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Exploratory analysis of flexicurity dimensions across EU countries: a statistical assessment and consensus clustering approach

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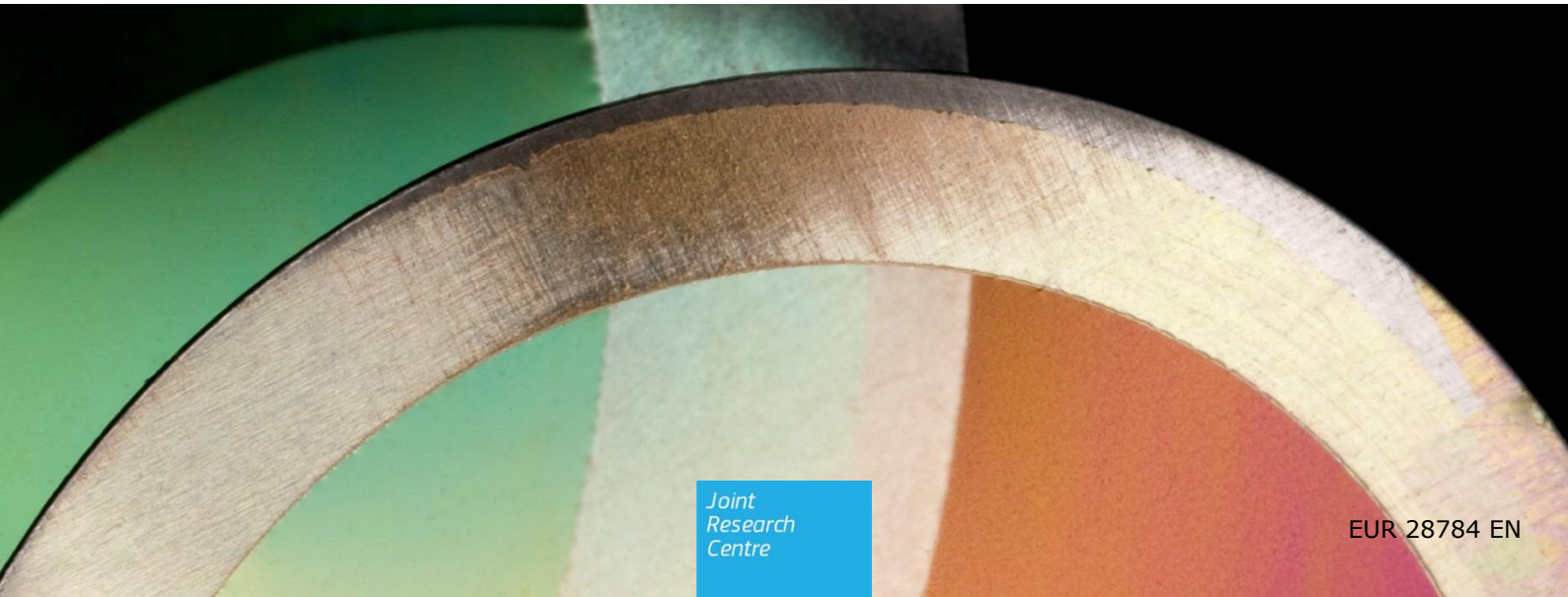

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Contents

Abstract

The present analysis of flexicurity dimensions across EU countries draws upon available data sources from Eurostat (Statistics on Living and Income Conditions and Labour Force Survey) and OECD. The results from the updated statistical assessment are very much in line with those from previous analyses, and underscore the lack of a sound and robust correlation structure among the indicators in the different flexicurity dimensions. In addition, cluster analysis has been brought into the picture to provide additional insights on the heterogeneity of flexicurity performance across countries. With regard to the results obtained from the clustering exercise, these appear to be to a great extent sensitive to the method applied and to the indicators (and time periods) considered for the analysis. However, consensus clustering optimisation techniques might be used to overcome the problem of non-uniqueness and disagreement between partitions, and to improve the robustness of cluster solutions.

