among them, gross domestic product, innovativeness, overall participation rate, employment rate, active labour-market policies and characteristics of the educational system are considered as relevant (e.g., Bassanini et al. 2007; Wolbers 2005; Groenez et al. 2007). Other studies have focused on the influence of the welfare regimes on the participation in adult education (e.g. Dammrich et al. 2014; Roosmaa and Saar 2016).

The third group includes models which consider the interaction between the individual and different social contexts. Among them is the Rubenson's expectancy valence model (1975). It links the individual's expectations about the value of participating, their attitude towards participating, and the likelihood of actual participation. According to this theory, participation will occur and persist if the learning activity is consistent with the learner's needs and expectations.

Another model that falls in this group is the Cross's chain-of-response model (Cross 1981). This model suggests that participation relates to a complex chain of responses made by the individual in response to the social circumstances.

For the classification of reasons that may impede learning participation, Rubenson and Desjardins (2009) depart in their study from the frequently cited framework of Cross (1981), classifies 'barriers' to participation in lifelong learning into (1) situational barriers; (2) dispositional barriers; and (3) institutional barriers. Situational barriers are related to a person's life situation at a given point in the family life cycle and working life. Dispositional barriers refer to personality traits or personal qualities acquired through early school experiences. Institutional barriers include institutional practices and procedures that discourage or prevent participation. These perspectives have become a basis for building more developed comprehensive understandings of participation which incorporate the influence of factors at different levels and which are relevant for comparative research (e.g., Rubenson and Desjardins 2009; Boeren 2017; Lee 2018).

By labelling their model "Bounded Agency", Rubenson and Desjardins (2009) wish to refer to the fact that adults have agency to decide on participation to education or training, however, due to bounds, or restrictions, they cannot take the preferred action to participate. More specifically, they focus on the interaction between structurally and individually based barriers to participation in adult education.

Boeren (2017) sees the participation in AL as a layered problem. Given this, she proposes an understanding of AL as an interplay between different actors: (i) the participants with their intentions, needs, attitudes and other behavioural characteristics as well as their personal characteristics such as gender, age, income and social/ cultural capital; (ii) the educational institutions and workplaces being the major learning providers; and (iii) the social policy adopted in the countries where the participants live. These players, representing three different levels, are not isolated but interact with each other in a new comprehensive lifelong learning participation model.

In his conceptual study Lee (2018) develops a framework for a cross-country empirical analysis of the degree of inequality in AL participation.

Specifically, his study considers social origins as a micro-level factor, and social inequality in three of its types: educational, economic and skill inequality and institutional settings such as active labour market policies and strictness of employment protection, as macro-level factors. This framework was empirically tested in a recent study which examined the country variation in social origins differences in AL participation by the use of cross-level interactions (Lee and Desjardins 2019).

2.2 Hypotheses

In this subsection, we describe the relationship between the hypotheses that can be explored in our empirical setting, with links to the literature. We propose ten hypotheses in total. We depart from the situational barriers, dealing with the life situation of an individual and mainly include time constraints owing to family reasons or job-related time allocation (Merriam 2005; Desjardins et al. 2006). Here we aim at answering three hypotheses:

H1 Caring duties are negatively associated with AL participation.

H1a This association is more pronounced in the case of females.

H2 Working longer hours translates into a lower AL participation.

H2a Workplace delivered AL might be positively associated with longer working hours.

H3 The share of non-earners in the household is positively associated with AL participation.

To improve the ability to capture the potential complexity of situational barriers, we restrict our interest to employed individuals. We do so because employed individuals comprise most of the adult lifelong learners in the European Union. At the same time, employed adults share a common life situation, allocating time between family, work and potentially AL. The life course approach proved its advantages in explaining participation in AL (Elder 1998); (Elder and Crosnoe 2002). Defining the population of our interest by conditioning on the employment status, rather than simply by the age group, takes into account also the trends of de-standardisation of the life course (Evans et al. 2013), as life course transitions (such as the transition from schooling to work) become more variable and less uniform. Due to our interest in the employed, we can analyse the hypothesis:

H4 AL participation is lower in the case of individuals employed in more routinised jobs, with a higher risk of computerisation.

H5 There is a statistically significant association between over-education and AL participation.

Concerning financial barriers to AL participation, poverty restricts individuals to invest in education or training, in particular, in the absence of government subsidies. On the other hand, regardless of labour earnings, individuals may be reluctant to pay the invoice when the benefit of learning do not outweigh the costs, or if learning comprises of job-related activities (Dhanidina and Griffith 1975).

The government often subsidises the costs of training of unemployed individuals within the scope of active labour market policy. However, Rubenson and Desjardins (2009) argue that in many European countries, with the exception of the Nordic countries, adult education policy is not aligned with active labour market policy. Due to lack of government support towards AL, high *perceived* costs of AL limit individuals' capability to participate in learning activities.

Furthermore, while a substantial share of European civilians indicates that employers should bear the costs of AL, economists have argued that employers are only willing to pay the invoice (partly) when the learning activity directly benefit the participant's production on the job (Acemoglu and Pischke 1998). Therefore, training offered to employees and paid for by the employer is often job-specific and less aimed at the acquisition of general transferable skills (Lazear 2009). Boeren and Whittaker (2018, p. 5) argue in this respect that "*This is in contrast to the mode of operation of expansive working environments that put more focus on the development of general and transferrable skills*." In line with previous literature, we pose the hypothesis:

H6 Where the perceived costs of AL participation present an obstacle, AL participation is lower.

Psychological drivers of adults to engage in learning, like positive motivation and attitude, are referred to as *dispositional barriers* (Lavrijsen and Nicaise 2017). These might be associated with qualities and past experiences of individuals; such as low educational aspirations or self-confidence. Capturing these puts additional requirements on data collection. In the case of the analysis presented here, we are not able to directly identify dispositional barriers in the data. Therefore, we proxy for them by distinguishing multiple disadvantaged groups. Such as for example, the low-skilled might be expected to have low educational aspirations.

In general, people have unequal chances to participate in AL (Desjardins et al. 2006). Previous literature shows that namely, those individuals with a high need for learning participate very little (Boeren et al. 2010; Desjardins et al. 2006). Thus, patterns of participation in AL, which have been identified and confirmed by several studies, clearly show that those with low education participate less than people with higher educational attainment (e.g. OECD 2003; Roosmaa and Saar 2012; Desjardins et al. 2006; Kyndt and Baert 2013; European Commission 2015). This is the source of variability we are aiming to explore in our analysis, by identifying various disadvantaged groups of interest in a similar life situation. Taking all this into account, we choose to fit our explanatory model to populations of three disadvantaged groups, namely: employed low-educated persons, employed low-educated young adults;³ and employed migrants.⁴⁵

Institutional barriers exist at the supra-individual level, for example, at the regional level or the country level. They are also referred to as system-level or macrolevel determinants. In selecting the relevant system-level determinants of AL participation, we depart from the model outlined in Groenez et al. (2007). Their model is inspirational in selecting the relevant, out of the wide list of potentially observable country-level variables.

