



Innovative Applications of O.R.

Measuring active ageing: A Data Envelopment Analysis approach

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ABSTRACT

The 'Active Ageing Index' was created with the purpose of helping policy makers implement and monitor active ageing policies both at European and national levels. However, this index has not fully achieved this purpose. In this article we propose a methodological approach based on Data Envelopment Analysis to enhance the measurement of active ageing in the European Union countries. We use a model with 22 indicators grouped into four domains. By introducing different types of virtual weight restrictions, we combine normative judgements with an optimisation procedure, showing each country in the best possible light. Furthermore, we undertake a sensitivity analysis regarding the effect of varying the limits of the relative contribution of each domain.

The results show that the proposed approach has great potential in this context, allowing the comparison of countries and the identification of relevant targets and benchmarks, even when there is uncertainty regarding the relative importance of the indicators and domains considered. For most countries, the results are robust regarding different levels of flexibility for the relative contribution of each domain. We identify six countries that represent relevant benchmarks for the underperforming countries. The underperforming countries have some potential for improvement in terms of active ageing, whilst respecting their preferences and specificities for the processes that can be used to actively age. Based on a flexible evaluation of the countries, we contribute to develop a better tool to guide the European Union countries towards the formulation and monitoring of more effective policy measures to promote active ageing.

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1. Introduction

Population ageing is characterised by an increase of the proportion of older individuals and by a decrease of the proportion of young individuals. Population ageing is one of the greatest triumphs of Humanity, yet it raises many challenges for governments and societies (World Health Organisation, 2002). The most cited challenges are the increased pressure on healthcare systems, the sustainability of social security systems and the reduced availability of informal/family care and formal care. However, it is also acknowledged that population ageing can offer many opportunities for governments and societies, and that these opportunities are compatible with the preservation of the older persons' rights to live a healthy, dignified and fulfilling life. Older people have the potential to make a great contribution to society, due to their accumulated experience and wisdom, by staying longer in the labour market and/or by having an active participation in society

(e.g. providing care to children or to adults, making voluntary work, participating politically, etc.). Whilst this participation can be very valuable to society, it will also be of benefit to the older persons, as long as they desire to participate, can choose the most appropriate ways to participate and are given the support needed to participate.

In the European Union (EU), active ageing has emerged as a crucial policy response to the challenges and opportunities of population ageing (Foster & Walker, 2015). According to several authors (see, for example, São José & Teixeira, 2014; Walker, 2002), the most comprehensive definition of active ageing is proposed by the World Health Organisation (WHO), which defines it as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" (WHO, 2002, p. 12). The WHO also stresses that "Active ageing applies to both individuals and population groups. It allows people to realize their potential for physical, social, and mental wellbeing throughout the life course and to participate in society according to their needs, desires and capacities, while providing them with adequate protection, security and care when they require assistance" (WHO, 2002, p. 12).

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While the active ageing discourse has been introduced in the EU policy agenda and in the policy agendas of its member states, the practical implementation of their ideals regarding this issue, through concrete policy responses, remains a challenge. This is related to the fact that active ageing is multidimensional, covering different domains of the persons' lives, requiring, therefore, a comprehensive policy approach based on strong empirical evidence.

The 'Active Ageing Index' (AAI) is a composite indicator which aggregates information regarding several dimensions of active ageing. The AAI was created precisely to help policy makers implement and monitor active ageing both at European and national levels. This index is a project managed jointly by the European Commission's Directorate General for Employment, Social Affairs and Inclusion, and the Population Unit of the United Nations Economic Commission for Europe. As described in Zaidi (2014), the AAI is an aggregated measure which takes into account four domains: employment; participation in society; independent, healthy and secure living; and capacity and enabling environment for active ageing. Each domain comprises a set of indicators. Twenty-two indicators in total are used to calculate a country's AAI. As an aggregate measure, the total score of the AAI for each country is calculated based on a fixed structure of weights, defined by a panel of experts on ageing (see Zaidi et al., 2013), which is assigned to the domains and to the indicators within each domain. The total score of the AAI ranges from 0 to 100, being the maximum value a theoretical possibility rather than a realistic target. Higher scores indicate greater levels of active ageing practices and better enabling conditions. The AAI 2014 (the latest index) ranks Sweden in first place with a weighted average of 44.8 percent. This result was discussed in the final AAI report (Zaidi, 2014) as evidence of great potential for improvement in all countries.