1 Introduction

The JRC Competence Centre on Composite Indicators and Scoreboards (COIN) has been requested by DG EMPL – Unit B.1 to update the statistical analysis of the EMCO-modified list of indicators adopted by the Commission to monitor the four flexicurity components.

Since taking office in 2014, the current European Commission has put at the core of its policy agenda the goals of completing a deeper and fairer Economic and Monetary Union and achieving a 'social triple-A rating' for Europe.[1] In this regard, the proposal of a European Pillar of Social Rights (EPSR) is part of the efforts by the European Commission to take into account the changing realities of Europe's societies and the world of work.[2] The aim of the EPSR is to serve as a compass for the renewed upward social convergence within the euro area. The Five Presidents' Report (European Commission 2015) acknowledged that, for the EMU to succeed, labour markets and social protection systems need to function well and in a fair manner in all euro area Member States. But defining standards for renewed upward convergence of the euro area economies requires deeper analysis. For instance, as stated in the Five Presidents' Report, the standards for labour markets should combine security and flexibility, and could thus be developed along the various dimensions of the flexicurity concept. Revisiting flexicurity under the light of the post-crisis socio-economic and political context should start with a clear understanding of the evidence in order to assess if, where and how the flexicurity concept needs adapting or complementing (European Commission 2016).

In a previous work, Nardo and Rossetti (2013) provided a concise evaluation of the statistical coherence for each indicator in each flexicurity dimension in every Member State. An updated statistical assessment is key for the evaluation of the flexicurity indicators' policy relevance, in line with the revision of the flexicurity concept in the context of 'The future of work and welfare systems' work stream of the EPSR. The present document provides relevant insights to be taken into account for further development and refinement of flexicurity indicator frameworks.

The underlying data used in the present analysis comes from currently available data sources from Eurostat (Statistics on Living and Income Conditions and Labour Force Survey) and OECD. As regards the scope of the statistical assessment undertaken herein, we have used the same correlation based methods as in the previous JRC report. The results from the updated statistical assessment are very much in line with those from Nardo and Rossetti (2013), since both of them highlight the lack of a sound and robust correlation structure among the indicators in the different flexicurity dimensions—with the exception of the pool of indicators included in the third dimension 'Effective active labour market policies'. In addition, cluster analysis has been brought into the picture to provide additional insights on the heterogeneity of flexicurity performance across countries. With regard to the results obtained from the clustering exercise, these appear to be to a great extent sensitive to the method applied and to the indicators (and time periods) considered for the analysis. However, consensus clustering optimisation techniques might be used to overcome the problem of non-uniqueness and disagreement between partitions, and to improve the robustness of cluster solutions.

The present work is structured as follows. After the introduction, a brief outline of the flexicurity concept and flexicurity dimensions is provided. Next, the available data—together with the data cleaning and treatment process—are described. Then, a statistical assessment of each of the flexicurity dimensions is presented. Following, different clustering techniques are also implemented to identify groups of EU countries with similar

[1] Jean-Claude Juncker: "A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change. Political Guidelines for the next European Commission." Opening Statement in the European Parliament, Plenary Session, Strasbourg, 22 October 2014. Downloadable at: https://ec.europa.eu/priorities/sites/beta-political/files/juncker-political-guidelines-speech_en_0.pdf

[2] Jean-Claude Juncker: "State of the Union 2015". Speech delivered in front of the European Parliament, Strasbourg, 9 September 2015. Downloadable at: https://ec.europa.eu/priorities/sites/beta-political/files/state_of_the_union_2015_en.pdf.

flexicurity patterns of behaviour. Finally, individual cluster results will be compared and combined together while searching for a robust consensus clustering solution.

2 The concept of flexicurity and flexicurity dimensions

As stated in European Commission (2012), flexicurity has been defined since the mid-2000s as "an integrated policy strategy to enhance both flexibility and security within the labour market". As such, the concept relies upon four main pillars—i.e. policy components:

- Flexible and reliable contractual arrangements, which help 'outsiders' (those employed on short-term or irregular contracts, together with the unemployed) to find work and to move into stable contractual agreements; flexicurity is also to help 'insiders' (permanent employees with open-ended contracts) to prepare themselves for job changes ahead of time in the case of redundancy due to economic change.