With individual returns to AL decreasing with higher age, at the society level, older societies should invest less in AL than the younger ones (Groenez et al. 2007).

When exploring available literature, Groenez et al. (2007) find support for both of the directions of the association between the level of specialisation in initial schooling and AL participation, namely: less specialised and more general systems of initial education precondition higher AL participation because of the lack of specialised skills received during initial education (Antikainen 2006; Brunello 2001); and more specialised and less general systems of initial education precondition higher AL participation because of specialised and less general systems of initial education precondition higher AL participation because of specialised skills getting obsolete faster than general skills (Bassanini et al. 2007).

We assume that AL participation might be higher in regions with higher employment rate mainly because the workplace generates an additional supply of training (McGivney 2001); adults are more confident that learning will be utilised in a better

³ We adopt an adjusted definition of early school leavers, looking specifically at youth (between 20 and 30) possessing not higher than lower secondary education. De Witte et al. (2013) dealt with a similar problem in their analysis of the determinants of school dropout using EU LFS data.

⁴ For more details on the identified disadvantaged sub-groups, please, refer to Sect. 3.1 on Data and Sample, or the appendix of the Online annexe. Identification of vulnerable sub-groups is in line with Tuparevska et al. (2019) who consider (1) migrants; (2) persons with disabilities; (3) young people; and (4) early school leavers, as disadvantaged groups in more than 50% of the policy documents.

⁵ In order to compare the results of each of these three disadvantaged groups, we choose to add an analysis on the determinants of AL participation among the whole employed population as a reference category.

job (McGivney 2001); companies invest more in human capital when confronted with shortages of skilled labour (Gorard and Rees 2002).

Although we control for individual-level working hours, the regional share of temporary contracts is included to proxy for the employment legislation. Lassnigg (2005) and McGivney (2001) hint that employers are less willing to invest in AL of employees working under part-time or temporary contracts, which might imply a lower regional supply of AL.

Finally, the economic performance of the region is assumed to be positively associated with AL participation, either directly, through a better performing labour market or innovation sector. Groenez and co-authors (2007) estimate multiple specifications of explanatory models on AL participation and inequality in AL participation. They identify the level of innovation as one of the key system determinants appearing to be significant in all of their model specifications.

In line with Groenez and co-authors (2007), we are able to suggest three hypotheses dealing with system-level (institutional) characteristics:

H7 Regions and countries with an older population are less incentivised to support AL participation, what is observable on a lower probability of individual-level AL participation.

H8 AL participation is higher, where initial education provides more general skills.

H9 AL participation is higher in regions with better performing labour markets.

H9a AL participation is higher where employment protection is stronger.

H10 AL participation is higher in more innovative economies.

Being aware of the multi-level nature of the drivers and barriers to participation in AL, our aim is to design an explanatory model capturing AL participation in its complex nature. We fit our model to available empirical data and specifically look at how differently the model fits when explaining the participation of the identified groups of interest. Using empirical evidence at the European level, allows us to adopt a supra-individual comparative framework that covers the multiple layers of the complex problem in order to reveal those barriers that distinguish participants from nonparticipants in distinct societies.

2.3 Explanatory model

We aim to explain as much of the variability in AL participation as possible by fitting an explanatory model consisting of multi-level determinants (explanatory variables). Considering the typology of barriers to AL participation, as well as the potential interplay of contextual factors varying at different levels, we group the factors of interest into:

- individual-level determinants;
- household-level determinants;
- job-related determinants;
- employer-level determinants;
- system determinants.

Determinants identified at the individual and household level overlap widely with the situational barriers discussed in the previous section. The household-level de-



Fig. 1 Overview of the explanatory model (All variables listed in the scheme are assumed to be explanatory variables, thus to have a direct association with the dependent variable (AL participation). For simplification purposes, these associations are not displaied in the Scheme. *Black arrows* only display associations assumed between the explanatory variables)

terminants are designed to capture the need to allocate time to household-related duties. Under the job-related determinants, we consider over-education and the occupation-specific risk of computerisation based on the influential study of Frey and Osborne (2016), assuming lower AL participation in jobs with a higher risk of computerisation.⁶

In an EU-wide analysis of employer-provided learning, CEDEFOP (2015) identifies the main determinants of employer-provided training; among the most important, the sector of economic activity together with the size of the employer.

At the level of system determinants, we focus on four areas, also considered by Groenez and co-authors (2007); namely the:

- a. demography;
- b. initial education;
- c. labour market;
- d. economy.

Since especially the system level determinants show a high level of collinearity (see Table B3 appended to the Online annexe), our model also allows associations between explanatory variables. Fig. 1 displays the complete list of explanatory variables included in the model with associations between them. A more detailed description of the considered determinants, with exact definitions of the explanatory variables included in the model, can be found in the online annexe.⁷

3 Empirical strategy

Our analytical framework explains AL participation in a multi-level context, by identifying individual, household, job, employer, as well as supra-individual, system-level determinants of AL participation. The supra-individual level determinants are usually considered at the country level, where the observed heterogeneity of AL participation is already substantial (Rubenson and Desjardins 2009). However, among others, Boeren (2016) already argued that the supply of AL is mostly organised at the regional level, rather than at the country level, because it depends on the availability of providers that are not nationally organised. Given this, we also consider the regional aspect of AL participation.

3.1 Data and sample

The empirical basis of our article is the European Union Labour Force Survey (EU-LFS).⁸ The EU-LFS is the only statistical survey measuring AL participation at the

⁶ Desjardins (2017) argues that the so called low-skill low-trust societies have more routinized jobs. In these societies less participation in AL is observed, because routinized jobs do not require learning activities of employed individuals. Especially low-educated are engaged in routinized jobs. So less participation in these societies is expected among the low-educated.

⁷ http://ekonom.sav.sk/dokumenty/online_annex.htm.

