Convergence of European healthcare systems: a cluster analysis

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Abstract

This paper examines whether European healthcare systems can be meaningfully grouped into distinct clusters based on institutional characteristics and health outcomes. To address this question, we conduct a cluster analysis of 26 European countries over the period 2001-2021. The findings provide limited empirical support for the conventional classification into Nordic, Continental, and Liberal models within the healthcare domain, both in terms of institutional features and health outcomes. Rather, most Western European countries cluster together, while a distinct and robust cluster of Eastern European countries clearly emerges.

Keywords: health, welfare state, cluster, Europe, Esping-Andersen

1 INTRODUCTION

In recent decades, European healthcare systems have faced increasing pressures from ageing populations, rising healthcare costs, and growing demands for equitable and high-quality services. These challenges have been accompanied by broader transformations in welfare states, including shifts in public spending priorities, marketisation of services, and evolving roles of the state, family, and private actors in providing care.[1] As a result, the organisation and performance of healthcare systems have become not only a matter of national policy, but also a key dimension of comparative welfare research, reflecting how different countries balance efficiency, equity, and social protection.

Accordingly, understanding whether healthcare systems continue to exhibit distinct national patterns or whether they exhibit performance similarities is crucial for both policymakers and academics. If similarities occur, traditional welfare state typologies may be less informative in explaining differences in health system performance. Conversely, persistent clustering along established welfare regime lines would suggest that historical institutional logics continue to shape healthcare provision and outcomes.

Against this backdrop, European healthcare systems can be examined in terms of both their institutional characteristics and health outcomes to assess whether distinct clusters emerge or whether performance similarities increase over time. A natural point of reference for this discussion – although not originally developed for the health sector – is Esping-Andersen's (1990) influential classification of welfare states. Esping-Andersen distinguishes three welfare regimes – liberal, corporatist, and social democratic – based on the extent to which social rights enable de-commodification, understood as individuals' capacity to access essential goods and services independently of market forces. Liberal regimes rely predominantly on markets, with limited public provision, modest benefits, and strict eligibility criteria. Corporatist regimes link social entitlements closely to occupational

[1] Hermann (2010); Taylor-Gooby, Leruth and Chung (2017), especially chapter 1; Pestieau and Lefebvre (2018), especially chapter 11.

status, while social democratic regimes are grounded in universalism and solidarity, providing comparatively generous benefits as a citizenship right. In this pioneering framework, European countries were grouped into distinct and internally coherent models, each characterised by a specific logic of welfare provision.[2]

Building on Esping-Andersen's approach, a vast literature has since emerged seeking to confirm, revise, or challenge the original "three worlds" typology in light of new empirical evidence and theoretical developments.[3] Despite these efforts, the debate remains far from settled. As Powell, Yörük and Bargu (2019:68) note, empirical support for the three-world classification is mixed at best, and few countries fully conform to the ideal-typical characteristics identified by Esping-Andersen. Rather than interpreting Esping-Andersen's typology as a rigid representation of empirical reality, it may therefore be more productive to conceptualise it as a set of ideal types differentiated by policy goals and instruments (Palier, 2010:22). This perspective allows for the possibility that different components of the welfare state – such as health, education, and pensions – may evolve asynchronously with respect to institutional structures, rights, benefits, financing, and organizational arrangements.

Thus, although Esping-Andersen's typology was developed primarily with reference to labour-market regulation and cash benefits, it is theoretically plausible that regime-specific logics of state-market-family relations also shape the organisation, financing, and performance of in-kind services such as healthcare. Indeed, one influential line of critique argues that analysing specific welfare domains separately may better capture cross-national variation, since different sectors do not necessarily follow the same trajectory. From this perspective, policy-specific analyses may offer greater explanatory power than global welfare typologies (Kasza, 2002:284). This is an argument originally advanced by Alber (1995:132) and reiterated by Bertin, Carrino and Pantalone (2021). However, with the notable exceptions of Kangas (1994), who examined health insurance in 1950 and 1985, and Bambra (2005a), the literature has devoted surprisingly limited attention to healthcare services. This omission is striking, given that healthcare is typically delivered in kind, often provides universal coverage, and is largely independent of labour market participation.[4] Health spending also constitutes a major share of public social expenditure – typically second only to pensions – and remains a key item in national budgets. In 2023, average health expenditure across OECD countries was approximately 9.3 per cent of GDP; in Europe, the figure was just below 8 per cent, with most spending allocated to hospital services (OECD, 2025a). Despite widespread recognition of healthcare as a core welfare function, it has often been marginal in comparative welfare analyses – still "at the corner of their eye rather than in the centre of their vision" (Moran, 2000:136).

[2] For a discussion see Bambra (2005b); Bergqvist, Yngwe and Lundberg (2013); Fosse (2011).
[3] See, for example, Arts and Gelissen (2002); Ferragina and Seeleib-Kaiser (2011); Danforth (2014); Emmenegger et al. (2015); Saint-Arnaud and Bernard (2003); Taylor Brown and Ben Brik (2024).
[4] See Rothgang (2021); for a recent review, Powell, Yörük and Bargu (2019).

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

When applied to healthcare systems, the available empirical evidence provides only limited support for Esping-Andersen's original clustering. Most studies agree that reconciling national healthcare arrangements with the three-world typology is problematic, particularly because welfare systems in many European countries have undergone substantial redefinition in recent decades. As a result, a complete overlap between healthcare typologies and the Esping-Andersen model is rarely observed (Bertin, Carrino and Pantalone, 2021). This suggests that health regimes are more hybrid than standard classifications imply,[5] although elements of the typology remain aligned with specific national health policies.[6] Recent contributions further question the continued relevance of prototypical cases. Sowula et al. (2023:11) argue that Germany and Sweden may no longer represent conservative and social democratic regimes, respectively. Similarly, Szebehely and Meagher (2017:304) document processes of de-universalisation across Nordic countries, including rising for-profit provision in publicly funded care, increased reliance on family care, and growing out-of-pocket payments – developments that challenge the principle of universalism.

Debates on a possible convergence of healthcare models reflect similar ambiguities. Giaimo and Manow (1999), analysing reforms in Britain, Germany, and the United States, found no evidence of convergence toward a common reform trajectory or a generalised shift toward privatisation. By contrast, Rothgang et al. (2010) identify convergence across OECD countries in public-private mixes, as measured by both beta and sigma convergence,[7] resulting in increasingly hybrid healthcare systems. Swank (2002:230) similarly notes significant retrenchment and efficiency-oriented reforms across pensions, income support, healthcare, and social services.

Other studies have examined specific healthcare domains. In the field of long-term care, evidence from Europe points to a gradual retrenchment of universalism. Ranci and Pavolini (2015:282) show that, since the financial crisis, universal access has often been curtailed through increased private-sector involvement, giving rise to forms of restricted universalism. While formal entitlements have largely remained intact, effective access has become increasingly dependent on constraints in provision and quality. Importantly, these developments cut across political orientations and are better explained by broader fiscal pressures than by ideological shifts (Barbier, 2012:391). In line with this interpretation, Tine et al. (2022:204) document growing inequalities in Denmark's long-term care provision driven primarily by resource constraints. Primary care, another key healthcare domain, has followed a different but related trajectory. Over the past two

[5] See also Reibling, Ariaans and Wendt (2019).
[6] See, for example, Fosse (2011) on health promotion policies. Similar challenges also arise with earlier classifications, such as Wilensky and Lebeaux (1965) residual-institutional distinction, later adopted by Pinker (1971) and Titmuss (1974). See Higgins (1981); Pierson (2006); Carreira Da Silva (2017).
[7] Beta-convergence occurs when units with initially lower levels of a given indicator grow faster over time than those with higher levels; sigma-convergence refers to a reduction in dispersion across units.

decades, it has been reshaped by systemic reforms, technological innovation, and, more recently, post-pandemic restructuring.[8] By the end of the 2000s, comparative studies identified relatively strong primary care systems – particularly in terms of organizational regimes, accessibility, continuity, and coordination – in countries such as Belgium, Denmark, Estonia, Finland, the Netherlands, Portugal, Slovenia, Spain, and the United Kingdom (Kringos et al., 2013). At the same time, former Eastern bloc countries made substantial progress by strengthening the role of general practitioners and introducing gatekeeping mechanisms aimed at moving away from hospital-centred models. During the 2010s, a range of organisational and professional innovations – including nurse prescribing, patient choice of family doctor, integrated health and social care, electronic health records, and telemedicine – became increasingly widespread. The COVID-19 pandemic subsequently underscored the central role of primary care in system resilience, prompting European WHO member states in 2021 to endorse a comprehensive strategy to further strengthen primary health care.[9]

In light of these transformations, traditional classifications of health systems – based on Bismarck, Beveridge, and Esping-Andersen – appear increasingly inadequate. Bismarckian and Beveridgean models primarily distinguish systems according to financing mechanisms, while Esping-Andersen's framework, as noted above, emphasizes degrees of de-commodification; yet, these dimensions may coexist. As a result, real-world health systems have become increasingly hybrid, limiting the explanatory power of these typologies for understanding contemporary patterns of access, inequality, and system performance.[10]

Taken together, this literature does not imply that welfare state classifications have become irrelevant, but rather that their applicability – particularly to healthcare – cannot be taken for granted. The aim of this paper is therefore to assess whether, and to what extent, observable patterns in healthcare systems and outcomes across Europe can be identified. By systematically analysing health-related indicators over a long-time horizon, the paper evaluates whether established welfare regime distinctions still correspond to meaningful differences in health system performance, or whether new empirical clusters have emerged that cut across traditional classifications.