- Comprehensive lifelong learning strategies, to keep the labour force updated in line with the demands of companies, ensuring EU citizens the opportunity to have a high quality initial education, that they complete at least their secondary education, develop a broad range of key skills, and upgrade and acquire new skills throughout their working lives; it is also about ensuring that enterprises invest more in human capital and allow employees to develop their skills;

- Effective active labour market policies to help unemployed people back to work, and ease the transition process;

- Modern social security systems that provide an adequate safety net when people are changing work, healthcare benefits if they fall ill, as well as pensions and childcare and other forms of support facilitating reconciliation between working and family life.

Flexicurity involves the combination of the above mentioned four components in order to exploit the complementarities and synergies between the different measures and policy areas. Moreover, as highlighted in ICF GHK (2012), the concept of flexicurity is based on the idea that new forms of flexibility and security are needed both by individuals and companies. Accordingly, flexicurity aims to enhance the flexibility of labour markets, work organisations and labour relations. But it also aims to foster employment and income security, as well as reconciliation of work and family life. All things considered, the overall objective of flexicurity policies would thus be to facilitate transitions between jobs and to tackle labour market segmentation, taking into account the specific circumstances of each Member State.

3 List of indicators considered and data description

As a starting point, the monitoring and analysis of flexicurity achievements in this paper is based on the indicator framework proposed by Nardo and Rosetti (2013). This indicator framework draws heavily upon the modified list of flexicurity indicators endorsed by the Employment Committee (EMCO) in 2010. The preliminary stage of our work involved data gathering and the construction of the dataset underpinning the analysis. However, and as already discussed in Nardo and Rosetti (2013), the data collection stage was affected by the presence of some currently unavailable or weakly defined indicators in the EMCO indicator framework. In light of this, the final pool of indicators selected for the present statistical assessment of flexicurity dimensions across EU countries is shown in Table 1.

Table 1: List of indicators considered (adapted from EMCO modified list and Nardo and Rosetti, 2013)

Indicators	Label	Comments	Latest year	Direction	Type
Dimension 1: FLEXIBLE AND RELIABLE CONTRACTUAL ARRANGEMENTS					
EPL[1]	Strictness of employment protection legislation – temporary contracts		2013	-	Input
lfsa_etgar	Share of employees with fixed-term contracts because they could not find a permanent job	Diversity and reasons for contractual and working arrangements	2015	-	Process
lfsa_eppgai	Share of employees in part-time because they could not find full-time job		2015	-	Process
	Employees with overtime work	Data not available			
ilc_lvhl33	Transitions by contract		2015	+	Output
job_tenure[2]	Job tenure in years	5 and more years	2014	-	Output
	Labour turnover	Data not available			
ilc_lvhl32	Transitions from temporary to permanent employment		2015	+	Output
lfso_04peovisco	Percentage of employees working overtime	Data only for 2004	2004	+	Process
Dimension 2: COMPREHENSIVE LIFELONG LEARNING STRATEGIES					
pshm	Public spending on human resources	2000-2015	2011	+	Input
trng_lfse_01	Life-long learning	25-64 2006-2015	2015	+	Process
	Gap in CVT participation btw temporary and permanent workers	Data not available			
edat_lfse_03	Educational attainment	Age 25-64, 2006-2015, tertiary education	2015	+	Output