⁸ This article uses data from Eurostat obtained for the needs of Research Project Proposal 124/2016-LFS-AES-CVTS-CSIS. The responsibility for all conclusions drawn from the data lies entirely with the authors.

regional level and in a European context. The survey covers EU-28 countries together with Norway, Iceland, and Switzerland. These 31 European countries comprise of 219 regions.⁹ Moreover, the data collected at the regional level count enough observations to remain representative. The EU-LFS has the most observations among EU wide surveys administrated by Eurostat. For these two reasons, we have decided to use the EU-LFS data for the year 2016. These data are then further linked with the variables available in the regional database on lifelong learning participation (Cabus et al. 2018).

We restrict our sample to employed individuals only, limiting the number of observations to 1.6 million. Employed individuals present the dominant share of AL participants. Moreover, their decisions to allocate time to AL activities become far more predictable, as they all decide in a similar nexus of work, family and further learning. Additionally, to proxy for the dispositional barriers, we focus on the AL participation of disadvantaged sub-groups of employed; namely the low-educated, younger (low-educated) population and migrants.¹⁰ Doing so, the design of our empirical model becomes more straightforward, and the coefficients easier to interpret. Table 1 summarises the total number of observations for each of the groups of interest.

Geographically, our analytical sample used in further analysis covers 27 EU member states and Norway. As such, we do not include three countries. First, Ireland was excluded because of missing data on "subjective assessment financial costs being the main obstacle to participation in AL"; collected by the authors from the Adult Education Survey (AES) 2016. Assessing the importance of this explanatory variable for our empirical estimations, we decided to leave Ireland from our sample. Additionally, Switzerland and Iceland are excluded from the sample. These countries miss data on important country/regional level system characteristics, like regional GDP per capita, expenditures on active labour market policies, and the subjective

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Groups of inter- est	Observations in the sample (Un- weighted)	Population (Weighted)	Participation rate—Formal AL (%)	Participation rate—Non-for- mal AL (%)
Employed adults 25–64	1,608,100	200,844,000	2.58	9.91
Low-educated adults 25–64	276,400	34,859,600	0.89	4.23
Low-educated young adults 20–29	31,600	4,958,200	13.37	5.77
Employed mi- grants 25–64	171,600	25,879,800	3.35	8.20

 Table 1
 Number of unweighted observations in the (EU-LFS 2016 dataset), by the type of AL activity.

 (Source: EU-LFS 2016)

For exact definitions of the sub-groups, please visit Table A1 in the Online annexe

⁹ Regions are defined at the level of NUTS 2. For an overview see: https://ec.europa.eu/eurostat/web/nuts/ nuts-maps-.pdf-.

¹⁰ For a detailed definition of the sub-groups, please, refer to the Online annexe (Table A1).

assessment of financial costs being the main obstacle to AL participation. Excluding Ireland, Switzerland, and Iceland from the EU-LFS sample, the total number of observations drops to 1.6 million.¹¹

3.2 Dependent variable

The dependent variable for further analysis is the AL participation observed at the individual level. The definition of AL participation differs between available data sources surveying European households (EU-LFS and AES) (CEDEFOP 2015, p. 31). While the AES inquires about AL participation during the period of 12 months prior to the collection of the survey, EU-LFS asks about AL participation within the last four weeks prior to the surveying period. The surveying period of EU-LFS observations shifts randomly during the whole calendar year (to avoid biases caused by seasonality), with a quarterly data collection and sample components remaining in the sample for up to 4 quarters.

EU-LFS further allows a more precise distinction between learning activities by distinguishing between (i) formal and non-formal learning; and (ii) work-related and not work-related learning. Nevertheless, the information necessary to identify work-related AL was not collected in all 31 European countries. Therefore, we only distinguish between formal learning and non-formal learning activities.

Our dependent variable is collected at the level of individuals and has the form of a dummy variable. It indicates whether the surveyed individuals did participate in the particular type of AL activity, during the four weeks reference period (1) or not (0).

3.3 Independent variables

Based on our reading of available literature, we design a rather complex model, by combining explanatory variables measured at multiple levels: individuals, region and countries (see Table 2). Our choice of the independent variables is limited by the options available in the EU-LFS data and based on the explanatory model of AL participation, introduced earlier.

In an attempt to capture some of the situational barriers, we introduce a few innovative variables. The care index is a proxy for the demand for carrying duties based on the age composition of other household members. Share of non-earners captures the share of not-employed household members. Over-education index places the individual based on his/her highest education attained, relative to the median education acquired in his/her occupational group.

Because the variables, especially from the group of system characteristics, are collinear, we allowed some of them to become endogenous to the model in separate sub-equations.

¹¹ Tables A1–A3, appended to the Online annexe, provide an overview of the group definitions, the number of observations by group and country.

Variable			Level of mea- surement	Model status
Individual	Female		Individual	Exogenous
charac- teristics	Age		Individual	Exogenous
teristics	Level of education	n	Individual	Exogenous
	Degree of urbani	sation	Individual	Exogenous
Household charac-	Care index		Individual	Exogenous
	Share of non-ear	ners in the HH	Individual	Exogenous
teristics	Working hours		Individual	Endogenous
Job	Over-education i	ndex	Individual	Exogenous
charac- teristics	Risk of computer	isation	Individual	Exogenous
	High skilled occu	upation (dummy)	Individual	Exogenous
	Supervision (dun	nmy)	Individual	Exogenous
Employer's	Looking for a job	, ,	Individual	Exogenous
charac- teristics	Economic sector		Individual	Exogenous
	Number of emplo	byees in the local unit	Individual	Exogenous
System	Costs of AL		Country	Exogenous
charac-	Demography	Mean age of the regional population	Regional	Exogenous
teristic	Initial	Years of compulsory schooling	Country	Exogenous
	education	Entrance age into lower secondary education	Country	Exogenous
		Share of students in vocational programmes	Country	Exogenous
		Government expenditure on educa- tion as a % of GDP	Country	Endogenous
	Labour market	Employment rate	Regional	Endogenous
		Share of dismissals	Regional	Exogenous
		Share of temporary contracts	Regional	Exogenous
		Active Labour Market Policy expen- diture on Training	Country	Exogenous
	Economy	Regional GDP	Regional	Endogenous
		Number of patent applications	Country	Endogenous

 Table 2
 List of independent (explanatory) variables used in the model. (Source: Authors)

3.4 Estimation technique

Dramatic country-level differences in the level of the dependent variables (participation in formal learning and non-formal learning) give us a good reason to expect a hierarchical structure of the data. For this reason, we first explore the variance of AL participation with a simple multi-level logit model allowing only for a random intercept at the level of country and region. In this way, we are able to explore the share of variance observable within and between our classes (countries/regions). Higher values of the interclass correlation index (ICC)¹² observed for classes at the

¹² For the values of the ICC, please visit the Table B4 appended to the Online annexe.

regional level, however, suggest that allowing for a random constant to vary at the regional level should improve the explanatory power of our model.