The analysis adopts a long-term perspective, covering the period from 2001 to 2021, to capture cumulative policy effects and avoid short-term fluctuations – particularly those associated with the 2008 financial crisis. The study includes 26 European countries, enabling comparisons among states operating within broadly similar socio-economic and regulatory contexts, yet still exhibiting substantial diversity in organization and access rules, financing mechanisms, and health

[8] The European Practice Assessment (EPA), introduced in the early 2000s, established a common framework for evaluating primary care performance across countries.
[9] See Kringos et al. (2015); Gilardi, Füglister and Luyet (2009); Dubas-Jakóbczyk et al. (2020); Polin et al. (2021).
[10] On Bismarck-type models, see Palier (2010).

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

outcomes. This diversity provides a rich empirical basis for assessing whether national health systems conform to Esping-Andersen's typology or have developed hybrid configurations in response to internal and external pressures, including EU-level recommendations promoting fiscal consolidation and efficiency following the crisis (Alsasua, Bilbao-Ubillos and Olaskoaga, 2007; Bilbao-Ubillos, 2023; Vaughan-Whitehead, 2017).

Methodologically, the paper applies cluster analysis to a set of indicators capturing multiple dimensions of healthcare, with the aim of identifying emerging empirical patterns, while acknowledging the inherently fuzzy boundaries of welfare regimes (Shalev, 2007; Taylor Brown and Ben Brik, 2024). Findings indicate that healthcare clustering in Europe does not closely align with traditional welfare state classifications. Instead, there is evidence that Western European countries tend to cluster together, primarily reflecting performance similarities in health outcomes rather than a true convergence in institutional structures. At the same time, a distinct group of Eastern European countries emerges, with this pattern remaining robust across alternative cluster specifications.

2 METHODS

2.1 THE CLUSTER ANALYSIS

The available literature on the classification of health regimes has made extensive use of cluster analysis. One fundamental reason is that understanding different welfare state regimes often requires examining multiple dimensions that cannot easily be reduced to a single, cross-nationally comparable indicator. When multidimensionality is an issue, clustering countries according to their internal cohesion (homogeneity), while also clarifying the nature of their external separation, adds value to the categorization of welfare states (Obinger and Wagschal, 2001; Kautto, 2002; Powell and Barrientos, 2004; Jensen, 2008; Wendt, 2009; 2014; Minas, Jacobson and McMullan, 2014; Reibling, Ariaans and Wendt, 2019). Additionally, Gough (2001:169) describes cluster analysis as "robust, meaningful and simple," strongly recommending it for the study of welfare regimes. In other contexts, Witt et al. (2018:21) also argue that cluster analysis can be used to investigate the complex and interrelated dimensions of nations, serving as "a foundational tool for sense-making and conceptualization of the object under investigation" or, as Ermakoff (2019) suggests, as a way of letting the data speak for themselves.

In the context of cross-sectional time-series data, a key methodological consideration is whether to perform a cluster analysis separately for each year or, alternatively, to conduct a single cluster analysis on pooled data. In what follows, the analysis initially proceeds by estimating a yearly-cluster solution. This strategy enables the examination of potential movements of countries across clusters over time. However, it implicitly treats each year as an independent dataset, thereby precluding the identification of trajectory effects and limiting the analysis to the observation of repeated relative positions. Such a limitation is particularly consequential when the objective is to assess the presence of absolute convergence in health outcomes across countries. For this reason, a subsequent step involves the implementation of a cluster analysis on pooled data, which allows for a more direct investigation of whether countries display increasing similarity in the joint distribution of structural and performance-related indicators over the period considered. In this context, the pooled-data clustering is intended to capture overall patterns of similarity across countries while retaining the time dimension at the observation level. Although this approach does not explicitly model transition dynamics or provide formal convergence tests, it allows for a comparative assessment of how country profiles relate to one another over time.[11]

Moreover, to prevent variables measured in different units from disproportionately influencing the dissimilarity matrix, all variables are standardised using a z-scoring procedure. Specifically, each variable is transformed by subtracting its mean and dividing by its standard deviation.[12] It is important to note that the choice between year-by-year and pooled clustering entails different z-scoring strategies. When clustering is performed separately for each year, standardisation is based on the mean and standard deviation computed within that specific year. Under this approach, even substantial changes in a variable's scale within a given year – for instance, a doubling of its values – leave its z-scores unchanged and therefore do not affect the resulting cluster solution. Moreover, because standardisation is applied across countries at each time point, mean-level changes over time cannot be detected, as all annual means are normalised to zero. By contrast, when clustering is conducted on pooled data, a sudden shift in a variable in a single year (such as a doubling of its values) alters the overall mean and standard deviation, thereby affecting the corresponding z-scores and potentially modifying the resulting clusters. Although year-by-year analysis can still provide valuable inter-temporal information, it is important to consider that the distribution of multiple indicators typically evolves unevenly across years. As a consequence, year-specific standardisation may modify the relative contribution of each variable to the clustering solution, potentially introducing artefactual temporal variation and complicating the interpretation of long-term patterns.[13] Since the two approaches

[11] As recently argued by Lu (2024), when applied to longitudinal data, clustering seeks to group units of analysis (individuals, regions, countries, etc.) according to the patterns and trends characterizing their repeated measurements over time. Hierarchical clustering represents one methodological option capable of accommodating temporal trajectories, even in the presence of sparse or irregular observations (Zhou, Zhang and Tu, 2023). Applications of longitudinal clustering span multiple domains, including criminology, sociology, medicine, and ecology. Recent examples include the identification of subgroups exhibiting distinct cigarette-smoking patterns for the purpose of predicting health outcomes (Lee et al., 2016), as well as the characterization of adolescent substance-use trajectories and their association with leisure experience (Weybright et al., 2016). For a comparative assessment of methods for clustering longitudinal data, see Den Teuling, Pauws and van den Heuvel (2021).

[12] After z-scoring, the variance of each variable equals 1, which can be interpreted as a special case of weighting based on the reciprocal of the sample standard deviation. This implies that, under the z-score transformation, the influence (or weight) of a variable decreases as its variability increases.

[13] To assess the temporal properties of the series across countries, correlograms were computed for each national time series. The analysis revealed significant autocorrelation in all cases, indicating that observations are not temporally independent but are influenced by their own past values. This evidence supports the use of a pooled-data framework for the subsequent cluster analysis, as it enables the identification of cross-country similarities in underlying dynamic patterns while appropriately accounting for the serial dependence inherent in each series and, potentially, cross-correlation across countries.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

can be viewed as complementary rather than mutually exclusive, the cluster analysis is performed using both methods.

With regard to the clustering method, the analysis is conducted using hierarchical agglomerative clustering, which involves a series of successive agglomerations of *n* countries into groups, beginning with *n* single-member clusters. A limitation of this method is that, once two countries are merged at a given agglomeration step, they cannot be separated in subsequent steps (Kaufman and Rousseeuw, 1990).

Regarding the dissimilarity measure, the analysis employs the squared Euclidean distance in combination with Ward's method. This hierarchical clustering approach merges clusters according to the criterion of minimizing total within-cluster variance (i.e., the error sum of squares). Ward's method is particularly effective in reducing within-cluster heterogeneity, often yielding clusters that are more compact and better separated.[14]

As a final point, a decision must be made regarding the definition of the optimal number of clusters. To this end, the most common and reliable stopping rules are those proposed by Duda and Hart (1973) and Calinski and Harabasz (1974), based, respectively, on a pseudo-T-squared statistic and a pseudo-F statistic.[15] A sensitivity analysis will additionally be conducted using the gap statistic.

2.2 DATA AND VARIABLES

The data used in this analysis are drawn from several sources: OECD Health Statistics; the European System of Integrated Social Protection Statistics (ESSPROS) database; the Health for All (HFA) database of the World Health Organization (WHO); the Social Insurance Entitlement Dataset (SIED); and the Comparative Political Data Set (CPDS). Data are collected for 26 European countries over the period 2001-2021; however, not all countries are observed in every year. Notable exceptions include Iceland (observed in 2005, 2010, 2015, and 2020), Estonia (observed from 2007 to 2021), Luxembourg (observed in 2010, 2015, and 2020), and Norway (observed from 2008 to 2021). Consequently, the resulting dataset constitutes an unbalanced panel.

The variables used in this paper capture various dimensions of the health sector. To address the observation that health spending alone is insufficient to meaningfully distinguish health regimes – due to the general tendency of countries to allocate similar shares of GDP to health – a set of health indicators is introduced to reflect the different aspects of health provision, as also suggested by the OECD classification

[14] Given two pairs of clusters with equally distant centroids, Ward's linkage will preferentially merge the smaller pair, aiming to minimize the total within-cluster inertia (or error sum of squares) rather than the direct distance between clusters. This implies that Ward's method is, in principle, less sensitive to noise and outliers, and it tends to produce compact, approximately spherical clusters of similar size and variance (see Everitt et al., 2011, Chapter 4; Kaufman and Rousseeuw, 1990).

[15] See also Milligan and Cooper (1985).

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

of health data (Esping-Andersen, 1990:19; Castles, 2002:616; 2007; Jensen, 2008:159).

Furthermore, the variables were selected to cover the period from 2001 to 2021 for 26 European countries without significant gaps. Occasional missing values were addressed by extrapolating the observed series. Limitations in the available data prevented the use of other potentially relevant indicators.[16] The analysis initially employs variables that allow all 26 countries to be included; subsequent analyses consider variables that may necessitate the exclusion of one or more countries. The variables used are described in table 1 and cover various dimensions of health characteristics that, in principle, allow for the differentiation of health regimes according to multiple aspects: (a) health expenditures; (b) health status; (c) health quality; (d) health care utilisation; (e) health insurance; (f) long-term care; (g) health resources; and (h) health protection (Kuitto, 2011:350).