isoc_sk_cskl_i	E-skills computer	Age 25-54 individuals who have carried out 1 or 2 of the 6 computer related activities (on total population)	2014	-	Output
isoc_sk_iskl_i	E-skills internet	Age 25-54 individuals who have carried out 1 or 2 of the 6 internet related activities (on total population)	2013	-	Output
Dimension 3: EFFECTIVE ACTIVE LABOUR MARKET POLICIES (ALMP)					
lmp_ind_exp	LMP measures (cat 2-7): spending per person wanting to work		2014	+	Input
lmp_ind_exp_gdp	Expenditure on Active Labour Market Policies (ALMP) as percentage of GDP		2014	+	Input
lmp_ind_actsup	Share of participants in regular activation measure (with respect to the number of persons wanting to work).	Cat. 2-7, total LMP measure	2014	+	Process
une_ltu_a	Long term unemployment rate	Percentage of active population	2015	-	Output
Dimension 4: MODERN SOCIAL SECURITY SYSTEMS					
4.a. Social security systems					
lmp_ind_exp2	LMP measures (cat 8): spending in out-of-work income maintenance and support per person wanting to work	Cat. 8	2014	+	Input
lmp_ind_exp2_gdp	Expenditure on out-of-work income maintenance and support (% of GDP)	Cat. 8	2014	+	Input
earn_nt_unemtrp	Unemployment trap		2014	-	Input
earn_nt_lowwtrp	Low wage trap		2014	-	Input
NRRUBHBSA[3]	Net replacement rate after 6 months	Single person, 67% of previous earnings, unemployment duration: 7 months	2014	+	Input

NRRUBHBSA2[3]	Net replacement rate after 5 years	Single person, 67% of previous earnings, unemployment duration : 60 months	2014	-	Input
lmp_ind_actsup2	% of persons wanting to work receiving out-of-work income support	Cat. 8-9	2014	+	Process
ilc_li04	At-risk-of-poverty rate of unemployed aged 18+	Population: unemployed, Cut off cut-off point at cut-off point at 60% of median equalized income after social transfers, age 18 and +	2015	-	Output
4.b. Reconciliation of work and private life					
ilc_caindformal	Formal childcare (1-29 hours) from 3 years to compulsory school age		2014	+	Input
Inact_single[3]	Inactivity trap _ Single parent with 2 children	67 % of average wage	2014	-	Input
Inact_couple[3]	Inactivity trap _ 2 earners couple with 2 children	67 % of average wage	2014	-	Input
lfsa_epgar	Part-time work due to other family and personal responsibilities	Age 15-64	2015	+	Process
lfsa_igar	Inactivity due to other family and personal responsibilities	Age 15-64	2015	+	Process
lfsa_epgar2	Part-time work due to looking after children or incapacitated adults	Age 15-64	2015	+	Output
lfsa_igar2	Inactivity due to looking after children or incapacitated adults	Age 15-64	2015	+	Output
	Participation break	Data not available			
	Transition by work-life/balance combinations	Data not available			

Note: Own elaboration. Raw data extracted from Eurostat Database (http://ec.europa.eu/eurostat/data/database) unless stated otherwise:

[1]OECD.Stat (http://stats.oecd.org/Index.aspx?DataSetCode=EPL_T)

[2] OECD.Stat (https://stats.oecd.org/Index.aspx?DataSetCode=TENURE_AVE)

[3]DG EMPL Tax and benefits database (http://ec.europa.eu/economy_finance/db_indicators/tab/)

In line with best practices on building composite indicators and scoreboards (OECD-JRC 2008), the raw dataset has been subject to an iterative process of data cleaning and treatment. Several steps are involved in this process, including detection and correction of outliers, normalisation of variables and imputation of missing data.

As regards outlier detection, potentially problematic variables have been defined as those whose skewness and kurtosis values exceed 2.0 and 3.5, respectively. Following this

criteria, one single outlier value was identified—and subsequently removed from the dataset—in the variable 'lmp_ind_actsup2'.