Because especially the variables referring to the main system determinants of AL participation are strongly inter-correlated,¹³ we have decided to design our model as a generalised structural equation model (GSEM), allowing not only association paths between the dependent variable and independent variables, but also between the explanatory variables (StataCorp 2015a).

These two aspects of our data, namely, a hierarchical structure of the data and significant correlations between explanatory variables, motivate our decision to apply the GSEM. This technique allows us to combine a multi-level modelling approach, together with implementing association paths between explanatory variables.

The structure of the model, with particular association paths, reflects the structure introduced in Fig. 1. Our dependent variable is a dummy (0, 1) variable of participation in AL, with the logit link function. All explanatory variables are expected to be associated with the dependent variable. Furthermore, associations between independent variables are allowed. We apply an endogenous function to working hours, public expenditures on education, employment rate, regional GDP and the number of patent applications, which will enable associations with other explanatory variables.

Our model can be formalised as a system of equations:

$$logit(P(AL = 1|x)) = \alpha_0 + \mu_{0j} + \beta_n X_{nij} + \beta_r S_{rj} + \varepsilon_{ij}$$
(1)

$$HOURS = \gamma_0 + \gamma_r X_{\rm rij} + \epsilon_{ij} \tag{2a}$$

$$EDU_EXP = \delta_0 + \delta_y S_{yj} + \ddot{O}_j \tag{2b}$$

$$EMPL = \theta_0 + \theta_z S_{zj} + \sigma_j \tag{2c}$$

$$\log(GDP) = \lambda_0 + \lambda_w S_{wj} + \omega_j \tag{2d}$$

$$\log(INOV) = \eta_0 + \eta_u S_{uj} + \iota_j \tag{2e}$$

The central Eq. 1 predicts the probability of AL participation (AL) conditional on observable characteristics (X), using a logit function. This equation allows region-specific constants (α_0) through the constant specific error (μ_{0j}), which varies between regions (*j*). X_{nij} is the vector of *n* explanatory variables varying at the level of regions (*j*) as well as at the level of individuals (*i*).¹⁴ These explanatory variables are linked to *n* coefficients of interest (β_n). S_{rj} is a vector of (*r*) explanatory variables varying at the level of regions (*j*).¹⁵ β_n and β_r are the coefficients reported in the next (results) section.

Simultaneously with the main equation, five sub-Eqs. 2a–2e are estimated, with the endogenous explanatory variables from the first equation being the dependent variables. These have the form of a classical regression equation, with simple constants $(\gamma_0, \delta_0, \theta_0, \lambda_0, \eta_0)$, errors $(\epsilon_{ij}, \ddot{O}_j, \sigma_j, \omega_j, \iota_j)$. Each of the sub-equations has

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¹³ For exact values of the correlation coefficients, please visit the Table B3 appended to the Online annexe.

¹⁴ Variable HOURS is one of the *n* variables in the vector of explanatory variables (X_{nij}) .

¹⁵ Because of the limited data availability, some of the variables in the vector S vary only at the country level. Variables: EDU_EXP, EMPL, GDP and INOV present a sub-set of the vector *S*.

a specific list of explanatory variables $(X_r, S_y, S_z, S_w, S_u)$ with related coefficients $(\gamma_r, \delta_y, \theta_z, \lambda_w, \eta_u)$, which are being reported only in the Online annexe.¹⁶

Considering the character of our model, we use the quasi maximum likelihood (QML) estimation method. This method is not as demanding in terms of assumptions in comparison to the widely used maximum likelihood method. It relaxes the conditional normality assumption and is able to deal with non-normality by adjusting standard errors (StataCorp 2015a, p. 45). It also allows us to use a random constant at the level of NUTS 2 regions as well as identify important associations between explanatory variables.

Selected estimation procedure has, by definition, a built-in model evaluation method, when miss-identified models do not converge (Brown 2006, p. 202). The applied technique is an equation-wise deletion of missing values and treats covariance between observed exogenous variables as given (StataCorp 2015b, p. 668).

4 Estimation results

We report results for eight models in total. These eight models distinguish between the two types of AL (formal and non-formal) and also between the four groups of interest (all employed; low-educated adults; low-educated young adults; and migrants). Interpretations are based exclusively on the statistical significance and direction of the measured associations. Here we focus purely at the associations between independent (explanatory) variables¹⁷ and the dependent variables (participation in formal and non-formal education), although the model includes several sub-equations grasping association between independent variables.

4.1 Assessment of the explanatory power

To give an overview of the fit of the model, we first report the change in the Pseudo R-square¹⁸ attributable to particular blocks of variables (see Figs. 2 and 3).

Models fitted on all employed, low-educated and migrants show explanatory power at levels expectable considering the nature of the data and complexity of the model. The proposed model is, on average, stronger in explaining participation in formal AL. Our model appears to be multiple times as strong in explaining AL participation of young and low-educated. This is mainly due to the contribution of household characteristics, suggesting that household-related barriers play a relatively more important role in the case of individuals under 30 and low-educated. In other words, for the young and low-educated, individual characteristics play a less important role in explaining AL participation, while they present the strongest block of variables in explaining formal AL participation of other considered groups.

¹⁶ Table B5 appended to the Online annexe.

¹⁷ Listed in Table 2.

¹⁸ Being aware of the limitations of the Pseudo-R2 statistics (see e.g. Menard 2000), we decided to use the McFadden's Pseudo R-square calculated from equation level log-likelihood. Despite its limitations, we still believe it is informative and frames the evidence presented here.



Fig. 2 Pseudo R-square contribution to the model of participation in formal AL. (Source: EU-LFS 2016)



Fig. 3 Pseudo R-square contribution to the model of participation in non-formal AL. (Source: EU-LFS 2016)

The contribution of system-level variables (institutional and policy framework of the country/region) steps forward in the case of disadvantaged groups (especially low-educated). In line with the expectations, job-related characteristics play a more important role in the case of non-formal AL participation.

4.2 Contribution of particular variables

Further, we report the regression coefficients capturing the association of particular explanatory variables and the dependent variable. Presented results are organised in the, already presented, variable blocks.

4.2.1 Individual characteristics

We include variables on the characteristics of individuals as standard, control variables. Jointly, they are stronger in explaining participation in formal AL. In the case of young and low skilled, only two out of four individual characteristics could be included in the model, as age and educational level are used in defining this target group. The results are presented in Table 3.