To begin with, health expenditures reflect the share of public resources allocated to health, although they do not fully capture the intensity or quality of care across countries (Huber and Stephens, 2001). Health expenditures can, in fact, embody the labour-intensive nature of medical services and the differential dynamics of their prices relative to the overall price index, as well as the potentially rising costs of technological innovations, particularly in specific medical areas (Sorenson, Drummond and Kahn, 2013:228). They may also reflect the increased demand for therapies resulting from the success of medical treatments and the growing number of elderly chronically ill patients, generating a kind of expenditure-growth cycle (Zweifel, Steinmann and Eugster, 2005; Breyer and Lorenz, 2020). Furthermore, as noted by Rothgang et al. (2010), tracking public health expenditures over time may provide insights into certain forms of "indirect" privatisation of the health system (Bambra, 2005a). Overall, as suggested by Freeman (1999), public funding of health care is often considered a key indicator of governmental involvement in health provision.[17]

[16] For example, the Global Health Database provides very limited data even for European countries on key variables related to primary care and health quality indicators.
[17] See also Burau and Blank (2006:65).

Table 1
Variables and source of data

OECD category	Description	Source	Variable	Unit of measure
Health expenditures	Health spending	OECD HS	health	Percentage of GDP
	Cash benefits non means-tested	ESSPROS	V1A	Share of total health benefits
	In kind benefits non means-tested	ESSPROS	V1B	Share of total health benefits
	Cash benefits means-tested	ESSPROS	V1C	Share of total health benefits
	In kind benefits means-tested	ESSPROS	V1D	Share of total health benefits
	Households out-of-pocket payments	OECD HS	outpocket	Percentage of GDP
	Private sector expenditures	WHO	H568	Percentage of GDP
	Public pharmaceutical expenditures	WHO	H580	Percentage of total spending
Health status	Life expectancy at birth	OECD HS	lifexpbirth	Age
	Death rate	OECD HS	deathrate	Per 1,000 inhabitants
	Population aged 65+	OECD HS	oldpop	Percentage of total population
Health quality	Congestive heart failure hospital admissions	OECD HS	congestive	Per 100,000 inhabitants
	Asthma and COPD hospital admissions	OECD HS	asthma	Per 100,000 inhabitants
	Diabetes hospital admissions	OECD HS	diabete	Per 100,000 inhabitants
Health care utilisation	Inpatient discharges	OECD HS	disch	Per 100,000 inhabitants
	Average length of stay (all hospitals)	WHO	H540	Number of days
Health insurance	Government compulsory health insurance	OECD HS	govins	Percentage of the population
	Voluntary health insurance	OECD HS	volins	Percentage of the population
Long-term care	Beds in residential long-term care facilities	OECD HS	longtermbeds	Per 1,000 population aged 65+
Health resources	Total health employment	OECD HS	totemp	Per 1,000 inhabitants
	Number of beds in publicly owned hospitals	OECD HS	beds	Per 1,000 inhabitants

OECD category	Description	Source	Variable	Unit of measure
Health protection	Sickness, gross 26-week replacement rate	SIED	srtsw26s	Percentage of wage
	Weeks during which sickness benefit is payable	SIED	sduratio	Number of weeks
	Waiting days before sickness payment	SIED	swaiting	Number of days
	Coverage ratio as proportion of labour force	SIED	scovratl	Percentage of workers
Institutional and political variables	Cabinet composition	CPDS	gov-party	Index from 1 to 5
	Voter turnout in elections	CPDS	vturn	Percentage of voters
	Fractionalization of party system	CPDS	rae-ele	Index from 0 to 1
	Index of federalism	CPDS	fed	Index from 0 to 2
	Executive-Legislative relations	CPDS	pres	Index from 0 to 3

Note: OECD HS = OECD Health Statistics, ESSPROS = European System of Integrated Social Protection Statistics, WHO = World Health Organization, SIED = Social Insurance Entitlement Dataset, CPDS = Comparative Political Data Set.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

Still on the side of monetary resources, a set of additional variables is considered:[18] means-tested and non-means-tested cash benefits; means-tested and non-means-tested in-kind benefits; household out-of-pocket payments as a percentage of GDP; private-sector expenditures as a percentage of GDP; and public pharmaceutical expenditures as a percentage of total health spending.[19] In particular, including cash transfers in our analysis helps identify the terms on which individuals can make claims on public resources and the type of solidarity fostered by systems of public support. The way cash transfers are organised also reveals the priorities that underpin governmental action (Daly, 1997). Moreover, observing cash and in-kind transfers over the last twenty years may capture the effects of reforms that have potentially restricted access to benefits by tightening eligibility criteria and regulations; reforms aimed at increasing the use of means-testing and replacing universal payments; or, finally, reforms promoting the expansion of private-sector involvement through the contracting out of services.[20]

In order to understand the dynamics of healthcare systems, it is also necessary to complement the previous information with data on the characteristics of health protection, so as to capture the relevance of the institutional architecture – particularly access requirements and the duration of sickness benefits – as a proxy for the decommodification of the labour market. To this purpose, four variables are included in this group: the gross 26-week replacement rate for sickness provisions; the number of weeks during which sickness benefits are payable; the number of “waiting days” at the beginning of a sickness spell when no benefits are paid; and the coverage ratio of sickness benefits as a proportion of the labour force. These variables make it possible to ascertain whether certain elements of health systems converge across countries, thereby contributing to a broader convergence of other system components (Barros, 2007; Leiter and Theurl, 2012).

With regard to health resources, two main indicators are used: the total health workforce and the number of beds in publicly owned hospitals. In particular, total employment can be interpreted as a complement to the level of health spending. As argued by Wendt and Kohl (2010), there may be only a weak correlation between the financial resources invested in a nation’s health system and the level of health employment, which suggests that total employment should be taken into account when assessing health performance.

Concerning health care utilisation, reference is made to inpatient discharges and to the average length of stay in hospital. To some extent, these two variables can provide information about the “indirect privatisation” of the health service,

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[18] See Sowula et al. (2023) for Sweden and Germany.

[19] Means-tested and non-means-tested cash and in-kind benefits are included under the category of health expenditure, as they represent either a direct monetary transfer or a direct form of public spending. To some extent, they also constitute an element of health coverage. However, both in-kind and cash components of the welfare state are classified within the same category, as part of a broader definition of collective resources. See, for example, Lundberg et al. (2015).

[20] See Polin et al. (2021) for a description of health reforms in 2018-2019.

achieved through shorter lengths of stay and a more rapid turnover. However, as shown in several studies, this does not necessarily imply lower prices or higher quality. Braithwaite, Travaglia and Corbett (2011), reviewing a large number of articles, found weak and at times conflicting evidence, while Tiemann, Schreyogg and Busse (2012) also showed that private hospital ownership is not necessarily associated with higher efficiency in the case of Germany.

Concerning health quality, the lack of available data for the entire period and for all countries substantially restricts the possible choices. One option – with gaps – is to use the rate of hospital admissions for congestive heart failure as a proxy for the quality of treatments. Asthma and chronic obstructive pulmonary disease (COPD) hospital admissions, as well as diabetes hospital admissions, are also included in some steps of the analysis, although this entails losing observations for certain countries.

With regard to health status, three indirect indicators of health outcomes have been selected: the share of the population aged over 65, life expectancy at birth, and the death rate. On the one hand, these indicators may imperfectly represent the general quality of "health outcomes"; on the other hand, they may help investigate the presence of performance similarities in health outcomes, given the correlation commonly observed between health care resources and health conditions. The choice is debatable also because the ranking of health performance proposed by the World Health Organization (WHO) in 2000 was criticised on academic grounds[21] and was effectively rejected at the political level by countries that had received an unfavourable ranking. Nevertheless, these variables are included in order to capture those cases, if any, in which comparable amounts of resources may give rise to non-comparable health outcomes.

The dimension of health insurance is also considered, including the share of the population covered by compulsory government health insurance and the share covered by voluntary health insurance. Furthermore, the dimension of long-term care is approximated by the number of beds in residential long-term care facilities.

Finally, a set of institutional and political variables is included to serve as proxies for missing data on welfare institutions. Specifically, the following variables are introduced: the composition of the cabinet, particularly whether it leans to the right or left; voter turnout in elections, as a proxy for individuals' participation in the political process; an index of party system fractionalization, which may correlate with the number of veto points affecting welfare provision; an index of federalism, to account for the degree of decentralization in the delivery of health services; and the nature of executive-legislative relations – particularly the prevalence of either parliamentary or presidential systems – which may also influence the overall structure of the welfare state.

[21] See, for example, Musgrove (2003).

It is important to note that the variables discussed above capture structural, process, and outcome dimensions. Accordingly, any observed convergence would reflect the combined effect of these indicators, without allowing for a clear identification of their individual contributions. However, the empirical analysis attempts to isolate the extent to which convergence can be attributed to structural rather than to performance-related factors.

Of particular interest in the attempt to classify health regimes is the possibility that the same country may belong to different clusters over time, a feature that allows for the consideration that health regimes – even within a given country – may have changed.[22] On the other hand, a general caveat in this analysis is that not all variables will be used simultaneously, as the inclusion of certain variables entails gaps either in years or in countries. However, in a first step, the focus will be on those variables that maximise the number of countries observed.[23]

3 RESULTS

3.1 STEP 1: REPLICATING EXISTING CLUSTERING

The analysis begins with a hierarchical clustering method based on the set of variables common to all European countries included. In a first step, the analysis seeks to maximise comparability by replicating the cluster analysis using the number of clusters proposed in similar studies, regardless of the specific information provided by the stopping rule. To this end, table 2 first describes how different countries have been grouped in the health sector by each available study. It can be noted that one study classifies countries into three clusters (Wendt, 2009), one study into five clusters (Reibling, Ariaans and Wendt, 2019), and one study into six clusters.[24] The remaining three studies identify four clusters (Jensen, 2008; Reibling, 2010; Wendt, 2014).

The same table also attempts to show how often the same countries are grouped together in different studies. Some persistence is observed for certain groups of countries: in particular, Austria, Belgium, France, Germany, and Luxembourg (all countries or a subset thereof) are often grouped in the same cluster; Finland, Spain, and Portugal form another frequently observed group; Denmark and the

[22] See, for example, De Simone, Gaeta and Ercolano (2012).