Once potentially problematic values have been identified and treated, the indicators need to be normalised to render the variables comparable. The strategy adopted herein to reach a homogeneous ground for comparison was the 'min-max normalisation' approach. Min-max normalisation sets an equal range of variation for all the indicators in the dataset (e.g. 0-100), taking into account whether the contribution contribution of the variable to the flexicurity dimension is expected to be positive or negative. The expected direction of the variable is indicated in the corresponding column of Table 1 above. For variables in which higher values are to be interpreted as positive contributions to flexicurity dimensions, we have used the following formula:

$$x_t = \frac{x_i - Min(x_n)}{Max(x_n) - Min(x_n)} * 100$$

For those variables for which we assume (conceptually) that higher values imply a negative contribution to the corresponding flexicurity dimension, we have applied the following formula:

$$x_t = \frac{Max(x_n) - x_i}{Max(x_n) - Min(x_n)} * 100$$

Finally, the 'Amelia II' software package (Honaker et al. 2011) has been used to impute missing values in our dataset, made up of 28 countries and 16 time periods (from the year 2000 to 2015). More precisely, missing data has been filled in taking advantage of the cross-section time-series functionality of the software. The imputations obtained from the software have been checked subsequently to prevent the presence of normalised values exceeding 100 or below 0. The resulting dataset has been used as the starting point for the statistical analyses undertaken in the sections below.

4 Statistical assessment of flexicurity dimensions

The statistical analysis of flexicurity dimensions is based on the normalised set of indicators described in the previous section. For each dimension, a descriptive analysis of levels and changes over time in the individual indicator scores is presented. Multivariate analysis and correlation based techniques have also been applied in order to gain additional insights on the statistical structure of the dataset (OECD-JRC 2008). Firstly, Pearson correlation coefficients have been calculated to check whether there are too poor (or negative) or too high correlations within the indicators in each dimension. Secondly, Principal Component Analysis (PCA) provides a more in-depth analysis of the variance and correlation structure of the data. PCA identifies "principal components"—i.e. common underlying statistical dimension within the original dataset—and helps reveal groups of indicators with similar statistical patterns of behaviour. When performing PCA on each of the flexicurity dimensions, the expectation is that one single latent dimension should be identified within the set of indicators considered. After rotation of the solution, all the indicators should load with equal sign and similar magnitude on that single principal component. Finally, Cronbach-alpha tests the level of internal consistency and scale reliability of the dataset. It helps to assess the extent to which a group of variables are measuring the same underlying construct. If Cronbach-alpha happens to increase when one of the variables in the flexicurity dimension is deleted, that variable should be flagged as a candidate to be removed from the dataset.

4.1 Statistical assessment of Dimension 1: Flexible and reliable contractual arrangements

Relative performance of the EU28 countries with regard to Flexicurity Dimension 1 is presented in

Table 2. The values shown therein are the normalised averages over the period 2011-2015 for the seven indicators considered. Coloured circles next to the score indicate country scores included in the lower half of the set of all values for that indicator (red), between 50% and 75% of all the country scores (yellow), or included in the upper quartile (green).

Table 2: Relative performance of countries in Flexicurity Dimension 1 (normalised values, average 2011-2015)