Out of the individual characteristics, we observe confirmation of the usual patterns widely described also in many previous empirical studies. In the case of non-formal AL, females are more likely to participate than males. This bias favouring women

Target		Employ	ed						
group		All	All		Low educated		l low-	Migrants	
Type of AL		Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal
Female			+++						+ +
Age						(Omitted)	(Omitted)		
Level of education (primary omitted)	Lower sec- ondary		+++	(Omitted)) (Omitted)	(Omitted)	(Omitted)		+++
	Upper sec- ondary	+ + +	+++	(Omitted)) (Omitted)	(Omitted)	(Omitted)	++ +	+++
	Tertiary	+ + +	+++	(Omitted) (Omitted)	(Omitted)	(Omitted)	+	+++
Degree of urbanisa-	Town		-						
tion (City omitted)	Rural		-		++				

 Table 3
 Estimation results for individual characteristics. (Source: EU-LFS 2016)

+++ positive coefficient with p < 0.001

++ positive coefficient with p < 0.01

+ positive coefficient with p < 0.05

– negative coefficient with p < 0.05

- negative coefficient with p < 0.01

-- negative coefficient with p < 0.001

disappears in the sub-group of young and low-educated, where household-related barriers appear to play a substantially more important role (see Figs. 2 and 3).

Older employees are less likely to participate in both formal and non-formal AL. Age is one of the strongest predictors in all of the models; this association is observable across all types of AL as well as target groups.

A higher level of education drives towards further AL in the case of formal as well as non-formal AL. The linear, positive, and statistically significant association between initial education and AL participation also holds across the types of AL, as well as groups of interest.

Living in a less urbanised area barriers mainly from participation in formal AL. Interestingly, this association is not observable for the low-educated, which appear to have a higher chance of participation in non-formal AL if living in a rural area (in comparison to cities).

4.2.2 Household characteristics

Variables constructed from the characteristics of households and their members are designed to proxy for household-related (situational) barriers. The ambition is to grasp the nexus of the allocation of time between the household (family) and labour earnings (work), which is faced by all employed. Employed individuals, when deciding about AL participation, have to find additional time out of their limited time budget. To capture this moment, our model includes indexes of the family-related time demand (Care index) and a proxy for the demand for income (Share of non-earners in the household). Both are included in the model separately for males and females. All four variables are first used to predict the number of usual working hours¹⁹ before their direct association with AL participation is estimated. As can be seen from Figs. 2 and 3, the nexus between family duties, work and participation in education seems to be working exceptionally well in explaining AL participation of young and low-educated (see Table 4).

First, consider the results on the care index. The care index is a proxy for the "care" related barriers and is of the same direction in the case of males and females. If a woman is living in a household with individuals in age usually demanding some care (kids or seniors), her chances to participate in AL are statistically significantly lower (confirming our H1a). This is true for both identified types of AL, formal as well as non-formal, and observed for all four groups. The only exemption is non-formal AL of low-educated young adults, where the coefficient is not statistically significant. When looking at males, the need for care within the household limits their participation only in formal AL (H1 was confirmed only in the case of formal AL). There is only marginally significant evidence for such an association in the case of non-formal AL among low-educated employed males.

Next, consider the share of non-earners in the household. We assume that a higher share of non-earners in the household is positively associated with a higher need for income of the employed individual whose AL participation is being considered. The higher need of income can be reflected either in an immediate increase in the

¹⁹ Which is one of the explanatory variables endogenous to the model, see Eq. 2a in Sect. 3.4.

Target		Employ	Employed							
group		All	All		Low educated		Young and low- educated		Migrants	
Type of	f AL	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	
House- hold	Female*care index			-	-					
re- lated bar- ri- ers	Male*care index					-				
	Male*non earners in the HH	+			-				-	
	Female*non earners in the HH	+ + +						+ +		
	Working hours		+++		+++	-			+++	

Table 4 Estimation results for the household characteristics. (Source: EU-LFS 2016)

+++ positive coefficient with p < 0.001

++ positive coefficient with p < 0.01

+ positive coefficient with p < 0.05

– negative coefficient with p < 0.05

-- negative coefficient with p < 0.01

-- negative coefficient with p < 0.001

number of working hours (for which we account for) or even in upgrading the qualification level in order to attempt for an increase in income (H3). We partially observe a positive association between the share of non-earners in the household and participation in formal AL (mainly in the case of the female when looking at all employed and migrants), thus females when under a higher income pressure seem to be choosing formal AL as a channel of a potential wage increase. Unfortunately, this is not observable for the low-skilled and young low skilled, where the potential benefit could be the highest. This finding is interesting from the perspective of designing a more inclusive AL policy. This pattern is only observable for females; the evidence for males is only marginally significant. We have thus found only partial support in favour of the H3.

We also observe a negative association between non-earners in the household and non-formal AL. Non-formal AL is, to a significant extent, driven by workplace provided AL. It seems that in the case of non-formal AL, increased income pressure results in more working hours as well as more work during the working hours at the expanse of AL.

The number of actual working hours is, in line with the expectations (phrased in H2 and H2a), negatively associated with participation in formal AL and positively associated with the participation in non-formal AL. These associations are one of the strongest in the model and clearly observable across all the groups of interest (with the only exemption of participation of young and low-educated in non-formal AL). There is clear evidence about a negative trade-off between the working time

and formal learning and positive association of non-formal learning and working time.

4.2.3 Job characteristics

With regard to job-related barriers, we explore the information on the occupation of employed individuals. First, we construct the over-education index, which is the difference of individuals' years of schooling from the median years of schooling within his occupational group. We follow this variable separately for those working in a high-skill or low-skill occupation. Thanks to this disaggregation, we intended to be able to observe potential heterogeneity in the direction of the association. Yielded evidence suggests rather towards homogeneity in the association of over-education and AL participation when disaggregated by occupation (see Table 5).

For those employed in a low-skill occupation, being overeducated at their current position leads to higher participation in formal as well as non-formal AL. This association disappears in the case of non-formal AL of low-educated. In support of the H5, those who work in a low-skill occupation where they do not fully utilise their education, AL seem to present a channel for improving this situation. In the case of those already working in high-skilled occupations, this association is less observable.