[23] A principal component analysis (PCA) was also performed to identify core characteristics of the health system. Although detailed results are not reported in the text, the analysis suggests that each variable has a significant loading (either higher or lower than ±0.3) on at least one component, and that each component can be meaningfully interpreted in terms of healthcare characteristics. If every variable has at least one significant loading on some component, it contributes to the variance (or correlation structure) of the data within the PCA subspace. This reduces the risk of including completely "noisy" or irrelevant variables. It also implies that clustering performance is less affected by the presence of less influential variables, as long as they are not entirely "silent" – i.e., they contribute with a significant loading somewhere (see, for example, Giuliani and Vici, 2024). Nevertheless, the presence of many "weak" variables – even if minimally contributing – can still introduce noise, increase model complexity, and reduce the stability or interpretability of the clusters. To avoid arbitrary variable selection, especially given the constraints posed by limited data availability, all variables were retained in the subsequent cluster analysis.

[24] Joumard, André and Nicq (2010). OECD (2025b) also provides a cluster analysis, identifying seven distinct clusters that include European countries. However, the analysis is not limited to European countries, encompassing other OECD member states.

Netherlands; Italy and the United Kingdom; and Estonia, Hungary, Poland, and Slovakia are recurrently grouped together across studies. It is also worth noting that in Joumard, André and Nicq (2010), two clusters are very small, as one includes only Belgium and France, and another includes only Iceland and Sweden. Furthermore, in Jensen (2008) there is a one-country cluster (Ireland) out of a total of four, while in the cases of Wendt (2009; 2014), some countries are not classified in any cluster (Greece, the Netherlands, Norway, and Switzerland). As it stands, table 2 leaves a considerable degree of uncertainty regarding the possibility of a stable classification of health regimes.

In the second stage, a hierarchical cluster analysis on pooled data is conducted to cover a range of 3 to 6 clusters, as in the previous studies, regardless of the optimal number of clusters identified by the stopping rule. For this exercise, average linkage is used for the sake of comparability, as it is the method most commonly adopted in the studies reported in table 2.

Tables A1 to A4 in appendix show the results. In all cases, and in contrast with the findings of other studies, a meaningful clustering of countries is hardly identifiable. Instead, two countries (Iceland and Ireland) consistently form their own separate clusters – an outcome that is insufficient to support claims of distinctive healthcare models, but that may suggest a broader convergence, at least when compared to the classifications emerging in earlier studies. Moreover, replicating the analysis while stopping at two clusters again reveals a lack of differentiation among countries, with the second cluster consisting solely of the Netherlands in five years (not reported in the table).

Table 2
Health systems: clusters of countries

Cluster	Jensen (2008)	Wendt (2009)	Reibling (2010)	Joumard et al. (2010)	Wendt (2014)	Reibling, Ariaans and Wendt (2019)
A	Spain	Spain	Italy	Hungary	Iceland	Finland
	Norway	Finland	Portugal	Ireland	Finland	Portugal
		Portugal	Finland	Italy	Spain	Sweden
				United Kingdom	Portugal	Norway
				Norway	Sweden	
				Poland		
B	Denmark	Denmark	Denmark	Denmark	Denmark	Denmark
	Netherlands	Ireland	Netherlands	Spain	Czechia	Netherlands
	Finland	Italy	Spain	Finland	Estonia	Spain
	Sweden	United Kingdom	Poland	Portugal	Hungary	United Kingdom
	United Kingdom				Poland	Italy
					Slovakia	
					Ireland	
					Italy	
					United Kingdom	
					Netherlands	
					Slovenia	

Cluster	Jensen (2008)	Wendt (2009)	Reibling (2010)	Joumard et al. (2010)	Wendt (2014)	Reibling, Ariaans and Wendt (2019)
C	Austria	Austria	Austria	Belgium	Austria	Austria
	Belgium	Belgium	Belgium	France	Belgium	Belgium
	France	France	France		France	France
	Germany	Germany	Sweden		Germany	Germany
	Italy	Luxembourg	Switzerland		Luxembourg	Luxembourg
						Czechia
						Iceland
						Ireland
D	Ireland	–	Czechia	Germany	Greece	Estonia
			Germany	Netherlands		Hungary
			Greece	Slovakia		Poland
				Switzerland		Slovakia
E	–	–	–	Austria	–	Switzerland
				Czechia		
				Greece		
				Luxembourg		
F	–	–	–	Iceland	–	–
				Sweden		
NC	–	Greece	–	–	Norway	–
		Netherlands			Switzerland	

Note: NC = Not assigned to any cluster.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

3.2 STEP 2: A REPEATED CLUSTER ANALYSIS FOR EACH YEAR

In this section, a new cluster analysis is performed based on the information provided by the Duda-Hart stopping rule and using Ward's linkage method. To obtain a clearer picture of clustering dynamics over time, the analysis is conducted separately for each year, treating observations as independent across time. This assumption will be relaxed in the following section. A general caveat in this type of analysis is that the optimal number of clusters should not be expected to remain constant across years. As shown in table 3, the number of clusters ranges from a minimum of 2 in 2021 to a maximum of 6 in 2009.[25]

The evolution of healthcare system typologies across European countries reveals both persistent structures and significant temporal shifts. On the one hand, there is a relatively stable quasi-Nordic-Continental model, encompassing countries with both Bismarck-type and Beveridge-type institutional arrangements, such as Austria, Belgium, Denmark, Germany, the Netherlands, Norway, Spain, Sweden, and Switzerland. These nine countries exhibit very high co-clustering stability overall from 2001 to 2021. The core group – Austria, Belgium, Germany, and the Netherlands – is clustered together 100 percent of the time. Countries such as Spain, Sweden, Norway, and Switzerland also maintain strong alignment, usually above 90 percent, although some pairs involving Denmark and Switzerland show lower consistency (around 75-85 percent). In short, this group represents a stable Western/Northern European cluster, with minor fluctuations mostly associated with Denmark and Switzerland.

This pattern suggests strong continuity in their institutional and policy frameworks, as well as relative internal homogeneity. Notably, this occurs despite Spain and Sweden typically being classified as Beveridge-type welfare systems, in contrast to the Bismarck-type model followed by the other cluster members. This may indicate that similar healthcare outcomes can emerge from different institutional configurations, thereby calling into question the determinative power of welfare regimes in shaping health system performance. These findings resonate with earlier work highlighting the diminishing explanatory power of traditional institutional models, such as Beveridge and Bismarck, in accounting for differences in health system performance.[26]

[25] The optimal number of clusters is determined using both the pseudo-F and pseudo-T-squared statistics from the Duda-Hart rule. In general, higher pseudo-F values indicate greater separation between clusters, suggesting a more distinct clustering structure. Conversely, lower pseudo-T-squared values imply greater within-cluster homogeneity. Thus, the optimal number of clusters reflects a balance between cluster separation and internal cohesion.

[26] This result is consistent with a recent study by OECD (2025b), which – addressing three key policy areas in the health domain – shows that there is no indication that any one group of health systems would systematically outperform another. See also Wendt (2009); Böhm et al. (2013). As argued by Giaimo and Manow (1999) and Reibling (2010), despite their formal differences, systems often converge functionally in response to shared policy pressures.

Table 3

Cluster assignments by country and year (2001-2021)

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Belgium	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Czechia	4	4	4	4	4	3	3	5	6	4	4	4	3	3	1	4	3	3	4	3	2
Denmark	1	1	1	1	1	1	1	2	2	3	1	1	1	1	3	1	1	1	1	1	1
Estonia	–	–	–	–	–	–	–	3	3	5	6	4	4	4	3	3	5	4	3	3	2
Finland	4	1	1	1	1	1	1	2	2	3	1	1	1	1	1	1	1	1	1	1	1
France	2	2	2	2	2	1	1	3	3	1	2	2	2	2	2	2	1	1	2	2	1
Germany	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Greece	2	2	2	1	1	3	1	3	4	1	2	2	2	2	1	1	1	1	1	1	2
Hungary	4	4	4	4	4	–	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2
Iceland	–	–	–	–	1	–	–	1	–	–	3	–	–	–	–	1	–	–	–	–	–
Ireland	3	3	3	3	3	2	2	4	5	2	3	3	2	2	4	3	2	2	3	2	1
Italy	1	1	1	1	1	1	1	3	4	1	2	2	2	2	1	1	1	1	1	1	2
Latvia	4	4	4	4	4	3	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2
Lithuania	4	4	4	4	4	3	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2
Luxembourg	–	–	–	–	–	–	–	–	3	–	–	–	–	–	3	–	–	–	–	–	1
Netherlands	1	1	1	1	1	1	1	2	2	3	1	1	1	1	3	1	1	1	1	1	1
Norway	–	–	–	–	–	–	–	–	2	2	3	1	1	1	1	3	1	1	1	1	1
Poland	4	4	4	4	4	3	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2
Portugal	2	2	2	2	2	1	1	3	3	1	2	2	2	2	2	2	1	1	2	2	1
Slovakia	4	4	4	4	4	3	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2
Slovenia	2	2	2	2	2	1	1	3	3	1	2	2	2	2	2	2	1	1	2	2	1
Spain	1	1	1	1	1	1	1	3	4	1	2	2	2	2	1	1	1	1	1	1	1
Sweden	1	1	1	1	1	1	1	2	2	3	1	1	1	1	3	1	1	1	1	1	1
Switzerland	1	1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1	2	2	1
United Kingdom	2	2	2	1	2	1	1	3	4	1	2	2	2	2	1	1	1	1	1	1	2
Optimal number of clusters	4	4	4	4	4	3	3	5	6	4	4	4	3	3	5	4	3	3	4	3	2