Country	job_tenure	EPT/EPR	lfso_04peovisco	ilc_lvhl33	lfsa_etgar	lfsa_eppgai	ilc_lvhl32
Austria	31.25	72.51	44.18	64.91	99.40	90.19	62.83
Belgium	25.53	39.79	34.08	63.57	20.30	92.07	49.07
Bulgaria	44.65	58.91	19.10	42.69	29.20	15.80	44.44
Croatia	42.71	70.27	31.45	13.12	54.48	70.22	45.09
Cyprus	46.32	53.46	20.23	51.03	0.90	20.82	27.02
Czech Republic	67.68	70.78	35.34	77.52	14.85	79.24	46.97
Denmark	36.88	69.33	26.99	62.85	53.24	81.79	39.30
Estonia	68.60	50.12	26.07	66.73	69.43	80.21	83.61
Finland	23.40	63.84	31.34	48.89	31.03	65.20	38.63
France	28.56	2.22	27.49	72.23	41.15	49.81	9.36
Germany	29.12	79.84	34.42	65.78	84.90	83.99	47.38
Greece	28.93	41.27	24.45	15.56	10.67	7.58	22.63
Hungary	62.69	74.53	15.17	56.39	26.53	47.28	51.10
Ireland	39.33	93.40	28.10	38.31	35.57	47.52	44.62
Italy	27.00	51.83	31.43	49.33	26.32	16.59	23.66
Latvia	71.82	84.88	33.04	43.43	33.95	48.72	68.30
Lithuania	89.61	60.90	17.75	60.97	37.40	57.74	61.55
Luxembourg	43.84	0.19	20.95	83.76	51.20	88.43	43.70
Malta	38.67	56.05	25.04	91.08	48.21	83.29	37.35
Netherlands	35.84	83.61	50.84	82.78	62.71	92.86	26.87
Poland	28.42	57.13	19.06	63.88	34.83	63.82	23.25
Portugal	14.03	54.15	23.15	32.13	11.52	35.92	35.08
Romania	38.82	52.51	15.20	95.79	11.43	25.46	77.66
Slovakia	65.81	66.05	28.38	56.32	10.62	61.91	57.67
Slovenia	13.57	57.91	39.52	49.08	43.15	91.98	53.50
Spain	33.11	31.44	21.22	17.41	4.39	16.21	14.54
Sweden	23.75	85.08	34.69	66.10	42.32	63.88	54.44
United Kingdom	51.49	98.61	71.30	72.73	47.09	78.68	76.30

Greece, Portugal and Spain have indicator scores in the bottom half of the distribution for all the indicators considered in the dimension. On the other hand, UK is the only country with all its indicators included in the upper half of the distribution of values.

As already discussed in Nardo and Rossetti (2010), ilc_lvhl33 ('Transitions by contract') has been proposed as the key overall indicator for the first flexicurity policy area.

Figure 1 compares performance across countries over time (2011-2015) with respect to this overall indicator. The horizontal axis represents the relative position of each country (i.e. whether a country belongs to the first, second, third or fourth quartile) according to the normalised values calculated for the indicator in 2015. The vertical axis represents the absolute change (positive or negative) in the normalised scores from year 2011 to year 2015.

Figure 1: Levels (2015) and changes (2011-2015) in normalised scores for 'Transitions by contract'