The risk of computerisation is negatively associated with both types of AL participation. Individuals working in occupations under a higher risk of computerisation

Target		Employ	ed							
group		All	All		Low educated		Young and low- educated		Migrants	
Туре с	of AL	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	
Job re- lated	Low- skilled*Over- education	+ + +	+++	++		++		+ + +	+++	
bar- ri- ers	High- skilled*Over- education		+++	+					++	
	Risk of com- puterisation									
	High skilled occupation (dummy)	+ + +	+++	++	+ + +	+ +		+ + +	+++	
	Supervision (dummy)	-	+ + +		+ + +				+++	

 Table 5
 Estimation results for the job characteristics. (Source: EU-LFS 2016)

+++ positive coefficient with p < 0.001

++ positive coefficient with p < 0.01

+ positive coefficient with p < 0.05

– negative coefficient with p < 0.05

- negative coefficient with p < 0.01

-- negative coefficient with p < 0.001

participate less either in formal AL, as well as in the (dominantly workplace-driven) non-formal AL. Confirming the H4, this is a pattern observable in the case of the main age group of employed, formal AL of low-educated and non-formal AL of employed migrants.

Working in a high skilled occupation (ISCO 1–4) is linked with higher participation in both formal as well as non-formal AL. Occupational complexity, thus according to the expectations, matters for the participation in AL. This association is observable across all the groups of interest (although the coefficient is not statistically significant for non-formal AL of young and low-educated).

Having supervising duties in the current job is associated with lower participation in formal AL and higher participation in (dominantly workplace driven) non-formal AL.

4.2.4 Employer's characteristics

Individuals looking for a new job²⁰ are more likely to participate in AL. The exemption here is the young and low-educated adults participating in formal AL, this

Target		Employ	ed						
group		All		Low educated		Young and low- educated		Migrants	
Type of AL		Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal
Looking for a job		+ + +	+ + +	+	+++				+ +
Economic sector	Agriculture								
(Public services omitted)	Industry					-	-		
	Construction								
	Private services					-			
Number of em- ployees in the local	Less than 10 11–20								
unit (over 50 omitted)	21–50								

Table 6 Estimation results for the employer's characteristics. (Source: EU-LFS 2016)

+++ positive coefficient with p < 0.001

++ positive coefficient with p < 0.01

+ positive coefficient with p < 0.05

– negative coefficient with p < 0.05

- negative coefficient with p < 0.01

-- negative coefficient with p < 0.001

²⁰ Looking for a new job was used among the characteristics of the employer as an employee's subjective assessment of the working conditions at his current employer.

segment might be fogged by employed individuals with unfinished initial education, not looking for a job until graduation (see Table 6).

Our results confirm that AL participation is higher among people who work in organisations with more employees, as well as in the sector of services and especially public services. Although all the three considered employer's characteristics appear to send a clear message, with dominantly statistically significant coefficients, the overall contribution of this set of variables does not appear as strong in contributing to the explanatory power of the model (Figs. 2 and 3).

4.2.5 System characteristics

In this section, we shift to variables varying at the level of region and country²¹. These are capturing the contextual factors influencing the decisions of individual actors to decide on participation in AL.

Opposing the expectations (H7), subjective assessment of costs being the main obstacle in AL participation shows a positive association with non-formal AL. This becomes more understandable when we again underline, that non-formal AL is dominantly driven by workplace provided training. A positive, statistically significant coefficient for subjective costs then indicates that individuals more likely participate in AL when employers pay for the costs associated with it. Further, as originally expected, a negative association is observed in the case of formal AL and only for low-educated and young and low-educated adults. This suggests that in countries, the low-educated are the most vulnerable to high costs associated with AL.

Evidence on the association between the mean age of the regional population and AL participation is inconclusive. This is contradictory to the expectation, based on the economic theory that the returns to learning declines with age and older countries/ regions should thus invest less in AL. Such an assumption seems to be based on an unjustified simplification because when controlling for individual age as well as other characteristics of the countries/regions, no patters suggesting a straightforward association prevail.

Out of the variables capturing the system of initial education in the region, government expenditures on education show a positive association mainly with nonformal AL participation. More interesting is perhaps the positive association between the entrance age into lower secondary education and formal AL participation. This pattern is observed for all groups of interest. The entrance age into secondary education is usually the moment at which specialisation occurs. Therefore, in line with H8, our findings are in favour of providing more general skills and education as a potential precondition for supporting formal AL.

The years of compulsory schooling are negatively associated with participation in non-formal AL of all four groups of interest. In the case of formal AL participation,

²¹ Table 7 reports coefficients β_r from Eq. 1. System characteristics are to a higher extent correlated with each other, and, therefore, we need to account for the associations between them. Some system determinant variables were therefore kept in the final version of the model even if their association with AL participation was not statistically significant, but they showed a significant association with other system determinant variables. Table B5 appended to the online annexo summarizes the results of the sub-equations with selected system characteristics as dependent variables.

Target group		Employed							
		All		Low ed	Low educated		Young and low- educated		Migrants
Type of A	L	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal	Formal	Non- formal
Costs of A	AL		+ +		+++		+ + +		+ +
Demo- graphy	Mean age of the	-		_			+++		
Initial edu-	Years of compul- sory								
cation	Entrance age into	+ + +		+ + +		+		+ +	
	Share of students in vocational programmes					_		+ +	
	Government expenditure on		+ + +		+++			+ +	+ +
Labour	Employment rate						+		+ +
mar- ket	Share of dis- missals								
	Share of tempo- rary contracts			+					
	Active Labour Market Policy expenditure on Training		++		+++				++
Economy	Regional GDP	+		+					
	Number of patent		+++		++		+ +	+ + +	+

Table 7	Estimation results for	or the role of	system ch	aracteristics	in AL	participation.	(Source:	EU-LFS
2016)								

+++ positive coefficient with p < 0.001

++ positive coefficient with p < 0.01

+ positive coefficient with p < 0.05

– negative coefficient with p < 0.05

- negative coefficient with p < 0.01

-- negative coefficient with p < 0.001

a higher number of compulsory schooling seems to decrease formal AL participation of migrants. This association is also observable for formal AL participation of the main age group of employed, but in this case, the statistical significance might be driven by the sample size. This variable is also used in other sub-equations, as it not only strongly determines the expenditures to education, but also the number of patent applications and GDP.

The share of students in vocational programmes at the upper secondary level does not show a clear pattern of association with AL participation. Marginally significant coefficients suggest a negative association with participation in formal AL of young and low-educated and a positive association with formal AL of migrants (see Table 7).

For the regional employment rate, we expected a positive association with AL (H9), but this was only marginally significant for non-formal AL of young, low-educated and migrants.

The evidence for the share of dismissals and temporary contracts is ambivalent, with no clear message in favour of the H9a hypothesis.

The active labour market policy expenditures on training, appear to be positively associated with non-formal AL (employed, low-educated and migrants) and negatively with formal AL (low-educated and migrants).