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

On the other hand, a distinct Eastern European model emerges, including countries such as Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, and Slovakia, all of which have welfare systems broadly inspired by the Bismarck tradition. These seven countries form an exceptionally cohesive cluster throughout the entire period from 2001 to 2021, with a co-clustering percentage above 94 percent for each pair of countries, and 15 pairs consistently falling in the same clusters across the whole period. After 1990, these countries underwent a transition from the common legacy of socialism to more Western-type economies. Their health systems, to some extent, may have experienced a hybridization process, which often involved a form of "shock therapy" by pursuing the privatisation of some welfare programmes and partly shifting the responsibility for their provision to social funds and private insurance markets.[27] As also suggested by Cerami (2010:249), from a broader perspective, after 1990 "the introduction of a welfare system based on professional diversity and private arrangements [...] corresponded to the functional necessity of occupational and market diversification, which stemmed from the excessively centralized and homogenized economic system in force during communism". Accordingly, in Eastern European countries, a new and distinctive welfare regime has emerged, in which traditional welfare models have been recombined – so much so that it recently also includes some non-Eastern European countries, such as Greece, Italy, and the United Kingdom. This unexpected assimilation may reflect the impact of structural reforms, economic constraints, or divergent responses to exogenous shocks, such as the COVID-19 pandemic.[28] In this regard, the results presented in table 3 lay the groundwork for assessing whether a broader convergence may occur in the future – potentially reflecting the many health reforms implemented in European countries in areas such as organizational regimes, hospital care, primary and ambulatory care, care coordination and specialised services, and healthcare purchasing and payment.[29]

In between, there is a mixed group of countries – Finland, France, Greece, Italy, Portugal, Slovenia, and the UK – which often cluster together despite featuring Bismarck-type, Beveridge-type, and hybrid healthcare systems. Their co-clustering, however, is less consistent than in the other groups. In particular, France, Portugal, Italy, Slovenia, and the UK form a relatively stable cluster, co-clustering more than 75 percent of the time across the 21-year period. Finland shows a weaker and more variable clustering pattern, aligning less consistently with the group, especially with Greece and the UK (co-clustering rates below 60 percent). Greece displays moderate co-clustering stability, with stronger ties to France and Italy (about 76-81 percent), but weaker connections to Portugal, Slovenia, and the UK. Overall, this group reflects a mix of southern and northern European countries with varying degrees of cohesion, with France, Portugal, Italy, Slovenia, and the UK forming the core cluster.

[27] Castles and Obinger (2008); Kuitto (2016). For a different perspective, see Filipovic and Dobrotic (2022:199).
[28] See Lamping and Rüb (2004) for the definition of a "recombinant welfare system" in the case of pensions.
[29] Polin et al. (2021); Dubas-Jakóbczyk et al. (2020). The argument was also anticipated by Ruggles and O'Higgins (1987).

In any case, it is worth noting that in 2021 – following the pandemic crisis – clustering became more homogeneous, as the previously mixed group tended to redistribute either into a broader Continental model or into the Eastern European cluster. This shift introduced hybrid elements into what had previously been a more internally consistent grouping, providing some evidence in support of the convergence hypothesis.

With regard to Ireland's peculiar position – often appearing as a one-member cluster – it can be noted that, in the dataset, the values of several variables lie at either the upper or lower extreme. In particular, this is the case for the death rate, the old-age population share, cash and in-kind means-tested benefits, waiting days of sickness before payment, public pharmaceutical expenditures, and the average length of stay in hospital. Once these variables are removed from the cluster analysis, Ireland no longer forms a one-member cluster (results not reported in the table). In addition to these dataset-specific features, there are other characteristics unique to Ireland. For example, during the period 2010-2015 (included in the analysis), it was observed that "approximately 40-60 per cent of the reduction in emergency inpatients' length of stay observed during this period may have been a result of bed supply reductions experienced in those years" (Walsh et al., 2022:506). Moreover, it has been noted that long waits for public hospital services are a feature of the Irish healthcare system, with limited evidence that waits for private hospital services are shorter (Whyte, Connolly and Wren, 2020; Brick and Connolly, 2021), a characteristic that distinguishes Ireland from other countries, where waiting times in the private sector tend to be shorter. Not to be underestimated with respect to its impact on the entire system and the overuse of hospital care is the fact that Ireland is the only European country without universal coverage of primary health care (The Lancet Regional Health – Europe, 2025). Finally, in 2019 "Ireland […] had the third lowest public hospital bed density in the EU, standing at over 40 per cent below the EU average […]. In 2021, outpatient care accounted for 40 per cent of total out-of-pocket spending – a share twice the EU average, which partly stems from the fact that the majority of the Irish population access GP services on a private basis" (McGeady et al., 2024:162). With regard to the public-private mix, it should also be noted that Ireland has long had the highest share of duplicative private insurance in Europe (about 45 per cent of the population), that is, private coverage for healthcare services already available in the public sector (OECD, 2018:174).

All these elements make Ireland a case with peculiar characteristics compared to other countries. Since 2017, Ireland has been undertaking health system reform through the Sláintecare initiative, which aims to create a more universal and publicly funded healthcare system with equal access for all. The reform is still ongoing, and the system is currently in a transitional phase. Due to this transitional state, combined with persistent challenges such as limited resources and a funding model that mixes public funding with private insurance, Ireland does not fit neatly into conventional healthcare system categories. This makes it stand out

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

as a distinct case in health system comparisons. Moreover, this transitional phase – together with the impact of the pandemic – may explain why Ireland no longer appears as a separate cluster in 2020 and 2021 (see table 3).[30]

3.3 STEP 3: A CLUSTER ANALYSIS WITH POOLED DATA

The year-to-year analysis highlights both episodes of differentiation in the periods 2001-2005 and 2008-2009, as well as similarities in more recent years. A complementary way to analyse the temporal dynamics is to conduct a cluster analysis on pooled data, which removes the assumption that each year represents an independent dataset, in order to assess whether the observed similarities in recent years are relatively stronger than the differentiation seen at the beginning of the century. For this purpose, the analysis initially uses the variables that maximise the number of countries and observations. Applying Ward's method again, the analysis identifies three as the optimal number of clusters. However, it is worth noting that the combination of the index calculated as the ratio of the within-cluster sum of squares after and before the split, and the pseudo-T-squared test (both outputs of the Duda-Hart rule), could also support an optimal number of clusters equal to two.

Table 4

Cluster composition

Cluster 1	Cluster 2	Cluster 3
Austria	France	Czechia
Belgium	Ireland	Estonia
Denmark	Portugal	Hungary
Finland	Slovenia	Latvia
Germany		Lithuania
Greece		Poland
Iceland		Slovakia
Italy		
Luxembourg		
Netherlands		
Norway		
Spain		
Sweden		
Switzerland		
United Kingdom		

Note: Optimal number of clusters: 3 (Duda-Hart rule, Ward linkage).

[30] Sláintecare is a cross-party, ten-year plan launched in Ireland in 2017 to create a universal, single-tier health and social care system. The plan aims to provide equitable access to care based on need rather than ability to pay, focusing on population health, integrated primary and community care, and reforms to entitlements, funding, and implementation. Key goals include shifting care to the community, expanding workforce capacity, and increasing public investment to deliver integrated, person-centred services for all Irish residents. See Burke et al. (2018); Thomas et al. (2021).

Results are reported in table 4, where it is evident that an Eastern European model emerges in Cluster 3. Cluster 1, by contrast, represents a blending of countries traditionally associated with all major welfare state classifications: the Nordic model (Denmark, Finland, Iceland, Norway, Sweden), the Continental model (Austria, Belgium, Germany, Luxembourg, the Netherlands, Switzerland, and the United Kingdom), and the Southern European model (Greece, Italy, and Spain). Cluster 2, meanwhile, consists of a small and less clearly defined group of countries (France, Ireland, Portugal, and Slovenia).

The analysis suggests two key points. First, a certain degree of differentiation can still be observed, although it does not align neatly with traditional welfare state models. Second, there appears to be similarities among Western European countries, as only France, Ireland, and Portugal do not fall within Cluster 1. To further investigate this – and considering that the Duda-Hart rule could also support two as the optimal number of clusters, as well as the fact that the Gap Statistic, computed for a range of 1 to 10 clusters with 300 iterations, also points to two clusters – the analysis is replicated using pooled data. In this latter case (not reported in the table), Cluster 2 disappears, with all countries falling into Cluster 1. This outcome supports the hypothesis of strong convergence across all European countries, with the only alternative recognisable cluster being that of the Eastern European countries.

The clustering presented in table 4 also reveals some interesting areas of overlap with the typology of "varieties of capitalism" proposed by Hall and Soskice (2001). Specifically, the cluster of "coordinated market economies" identified by Witt et al. (2018) – which includes Austria, Belgium, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, and Switzerland – falls entirely within Cluster 1 of table 4. This cluster also includes some countries categorized as "European peripheral economies" (Greece, Italy, and Spain), a group which, in Witt et al. (2018:23), also includes several Eastern European nations. Similarly, Cluster 1 in table 4 overlaps with the "social democratic market economies" identified by Movahed (2023). In both cases, however, the clustering in table 4 is less sharply defined than the groupings reported in Witt et al. (2018) and Mohaved (2023).[31]

In order to verify the robustness of the previous results, the cluster analysis was replicated using a robust scaling procedure instead of a z-scoring technique, to reduce the potential influence of outliers on the clustering results. The robust scaling provides a new variable given by $x^{'} = \frac{x - median(x)}{IQR(x)}$, where $IQR\left(x\right) = p_{75}\left(x\right) - p_{25}\left(x\right)$ is the interquartile difference. In this case, the analysis identifies four as the optimal number of clusters. However, the differences from those reported in table 4 are negligible: in particular, Czechia moves from Cluster 3 to Cluster 1, and Ireland moves from Cluster 2 to form a single-member cluster. This provides reasonable confidence that the outcome does not depend critically on modelling choices. Furthermore, the same

[31] Note that Witt et al. (2018) use average linkage clustering, while Movahed (2023) employs a k-means method.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

analysis was replicated with an alternative distance metric, namely the Manhattan (absolute) distance, in place of the squared Euclidean distance. While the overall cluster structure remained largely consistent, a few countries were reassigned under the alternative metric: Greece, Italy, Spain, and the UK moved to Cluster 2. This observation suggests that Clusters 1 and 2 may not be sharply separated and that certain countries lie near the boundaries between clusters. Such sensitivity to the choice of distance metric without altering the fundamental clustering outcome highlights a degree of overlap and underscores the importance of interpreting membership in Clusters 1 and 2 as indicative rather than definitive. By contrast, Cluster 3 remains unchanged, confirming the distinct profile of this group of countries in terms of health system performance.