In January 2014, the researchers involved in the measurement of the AAI undertook a meeting with a panel of experts on ageing, in order to receive feedback regarding the methodology used and the results obtained. Whilst recognising the important step that had been achieved with the production of the AAI, the panel of experts raised several issues regarding the need to undertake future studies in order to enhance the methodology behind the measurement of the index (Report on the Third Meeting of the Expert Group on the Active Ageing Index – RTMEGAA, 2014). The first main suggestion made relates to the need to further investigate the weights chosen for the domains and the indicators, as the panel expressed concerns regarding the arbitrariness involved in the choice of the weights. The second main suggestion relates to the need to investigate the possibility of identifying relevant benchmarks and setting achievable targets for performance improvement. The panel considered that identifying benchmark countries and realistic targets (as the target of 100 percent is not achievable) would be very useful for learning purposes and performance improvement. To the first concern expressed by the experts, we would like to add another important limitation of the AAI: the fixed weight structure applied to the domains and indicators, which assigns equal weights to all countries being compared. A fixed structure of weights in the comparison of countries has been criticised by other authors (see, for example, Lovell, Pastor, & Turner, 1995).

These limitations of the AAI are of paramount importance for two reasons. Firstly, as emphasised by Nardo et al. (2005), the choice of weights is crucial in the measurement of the multidimensional performance of countries for two important reasons: (1) the weights can have a significant impact on their scores and rankings; (2) the weighting scheme may create incentives for the evaluated countries (more effort will tend to be put on the indicators that have higher weights). However, as suggested by Cherchye, Moesen, Rogge, and Van Puyenbroeck (2007), if a consensus cannot be reached regarding the most appropriate weights to use, it is

important to use a methodology that accounts for the diversity of perspectives and gives the countries the "benefit of the doubt" in the choice of weights. Secondly, if the AAI is aimed at supporting the formulation of policies to improve the level of active ageing, it is essential to identify benchmarks and achievable targets that can guide underperforming countries in the formulation of these policies. Overcoming these limitations has the potential to make the AAI a better tool for policy-making and analysis. This article aims to contribute to overcome these problems and, at the same time, identify the relative strengths and weaknesses of each country with respect to active ageing. In order to achieve this aim, we use a methodological approach based on Data Envelopment Analysis (DEA), a non-parametric technique initially developed by Charnes, Cooper, and Rhodes (1978). We use the 22 indicators included in the AAI to construct a composite indicator of active ageing, but instead of using a fixed weight structure, we allow some flexibility in the choice of weights. We undertake an optimisation procedure constrained by ordinal and proportional virtual weight restrictions supported by sensitivity analysis. In developing the weight restrictions, we follow the work initiated by Sarrico and Dyson (2004), Wong and Beasley (1990) and Zanella, Camanho, and Dias (2013), whilst adapting the restrictions in order to address the specific challenges raised by the measurement of active ageing.

DEA has been widely used to construct composite indicators to compare countries and regions. Mariano, Sobreiro, and Rebelatto (2015) provide a review of 57 studies that use DEA for human development assessment. Mahlberg and Obsteiner (2001) pioneered this type of studies by using DEA to re-evaluate the Human Development Index (HDI) of countries. Following this initial study, other researchers continued to explore the use of DEA to assess countries HDI (see, for example, Despotis, 2005a, 2005b). Other researchers have explored the use of DEA to compare countries in different contexts. For example, Cherchye et al. (2008) used DEA to compare the level of Technological Achievement of countries, undertaking a robustness analysis regarding the weights proposed by a panel of experts; Filipetti and Peyrache (2011) contrasted the use of DEA with the use of composite indicators with fixed weights to measure the level of technological capabilities of countries; and Zanella et al. (2013) combined DEA with cluster analysis to compare the level of environmental performance of countries. In the context of the EU, we also find some examples of studies that have explored the potential of DEA to compare the level of development of countries. Cherchye, Moesen, and Van Puyenbroeck (2004) demonstrated that, despite the fact that European countries have some specificities, DEA can be used for policy benchmarking in terms of social inclusion; Lefebvre, Coelli, and Pestieau (2010) used DEA to analyse the evolution of social protection performance of 15 European countries from 1995 to 2006, concluding that there was evidence of convergence between the countries analysed; and more recently, Giambona and Vassalo (2014) used DEA to compare the level of social inclusion of 27 EU countries, concluding that it increased from 2006 to 2010.

Some authors have also used modified versions of the mathematical DEA model in order to incorporate some important aspects in the evaluation of countries. For example, Cheng and Zervopoulos (2014) used a Directional Distance Function to compare countries health systems including both desirable and undesirable outputs.

Despite the vast range of studies using DEA for multidimensional performance assessment of countries, to the best of our knowledge, no published study has explored the use of DEA to measure the level of active ageing, and this is precisely what we do in this article.

The remainder of this article is structured in the following way. In the second section we critically review the literature regarding the concept of active ageing and the methodology used by Zaidi et al. (2013) to measure the AAI. In the third section, we

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