Finally, the indicators of economic development, regional gross domestic product (GDP) per capita, as well as the number of patent applications are clearly, positively associated with AL participation. The association of regional GDP, in the case of non-formal AL, twists to negative but not statistically significant figures. For the number of patents, a statistically significant and uniformly positive association is observed for most of the combinations of type of AL and group of interest. This is in line with expectations (H10) based on previous studies, as Groenez and co-authors (2007) claim that the innovativeness of the economy should be a strong determinant of AL participation.²²

5 Conclusions

Building on previous frameworks in the field of adult education and economics, we have developed a supra-individual comparative framework that covers the multiple layers of the complex problem in order to reveal those barriers (hindrances or bounds) that distinguish participants from nonparticipants to AL in distinct societies in 27 European Union countries and Norway. Furthermore, we have constructed new indicators which, to this moment, where not fully covered in the analysis of barriers to participation in AL, such as the indicator for over-education and for caring for family members. We have empirically operationalised the new framework by using Generalised Structural Equation Modelling (GSEM) techniques that allow us to control, as best as possible, for individual-level confounding factors and interdependency of system characteristics. At the same time, we do not have to assume independence of observations, since individual decisions to participate in AL may be jointly influenced; for example by the features of the supply of AL organised at the regional level.

Controlling as for confounding variables and interdependency, we identify several system characteristics that play a key role in AL participation. For example, we estimate a positive association between the entrance age into lower secondary education and formal AL participation. This pattern is observed for all disadvantaged groups. The entrance age into secondary education is usually the moment at which specialisation occurs. From this finding, it is argued that general skills retrieved in initial education are potentially important for engagement with formal AL at adult age.

²² Results are robust to changes in the definition of the most important explanatory variables, as well as to minor changes in the design of the model (Table C in the Appendix to the Online Annexe).

With regard to other (than education) system characteristics, the (perceived) costs of AL are important determinants of (non-)participation. Here, the results indicate that employees participate more often in AL when the employer pays for the (workplace provided non-formal) AL. However, we find a different picture with regard to participation in formal learning. We observe a negative association between the costs of AL and the participation rate for low-educated employees and for low-educated young adults. From these findings we argue that: (1) the low-educated generally perceive the costs associated with AL higher than the high-educated; (2) the loweducated need support from employers the most, while, according to previous literature, they receive it the least; and (3) altogether the low-educated are most vulnerable to exclusion from AL participation.

Because our analysis separately considers formal and non-formal AL, it was able to reveal different patterns associated to each of the types of AL. For instance, usual working hours are negatively associated with participation in formal AL and positively associated with participation in non-formal AL. This suggests that nonformal AL is driven by workplace training. Further, we observe that overqualified individuals are more likely to participate in AL, especially if they work in a lowskilled occupation. At the same time, working in an occupation with a higher risk of computerisation is linked with a lower AL participation.

It is observed that the nexus between household-related duties and working time works better in explaining AL participation of the low-educated (young) adults, in comparison to other (age) groups. Policymakers and government officials could respond to this observation with a more inclusive policy designed to address their life situation.

Our study results suggest that household-related barriers play a substantially more important role if one is under 30 and low-educated, whereas the individual characteristics present the strongest block of variables in explaining formal AL participation of other considered groups. At the same time, the contribution of system-level variables (institutional and policy framework of the country/region) steps forward in the case of disadvantaged groups (especially low-educated). In line with the expectations, job-related characteristics play a more important role in the case of non-formal AL participation.

Despite the contributions to previous literature we have made, there are limitations to mention. While GSEM offers statistical advantages, it does not account for the problem of reversed causality. This problem implies that, for example, increases in the AL participation rates induce public expenditures on education to rise, in particular, in countries which focus on public provision of formal learning to adults, or in countries with public funding schemes for non-formal learning. The rise in public expenditure on education is then (partially) driven by increase AL. This cannot be disentangled using GSEM.

To conclude, there are avenues for further research. First, statistical analysis would benefit from longitudinal data, which track the same person over time, and from qualitative data that support our findings. Second, we could expand the range of disadvantaged groups. Third, it is worthwhile to consider analyses of informal learning in addition to formal learning and non-formal learning. Moreover, additional research is advised in order to investigate policy or practical implications.

Acknowledgment This article uses data from Eurostat obtained for the needs of Research Project Proposal 124/2016-LFS-AES-CVTS-CSIS. The responsibility for all conclusions drawn from the data lies entirely with the authors.

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References

- Acemoglu, D., & Pischke, J. S. (1998). Why do firms train? Theory and evidence. *The Quarterly Journal of Economics*, 113(1), 79–119.
- Antikainen, A. (2006). Participation in adult education in a Nordic context. In A. Antikainen, P. Harinen & C.A. Torres (Eds.), From the margins. Adult education, work and civil society (pp. 131–145). Rotterdam/Taipei: Sense Publishers.
- Bassanini, A., Booth, A., Brunello, G., De Paola, M., & Leuven, E. (2007). Workplace training in Europe. In G. Brunello, P. Garibaldi & E. Wasmer (Eds.), *Education and training in Europe* (pp. 143–309). Oxford: Oxford University Press.
- Becker, G. (1993). Human capital: a theoretical and empirical analysis with special reference to education (3rd edn.). London: University of Chicago Press.
- Boeren, E. (2016). Lifelong learning participation in a changing policy context: an interdisciplinary theory. New York: Palgrave Macmillan.
- Boeren, E. (2017). Understanding adult lifelong learning participation as a layered problem. *Studies in Continuing Education*, 39(2), 161–175. https://doi.org/10.1080/0158037X.2017.1310096.
- Boeren, E., & Whittaker, S. (2018). A typology of education and training provisions for low educated adults: categories and definitions. *Studies in the Education of Adults*, 50(1), 4–18. https://doi.org/10. 1080/02660830.2018.1520017.
- Boeren, E., Nicaise, I., & Baert, H. (2010). Theoretical models of participation in adult education: the need for an integrated model. *International Journal of Lifelong Education*, 29(1), 45–61.
- Boudon, R. (1974). Education, opportunity, and social inequality: changing prospects in western society. New York: Wiley.
- Brown, T. A. (2006). Confirmatory factor analysis for applied research. New York: Guilford.
- Brunello, G. (2001). On the complementarity between education and training in Europe. IZA discussion paper no. 309.
- Cabus, S. J., Ilieva-Trichkova, P., & Stefanik, M. (2018). A pseudo-panel dataset on lifelong learning. MS3: enliven project.
- CEDEFOP (2015). Job-related adult learning and continuing vocational training in europe, a statistical picture. Research paper no. 48. Luxembourg: Publications Office of the European Union.
- Chapman, J., McGilp, J.E., Cartwright, P., De Souza, M., & Toomey, R. (2006). Overcoming barriers that impede participation in lifelong learning. In J. Chapman, P. Cartwright & J.E. McGilp (Eds.), *Lifelong learning, participation and equity* (pp. 151–174). Dordrecht: Springer.
- Cross, K.P. (1981). Adults as learners: increasing participation and facilitating learning. San Francisco: Jossey-Bass.
- Dammrich, J., Vono de Vilhena, D., & Reichart, E. (2014). Participation in adult learning in Europe: the impact of country-level and individual characteristics. In H. P. Blossfeld, E. Kilpi-Jakonen, D. Vono de Vilhena & S. Buchholz (Eds.), Adult learning in modern societies: an international comparison from a life-course perspective (pp. 29–55). Cheltenham: Edward Elgar.
- Darkenwald, G.G., & Merriam, S.B. (1982). Adult education: foundations of practice. New York: Harper and Row.
- De Witte, K., Nicaise, I., Lavrijsen, J., Van Landeghem, G., Lamote, C., & Van Damme, J. (2013). The impact of institutional context, education and labour market policies on early school leaving: a comparative analysis of EU countries. *European Journal of Education*, 48(3), 331–345.