All these results are based on the set of variables that maximizes the number of countries and observations in the dataset. Further analyses were conducted by progressively including additional variables, whose inclusion resulted in the loss of one or more countries. Several steps are considered:

a) Including long-term care beds, which results in the exclusion of Portugal. In this case, Clusters 1 and 2 from table 4 are slightly reconfigured, yielding a clearer Nordic-Continental model in Cluster 1, while Greece, Iceland, Italy, and Spain move to Cluster 2. The Eastern European model remains stable.
b) Adding congestive heart failure hospitalizations, which leads to the exclusion of Portugal, Greece, and Latvia. In this scenario, Austria, Germany, Spain, Switzerland, and the UK move to Cluster 2, producing a mixed and relatively undefined model. The Eastern European cluster remains stable.
c) Including the number of beds in publicly owned hospitals, which results in the exclusion of Denmark, Portugal, Greece, and Latvia. Compared to the clusters in table 4, only Switzerland moves to Cluster 2, while the Eastern European cluster persists.
d) Adding hospital admissions for diabetes, asthma, and chronic obstructive pulmonary disease results in the exclusion of Denmark, Portugal, Greece, Latvia, and Slovakia, and reveals a much stronger convergence in clustering. While the Eastern European cluster still persists, all other countries – with the exception of Ireland, which forms a single-member cluster – fall into Cluster 1.
e) The same pattern as in d) holds when out-of-pocket health expenditures are included, which leads to the loss of observations for Germany and Iceland.

In order to obtain more detailed information on whether performance similarities are driven by outcomes or by institutional characteristics, the cluster analysis was also replicated using the variables that best capture the structure of health systems. Specifically, the analysis focused on financing, coverage, and resources (i.e., health expenditures, health resources, and health protection variables in table 1). In this case (not reported in the table), using three clusters, a Nordic model – including Austria, Belgium, Denmark, Germany, the Netherlands, Norway, Sweden, and Switzerland – is clearly identified. A second cluster is composed of France, Ireland, Portugal, and Slovenia – as it was in Cluster 2 of table 4 – enlarged to include Greece and the United Kingdom, while the third cluster becomes a hybrid due to the presence of Italy, Luxembourg, and Spain. This implies that when focusing on institutional characteristics, the convergence of health models is weaker than the similarities observed for health outcomes. To further investigate this point, the Gap Statistic was recalculated on the new set of variables, yielding an optimal number of seven clusters. The results are reported in table 5, where Cluster 1 mostly identifies a Continental model, Cluster 2 a Nordic model, Cluster 3 (with the exception of Luxembourg) an Eastern European model, and Cluster 4 a subset of the Mediterranean model. The remaining three clusters, however, cannot be clearly classified according to standard definitions.

Table 5

Cluster composition

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
Austria	Denmark	Czechia	Italy	France	Greece	Ireland
Belgium	Finland	Estonia	Spain	Portugal	UK	
Germany	Norway	Hungary		Slovenia		
Netherlands	Sweden	Latvia				
Switzerland		Lithuania				
		Luxembourg				
		Poland				
		Slovakia				

Note: Optimal number of clusters: 7 (Gap Statistics, Ward linkage).

In any case, what emerges from this sensitivity analysis is that similarities in outcomes do not necessarily entail convergence in health models. Put differently, this suggests that different institutional models may no longer produce distinct outcomes. As mentioned above, this finding supports the hypothesis that similar health outcomes can emerge from different institutional configurations, blurring the distinction between Beveridge and Bismarck models when moving from institutions to outcomes.

3.4 CHARACTERISTICS OF THE CLUSTERS

The analysis conducted so far shows that, if any clear partition exists, it is into two or three clusters. To comment on the specific characteristics of the larger clustering outcome, reference is made to the results in table 4, where a quasi-Nordic-Continental model is recognisable in Cluster 1, an Eastern European model is confirmed in Cluster 3, and a mixed group of countries belongs to Cluster 2. To meaningfully discuss the characteristics of these clusters, it is worth starting with the most persistent outcome – namely, the Eastern European model – and understanding the empirical evidence that explains why it forms a distinct cluster. Compared to the other two clusters, this group shows several distinctive indicators (see tables A5, A6, and A7 in appendix).

First, compared with Cluster 1, there is evidence of lower public health spending, with a marked upward trend observable only during the pandemic years. This lower spending level is associated with both a higher death rate and lower life expectancy at birth. Second, to some extent, a historically lower level of total health employment may have contributed to inadequate public health spending.[32]

Given that both the share of private health spending and the share of public pharmaceutical expenditures are also lower (H568 and H580), this group of countries can be clearly characterised by total health spending below the European average, which helps explain their distinct status in the cluster analysis. Furthermore, as additional indicators of divergence from the other two clusters, one can observe a slightly lower level of government compulsory health insurance (govins), suggesting relatively lower universal coverage; a shorter duration for which sickness benefits are payable (sduratio); and a longer average hospital stay (H540) – even when compared to the OECD average of 7.6 days. According to standard interpretation, longer hospital stays may reflect lower efficiency in bed management.

To some extent, compared with the other two clusters, there also appears to be greater difficulty in reducing the number of discharges (with the exception of 2020 and 2021), although this has no clear-cut interpretation. On the one hand, improved discharge rates can help free up hospital beds and staff time; on the other hand, premature discharges can worsen health outcomes and lead to costly readmissions. Regardless of interpretation, in 2019 – before the pandemic – the average number of discharges in Cluster 3 was about 185 per 1,000 inhabitants, compared to the OECD average of approximately 146.

Turning to Clusters 1 and 2, some differences can be observed. It is particularly useful to focus on Cluster 2 – a mixed cluster – and examine how it differs empirically from the more populous Cluster 1. In Cluster 2, there is a combination of variable public health expenditures, a mild upward trend in private health spending (H568), and a more pronounced downward trend in the share of public pharmaceutical expenditures (H580). Together, these three elements suggest a possible decline in overall healthcare expenditure, which – at least in some countries – supports the hypothesis that public health performances may be converging toward relatively lower standards.

It is also worth noting that, even during the pandemic, the average increase in health spending in Cluster 2 was lower than that observed in Cluster 1. This difference becomes more evident when considering a lower use of in-kind non-means-tested benefits (V1B), a lower level of discharges (disch) – an indirect efficiency indicator – a lower gross replacement rate for sickness benefits (srtsw26s), a significantly

[32] It is also worth noting that this shortage in Cluster 1 reflects a broader EU-wide issue. As reported by OECD (2024), the EU faces a health workforce deficit, with an estimated shortage of 1.2 million doctors, nurses, and midwives as of 2022. This shortage stems from multiple factors: demographic ageing affecting both patients and the health workforce, combined with difficult working conditions that contribute to staff burnout and retention challenges.

longer waiting period for payments (swaiting), a historically longer duration of payable sickness benefits (sduratio), and slightly lower coverage as a proportion of the labour force (scovratl).

It is also useful to examine the evolution of some key healthcare indicators across the three clusters. Public health spending has clearly grown in Cluster 1, helping maintain stability in private health expenditures, while private spending has increased in the other two clusters. Conversely, the share of public pharmaceutical expenditure in total health spending has decreased across all clusters. In Cluster 2, both the increase in private spending and the reduction in public pharmaceutical expenditures are particularly pronounced.

Furthermore, although not reported in the tables, two additional elements may support the idea of convergence: the number of beds in publicly owned hospitals (measured as days per person) has decreased across all clusters, while the increase in households' out-of-pocket payments is especially evident in Clusters 2 and 3.[33]

Regarding the robustness of these differences among clusters, all pairwise differences across the variables are statistically significant according to the Wilcoxon test, with one minor exception: the difference in health spending between Clusters 1 and 2, where the p-value exceeds the 5 percent significance level.

4 CONCLUSIONS

The main finding of this analysis is that the clustering of healthcare systems in Europe does not correspond to traditional welfare state classifications. The conventional distinctions between Nordic, Continental, and Liberal models receive little empirical support within the healthcare domain, whether in terms of system characteristics or health outcomes. Instead, most Western European countries cluster together, while a distinct and robust cluster of Eastern European countries emerges.

For Western Europe, this finding challenges the long-standing assumption that institutional legacies are the principal determinants of cross-national differences in healthcare performance (Pierson, 2004:17; Hacker, 1998; Taylor-Gooby, 1996; Wilsford, 1994). Rather, it lends support to the view of contemporary welfare states as "patchwork mixes of old and new policies and institutions" (Hemerijck, 2012:12) in which inherited arrangements coexist with newer policy instruments and governance logics.

Several factors may account for these patterns. First, the tendency of Western European countries to cluster together – despite heterogeneous institutional arrangements – may reflect their diminishing capacity to pursue autonomous healthcare policy paths.[34] As Ploug (1995) observed, policy debates have long revolved aro-

[33] Note that these indicators are not strictly comparable with the other data, as the number of countries for which data are available is smaller than in the general case.
[34] See also Rothgang et al. (2010:247).

und whether European states can maintain acceptable health standards while preserving universal access, or whether future trajectories point toward more restricted forms of universalism.

The absence of clear-cut distinctions across countries may also be linked to a broader shift toward market-compatible social policies, whereby welfare provision increasingly operates in accordance with market logics (Ferge, 1997). Since the early 1990s, this "rightward" shift has often been interpreted as a response to globalization and the lack of effective countervailing forces at the international level (Swank, 2002). In this context, Castles (1999) noted that whereas public healthcare expenditure had previously been driven primarily by political variables, cost-containment strategies have dominated since the 1980s, particularly across Europe during the 1990s.

Although differences in financing structures persist, convergence may be fostered by the introduction of market-based solutions in Beveridge-type systems, alongside efforts within Bismarckian systems to reduce inequalities in access to essential care. This has generated increasingly hybrid health systems and, ultimately, convergent health outcomes. However, the implications of these developments remain contested. Extensive welfare provision risks losing political legitimacy as an electoral platform, potentially encouraging more restricted forms of universalism and the adoption of minimum, rather than socially acceptable, standards.[35] Others caution that reductions in public intervention may facilitate the expansion of private insurance, thereby undermining the principle of universality and weakening collective protection against shared risks (Sunstein, 1993; Losada and Ares, 2021).

Finally, while healthcare reforms continue to be shaped by country-specific factors, they are increasingly influenced by processes of policy diffusion. As Panic (2003:74) observes, national stability and long-term progress often depend on policy developments in closely connected countries. This dynamic is particularly salient within an integrated European economic system, where states face similar fiscal and political constraints, even as a coherent "European social space" has yet to fully materialize (Alsasua, Bilbao-Ubillos and Olaskoaga, 2007:297). In this context, policy diffusion may represent an additional mechanism contributing to the clustering patterns identified in this analysis.

These findings carry important implications for both research and policy. The weak correspondence between healthcare clustering and traditional welfare typologies highlights the need to move beyond rigid classifications when analysing cross-national health outcomes. Future research could examine how hybrid health systems emerge, identifying which combinations of policies contribute to similarities in outcomes, and investigate the role of policy diffusion in shaping national reforms

[35] For a different perspective, see Goodin and Le Grand (1987).

within a shared European context. Researchers might also assess whether observed similarities in health outcomes mask persistent inequalities within populations.

For policymakers, the results suggest that institutional heritage alone does not determine performance. Recognizing emerging clusters of countries may help governments design adaptable reforms that balance universality, financial sustainability, and quality of care. In light of rising healthcare needs, indeed, the role of public intervention is likely to become increasingly complex, underscoring the importance of defining the appropriate level of public involvement needed to address these demands.

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The author has no conflicts of interest to declare.

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PUBLIC SECTOR
ECONOMICS
50 (2) 167-213 (2026)

APPENDIX

Table A1

Cluster composition (stopping at 3)

Cluster 1	Cluster 2	Cluster 3
Austria	Iceland	Netherlands (5)
Belgium		
Czechia		
Denmark		
Estonia		
France		
Finland		
Germany		
Greece		
Hungary		
Ireland		
Italy		
Latvia		
Lithuania		
Luxembourg		
Netherlands (16)		
Norway		
Poland		
Portugal		
Slovakia		
Slovenia		
Spain		
Sweden		
Switzerland		
United Kingdom		

Note: Average linkage – Euclidean distance.

Table A2

Cluster composition (stopping at 4)

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Austria	Iceland	Ireland	Netherlands (5)
Belgium			
Czechia			
Denmark			
Estonia			
France			
Finland			
Germany			
Greece			
Hungary			
Italy			
Latvia			
Lithuania			
Luxembourg			
Netherlands (16)			
Norway			
Poland			
Portugal			
Slovakia			
Slovenia			
Spain			
Sweden			
Switzerland			
United Kingdom			

Note: Average linkage – Euclidean distance.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

Table A3

Cluster composition (stopping at 5)

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Austria	Sweden (6)	Iceland	Ireland	Netherlands (5)
Belgium				
Czechia				
Denmark				
Estonia				
Finland				
France				
Germany				
Greece				
Hungary				
Italy				
Latvia				
Lithuania				
Luxembourg				
Netherlands (16)				
Norway				
Poland				
Portugal				
Slovakia				
Slovenia				
Spain				
Sweden				
Switzerland				
United Kingdom				

Note: Average linkage – Euclidean distance.

PUBLIC SECTOR ECONOMICS
50 (2) 167-213 (2026)

Table A4
Cluster composition (stopping at 6)

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Austria	Switzerland	Sweden (6)	Iceland	Ireland	Netherlands (5)
Belgium					
Czechia					
Denmark					
Estonia					
Finland					
France					
Germany					
Greece					
Hungary					
Italy					
Latvia					
Lithuania					
Luxembourg					
Netherlands (16)					
Norway					
Poland					
Portugal					
Slovakia					
Slovenia					
Spain					
Sweden (15)					
United Kingdom					

Note: Average linkage – Euclidean distance.

Table A5

Cluster 1: Average values

Year	health	old pop	death rate	life exp	V1A	V1B	V1C	V1D	tot emp	disch	gov ins	srtsw26s
2001	8.2	16.1	9.6	78.8	0.17	0.83	0	0	49.9	16776	96.0	0.58
2002	8.5	16.2	9.7	78.9	0.17	0.83	0	0	50.9	16721	95.7	0.58
2003	8.8	16.3	9.8	79.0	0.16	0.84	0	0	51.8	16720	95.7	0.58
2004	8.8	16.4	9.3	79.5	0.15	0.84	0	0	52.5	16868	95.7	0.58
2005	8.9	16.3	9.2	79.8	0.15	0.84	0	0	53.9	16881	95.9	0.58
2006	8.8	16.8	9.3	80.0	0.14	0.85	0	0	54.0	16898	98.7	0.59
2007	8.8	17.0	9.3	80.1	0.14	0.85	0	0.01	54.7	16968	98.7	0.58
2008	9.0	16.9	9.3	80.4	0.15	0.85	0	0	59.3	17224	98.9	0.62
2009	9.8	17.2	9.2	80.6	0.15	0.85	0	0	60.2	17379	99.7	0.61
2010	9.4	16.8	8.9	80.9	0.15	0.85	0	0	61.4	16988	99.8	0.63
2011	9.8	17.6	9.1	81.1	0.15	0.85	0	0	61.9	17211	99.8	0.61
2012	9.9	17.9	9.4	81.1	0.14	0.85	0	0	62.2	17106	99.8	0.61
2013	9.9	18.3	9.3	81.4	0.14	0.85	0	0	62.7	16557	99.8	0.61
2014	9.9	18.6	9.1	81.7	0.14	0.85	0	0	62.9	16509	99.8	0.61
2015	9.6	18.2	9.2	81.6	0.15	0.85	0	0	64.1	15756	99.8	0.63
2016	10	19.1	9.3	81.8	0.14	0.85	0	0	64.3	16066	99.8	0.61
2017	9.9	19.4	9.5	81.9	0.14	0.85	0	0	64.9	15894	99.8	0.61
2018	9.9	19.6	9.5	82.0	0.14	0.85	0	0	65.8	15820	99.9	0.61
2019	10.1	19.8	9.4	82.3	0.14	0.85	0	0	66.6	15683	99.9	0.60
2020	10.6	19.3	9.8	81.8	0.15	0.84	0	0	68.1	13576	99.9	0.62
2021	11	20.3	10.1	82.0	0.14	0.85	0	0	69.8	14311	99.9	0.60

Cluster 1: Average values (continued)

Year	swaiting	sduratio	scovratl	H568	H580	H540	fed	gov	vturn	rae	pres
2001	1.2	92.8	0.85	2.4	62.5	9.5	0.75	3.3	74.5	0.77	0.33
2002	1.2	93.7	0.86	2.5	63.7	9.4	0.75	2.8	75	0.77	0.33
2003	1.2	94.5	0.86	2.5	63.8	9.3	0.75	2.8	75.4	0.76	0.33
2004	1.2	95.4	0.87	2.5	64	9	0.75	2.8	76.9	0.76	0.33
2005	2.2	92.8	0.88	2.4	62.8	8.6	0.69	2.5	77.6	0.77	0.38
2006	1.2	88.5	0.87	2.3	67	8.7	0.75	2.7	76.7	0.77	0.33
2007	1.2	80.7	0.87	2.3	67.1	8.6	0.75	2.7	76.4	0.78	0.33
2008	1.1	71.2	0.88	2.2	65.9	8.4	0.69	2.6	76.2	0.78	0.31
2009	1.1	64	0.88	2.3	65.8	8.2	0.69	2.6	75.3	0.78	0.31
2010	1.9	56.2	0.88	2.1	65.1	7.9	0.6	2.5	76.9	0.78	0.33
2011	1.1	57.8	0.87	2.3	64.2	7.8	0.69	2.2	75.1	0.79	0.31
2012	1.1	58.8	0.87	2.3	64.1	7.7	0.69	2.2	73.5	0.8	0.31
2013	1.1	59.7	0.87	2.3	62	7.6	0.69	2.4	72.9	0.81	0.31
2014	1.1	60.7	0.87	2.3	61.3	7.5	0.69	2.4	73	0.81	0.31
2015	1.9	60.3	0.88	2.2	60.5	7.4	0.6	2.5	74.6	0.81	0.33
2016	1.1	61.7	0.87	2.3	60.8	7.3	0.69	2.3	72.2	0.81	0.31
2017	1.1	61.7	0.87	2.3	60.1	7.2	0.69	2.3	73.8	0.81	0.31
2018	1	61.8	0.87	2.2	59.6	7.1	0.69	2.1	73.7	0.81	0.31
2019	1	61.9	0.86	2.2	58.7	7.1	0.69	2.4	73.3	0.82	0.31
2020	1.7	62.3	0.87	2.1	57.1	7.1	0.6	2.6	75	0.82	0.33
2021	0.9	62	0.86	2.2	57.1	6.9	0.69	2.7	73.1	0.82	0.31