- Desjardins, R. (2017). Political economy of adult learning systems comparative study of strategies, policies and constraints. London: Bloomsbum.
- Desjardins, R., Rubenson, K., & Milana, M. (2006). Unequal chances to participate in adult learning: international perspectives. Paris: UNESCO. (No. null)
- Dhanidina, L., & Griffith, W.S. (1975). Costs and benefits of delayed high school completion. Adult Education, 25(4), 217–230.
- Elder, G. H. (1998). The life course as developmental theory. Child Development, 69(1), 1-12.
- Elder, G. H., & Crosnoe, R. (2002). The influence of early behavior patterns on later life. In L. Pulkkinen & A. Caspi (Eds.), *Paths to successful development* (pp. 157–176). Cambridge: Cambridge University Press.
- European Commission/EACEA/Eurydice, 2015. Adult Education and Training in Europe: Widening Access to Learning Opportunities. Eurydice Report. Luxembourg: Publications Office of the European Union.
- EUROSTAT (2016). EU labour force survey explanatory notes. Luxembourg: EUROSTAT.
- Evans, K., Schoon, I., & Weale, M. (2013). Can lifelong learning reshape life chances? *British Journal of Educational Studies*, 61(1), 25–47. https://doi.org/10.1080/00071005.2012.756163.
- Fishbein, M., & Ajzen, I. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice Hall.
- Frey, C. B., & Osborne, M. A. (2016). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting & Social Change*, 114, 254–280. https://doi.org/10.1016/j.techfore. 2016.08.019.
- Gambetta, D. (1987). Were they pushed or did they jump? Individual decision mechanisms in education. Cambridge: Cambridge University Press.
- Gorard, S., & Rees, G. (2002). Creating a learning society? Learning careers and policies for lifelong learning. Bristol: The Policy Press.
- Groenez, S., Desmedt, E., & Nicaise, I. (2007). Participation in lifelong learning in the EU-15: the role of macro-level determinants. In *ECER Conference*. Ghent, Belgium, September 19–21. Paper.
- Kyndt, E., & Baert, H. (2013). Antecedents of employees' involvement in work-related learning: a systematic review. *Review of Educational Research*, 83(2), 273–313.
- Laal, M. (2011). Barriers to lifelong learning. Procedia-Social and Behavioral Sciences, 28, 612-615.
- Lassnigg, L. (2005). Lifelong learning, school to work and labour market transitions. Position paper workpackage 4. Amsterdam: SISWO/Social Policy Research. TLM.NET 2005 Working Paper No. 2005-06
- Lavrijsen, J., & Nicaise, I. (2017). Systemic obstacles to lifelong learning: the influence of the educational system design on learning attitudes. *Studies in Continuing Education*. https://doi.org/10.1080/ 0158037X.2016.1275540.
- Lazear, E. P. (2009). Firm-specific human capital: A skill-weights approach. Journal of political economy, 117(5), 914–940.
- Lee, J. (2018). Conceptual foundations for understanding inequality in participation in adult learning and education (ALE) for international comparisons. *International Journal of Lifelong Education*, 37(3), 297–314.
- Lee, J., & Desjardins, R. (2019). Inequality in adult learning and education participation: the effects of social origins and social inequality. *International Journal of Lifelong Education*, 38(3), 339–359.
- McGivney, V. (2001). Fixing or changing the pattern. Reflections on widening adult participation in learning. Leicester: NIACE.
- Menard, S. (2000). Coefficients of determination for multiple logistic regression analysis. *The American Statistician*, 54, 17–24.
- Merriam, S.B. (2005). How adult life transitions foster learning and development. New Directions for Adult and Continuing Education, 108, 3–13.
- OECD (2003). Beyond rhetoric: adult learning policies and practice. Paris: OECD.
- Roosmaa, E., & Saar, E. (2012). Participation in non-formal learning in EU-15 and EU-8 countries: demand and supply side factors. *International Journal of Lifelong Education*, 31(4), 477–501. https://doi.org/ 10.1080/02601370.2012.689376.
- Roosmaa, E., & Saar, E. (2016). Adults who do not want to participate in learning: a cross-national European analysis of their perceived barriers. *International Journal of Lifelong Education*, 36(3), 254–277. https://doi.org/10.1080/02601370.2016.1246485.

Rubenson, K. (1975). Participation in recurrent education. Paris: CERI/OECD.

Rubenson, K., & Desjardins, R. (2009). The impact of welfare state regimes on barriers to participation in adult education: a bounded agency model. *Adult Education Quarterly*, 59, 187–207.

- Schultz, T. W. (1961). Investment in human capital. The American Economic Review, 51(1), 1–17.
- StataCorp (2015a). STATA structural equation modeling reference manual release 14. Statistical software. College Station, TX: StataCorp LLC.
- StataCorp (2015b). Statabase reference manual release 14. Statistical software. College Station, TX: StataCorp LLC.
- Tuparevska, E., Santibáñez, R., & Solabarrieta, J. (2019). Equity and social exclusion measures in EU lifelong learning policies. *International Journal of Lifelong Education*. https://doi.org/10.1080/ 02601370.2019.1689435.
- Wolbers, M. H. J. (2005). Initial and further education: substitutes or complements? Differences in continuing education and training over the life-course of European workers. *International Review of Education*, 51(5/6), 459–478.

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