Table A6
Cluster 2: Average values

Year	health	old pop	death rate	life exp	V1A	V1B	V1C	V1D	tot emp	disch	gov ins	srtsw26s
2001	8.2	14.5	9	77.5	0.02	0.19	0	0.03	34.5	15997	99.5	0.35
2002	8.4	14.6	9	77.8	0.02	0.19	0	0.04	35.6	15776	99.5	0.36
2003	8.6	14.8	9.1	77.9	0.02	0.19	0.01	0.04	36.4	15294	99.7	0.36
2004	8.7	14.9	8.6	78.7	0.02	0.19	0.01	0.04	37.1	15300	99.7	0.36
2005	8.9	15.1	8.7	78.8	0.02	0.19	0.01	0.04	38	15317	99.7	0.37
2006	8.8	15.1	8.5	79.3	0.02	0.19	0.01	0.04	39	15435	99.7	0.41
2007	8.7	15.2	8.4	79.6	0.02	0.18	0.01	0.04	39.7	15489	99.7	0.46
2008	9.3	15.4	8.5	79.9	0.02	0.18	0.01	0.04	40.5	15476	100	0.5
2009	10.1	15.6	8.5	80.1	0.02	0.18	0.01	0.04	41.3	15264	100	0.55
2010	10.1	15.8	8.4	80.4	0.03	0.17	0.01	0.04	42.6	15158	100	0.59
2011	10	16	8.4	80.7	0.02	0.18	0.01	0.04	43.2	15076	100	0.59
2012	10.1	16.4	8.7	80.8	0.02	0.18	0.01	0.04	43.5	15011	100	0.58
2013	10	16.7	8.7	81	0.02	0.18	0.01	0.04	43.8	15367	100	0.58
2014	9.7	17.1	8.5	81.5	0.02	0.18	0.01	0.04	44.3	15401	100	0.57
2015	9.2	17.5	8.9	81.4	0.02	0.18	0.01	0.04	44.9	15311	100	0.57
2016	9.2	17.9	8.9	81.6	0.02	0.18	0.01	0.04	45.6	15279	100	0.56
2017	9	18.3	9	81.7	0.02	0.19	0.01	0.03	46.4	15032	100	0.56
2018	8.9	18.7	9.1	81.9	0.02	0.19	0.01	0.03	46.8	14933	100	0.56
2019	9	19.1	9.1	82.1	0.02	0.19	0.01	0.03	47.2	14755	100	0.56
2020	9.8	19.4	10	81.5	0.02	0.19	0.01	0.03	47.5	13080	100	0.56
2021	9.9	19.8	9.9	81.6	0.02	0.2	0.01	0.03	49.2	13780	100	0.56

Cluster 2: Additional variables (continued)

Year	swaiting	sduratio	scovratl	H568	H580	H540	fed	gov	vturn	rae	pres
2001	2.3	195	0.9	2.2	63.3	8.9	0	3.3	66.5	0.77	1
2002	2.3	195	0.9	2.2	63.7	8.8	0	2.3	64.7	0.76	1.5
2003	2.3	195	0.89	2.3	63.8	8.8	0	1.5	64.7	0.76	1.5
2004	2.3	195	0.89	2.3	64.5	9	0	1.3	62.3	0.77	1.5
2005	2.3	195	0.89	2.3	64.7	8.8	0	2	63	0.77	1.5
2006	2.3	174	0.89	2.4	64.6	8.7	0	2	63	0.77	1.5
2007	2.3	153	0.89	2.4	64.7	8.5	0	2.3	63.1	0.75	1.5
2008	2.3	133	0.89	2.5	64.7	8.5	0	2.5	63.7	0.74	1.5
2009	2.3	112	0.89	2.7	64.7	8.2	0	2.8	62.6	0.76	1.5
2010	2.3	91	0.9	2.7	66	8.1	0	2.8	62.6	0.76	1.5
2011	2.5	114	0.89	2.7	64.3	8.1	0	2.5	63.5	0.77	1.5
2012	2.7	138	0.89	2.8	61	8.2	0	2.3	62.7	0.79	1.5
2013	2.9	161	0.89	2.8	58.9	8	0	3	62.7	0.79	1.5
2014	3.1	185	0.89	2.8	57	8	0	2.8	59.2	0.79	1.5
2015	3.3	208	0.89	2.8	55.7	8	0	3	58.7	0.78	1.5
2016	3.2	208	0.9	2.8	54	8	0	3.5	57.5	0.8	1.5
2017	3.2	208	0.91	2.8	52.4	8.1	0	2.8	55.4	0.81	1.5
2018	3.1	208	0.92	2.8	50.9	8.1	0	2.3	55.6	0.82	1.5
2019	3.1	208	0.92	2.8	50.9	8.1	0	2	53.8	0.84	1.5
2020	3	208	0.93	2.8	51.1	8.1	0	2.8	53.2	0.85	1.5
2021	3	208	0.94	2.8	51.3	8.2	0	2.8	53.2	0.85	1.5

Table A7
Cluster 3: Average values

Year	health	old pop	death rate	life exp	V1A	V1B	V1C	V1D	tot emp	disch	gov ins	srtsw26s
2001	5.9	13.7	11.4	72.9	0.15	0.84	0	0	24.4	20703	95.6	0.7
2002	6.1	13.9	11.5	73.1	0.15	0.85	0	0	24.4	20804	95.9	0.69
2003	6.3	14.1	11.6	73.2	0.15	0.85	0	0	25.3	20964	96.3	0.69
2004	6.4	14.3	11.5	73.5	0.13	0.86	0	0	24.9	21195	96.5	0.68
2005	6.4	14.5	11.9	73.5	0.13	0.86	0	0	24.7	20873	97.2	0.67
2006	6.4	14.8	11.9	73.7	0.13	0.86	0	0	25.3	20886	97.4	0.66
2007	6.1	15.3	12.2	73.8	0.14	0.85	0	0	25.3	20246	97	0.67
2008	6.4	15.5	11.9	74.3	0.14	0.85	0	0	25.3	20210	96.6	0.66
2009	7	15.7	11.8	74.8	0.15	0.85	0	0	25.4	19804	96.6	0.65
2010	7	15.9	11.8	75.1	0.12	0.87	0	0.01	25.3	19170	96.4	0.64
2011	6.7	16.1	11.7	75.6	0.11	0.88	0	0.01	25.8	19335	96.2	0.64
2012	6.7	16.4	11.8	75.8	0.11	0.88	0	0	26.1	19304	95.4	0.64
2013	6.6	16.7	11.8	76.1	0.12	0.88	0	0	26.5	19267	95.4	0.64
2014	6.6	17	11.7	76.5	0.12	0.88	0	0	27.1	19336	95.2	0.64
2015	6.6	17.5	12.1	76.5	0.13	0.87	0	0	27.7	19306	95.2	0.64
2016	6.8	17.8	11.9	76.8	0.13	0.86	0	0	28.4	19374	95.4	0.64
2017	6.6	18.3	12.2	76.9	0.14	0.85	0	0	28.8	19058	95.6	0.64
2018	6.6	18.6	12.3	77	0.14	0.85	0	0	29.4	18835	96.3	0.64
2019	6.8	18.9	12	77.4	0.14	0.85	0	0	29.9	18553	96.5	0.64
2020	7.5	19.3	13.2	76.7	0.16	0.84	0	0	30.3	14840	96.6	0.64
2021	7.9	19.7	15.2	75.4	0.14	0.85	0	0	31	14614	97.0	0.64

Cluster 3: Additional variables (continued)

Year	swaiting	sduratio	scovratl	H568	H580	H540	fed	gov	vturn	rae	pres
2001	0.17	45	0.82	1.6	52.8	10.1	0	2.3	65	0.81	0.5
2002	0.17	44.2	0.81	1.7	54	9.8	0	3	62.5	0.8	0.5
2003	0.17	43.4	0.81	1.7	54.3	9.5	0	2.7	62.5	0.8	0.5
2004	0.17	42.6	0.81	2	52.2	9.5	0	2.7	60.4	0.8	0.5
2005	0.17	41.8	0.81	1.9	52.4	9.3	0	2.8	59.4	0.81	0.5
2006	0.17	41	0.8	2	52.3	9.1	0	2.8	55.5	0.79	0.5
2007	0.4	38.2	0.81	1.9	47.9	8.8	0	2.7	58.7	0.77	0.43
2008	0.46	37.5	0.81	2	49.1	8.8	0	2.7	59.1	0.78	0.43
2009	0.51	36.8	0.8	2.2	50.1	8.5	0	2.4	59.1	0.78	0.43
2010	0.57	36.1	0.8	2	49.6	8.5	0	1.7	59	0.78	0.43
2011	0.66	36.1	0.81	1.9	49.4	8.4	0	1.1	58	0.79	0.43
2012	0.74	36.1	0.82	2	48.8	8.3	0	1.7	58.7	0.78	0.43
2013	0.83	36.1	0.83	1.9	48.2	8.1	0	2.1	58.2	0.78	0.57
2014	0.91	36.1	0.85	1.9	48	8.1	0	2.6	57.9	0.79	0.57
2015	1.00	36.1	0.86	1.9	47.6	8.2	0	2.6	58.3	0.8	0.57
2016	0.91	36.1	0.86	1.9	47.9	8.2	0	2.3	58	0.81	0.57
2017	0.83	36.1	0.86	1.9	48.1	8.2	0	2.3	58.2	0.81	0.57
2018	0.74	36.1	0.87	1.9	48.3	8.2	0	2.1	58.7	0.82	0.57
2019	0.66	36.1	0.87	1.8	49.2	8.3	0	2	60.1	0.81	0.57
2020	0.57	36.1	0.87	1.8	49.9	8.3	0	1.7	60.6	0.81	0.57
2021	0.57	36.1	0.88	1.8	50.6	8.3	0	1.1	61.2	0.81	0.57