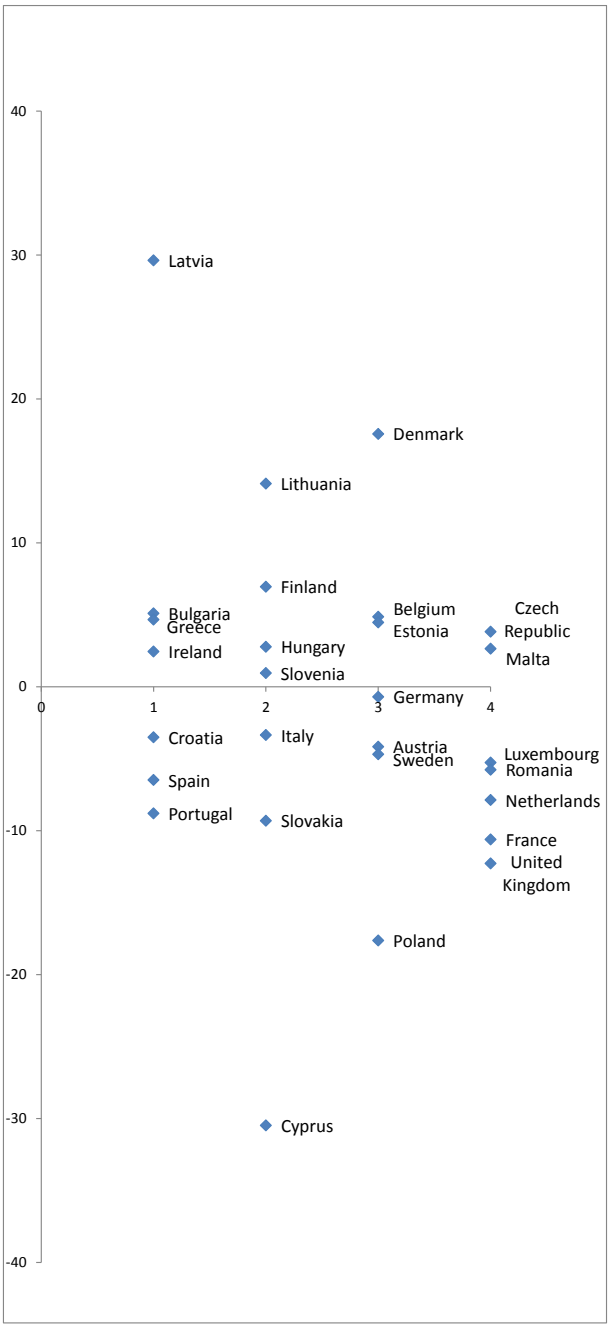


Figure 1 shows that countries like Latvia have been doing a great effort to leave behind the group of low performance countries, whilst Croatia, Spain and Portugal seem to be in an even worse situation than at the beginning of the period. Amongst the countries with higher scores for the overall indicator (i.e. those countries assigned to the fourth quartile), Czech Republic and Malta seem to be advancing in the right direction, whilst other countries such as France and United Kingdom are losing ground in relative terms when compared to the top performers. Finally, the largest dip in performance registered over the period for an individual country corresponds to Cyprus.

Correlation coefficients calculated for the selected variables in 2015 are shown in Table 3 below. Even though all the correlation coefficients appear to be positive, in many cases correlations are poor and not significantly different from zero (at 5% significance level). Both lfsa_eppgai ('Share of employees in part-time because they could not find full-time job') and ilc_lvhl32 ('Transitions from temporary to permanent employment') show the highest number of significant positive associations with the remaining variables in the flexicurity dimension—but not to each other.

Table 3: Pearson correlation coefficients of indicators (year 2015) in Flexicurity Dimension 1

	job_tenure	EPT/EPR	lfso_04peovisco	ilc_lvhl33	lfsa_etgar	lfsa_eppgai	ilc_lvhl32
job_tenure	**1.000 (.000)**	.209 (.285)	-.042 (.833)	.200 (.307)	-.002 (.992)	.093 (.640)	**.521 (.004)**
EPT/EPR		**1.000 (.000)**	**.492 (.008)**	.036 (.856)	.247 (.205)	.292 (.131)	**.585 (.001)**
lfso_04peovisco			**1.000 (.000)**	.110 (.577)	**.399 (.036)**	**.527 (.004)**	.270 (.165)
ilc_lvhl33				**1.000 (.000)**	.260 (.182)	**.530 (.004)**	**.476 (.010)**
lfsa_etgar					**1.000 (.000)**	**.638 (.000)**	.324 (.093)
lfsa_eppgai						**1.000 (.000)**	**.465 (.013)**
ilc_lvhl32							**1.000 (.000)**

Note: Significant correlations (at 5% significance level) highlighted in bold.

PCA applied to the first flexicurity dimension indicators (normalised scores, year 2015) identifies not one but three principal components with eigenvalues above 1.00, which are able to explain 78.5% of the total variance in the dataset. The loadings (i.e. correlation coefficients) of the variables on the principal components after varimax rotation are presented in Table 4. In this case, three variables load mainly on the first component, two on the second component and two on the third component. Overall, the results above—low correlations and no single latent dimension identified using PCA—highlight the presence of statistical problems in the dataset, such as multidimensionality and heterogeneous patterns of behaviour across indicators.

Table 4: Component matrix for indicators (year 2015) in Flexicurity Dimension 1

	Component		
	1	2	3
lfsa_eppgai	**.851**	.326	.090
ilc_lvhl33	**.769**	-.251	.383
lfsa_etgar	**.712**	.369	-.093
EPT/EPR	.002	**.833**	.391
lfso_04peovisco	.356	**.780**	-.113
job_tenure	-.030	-.018	**.875**
ilc_lvhl32	.374	.354	**.762**

4.2 Statistical assessment of Dimension 2: Comprehensive lifelong learning strategies

Relative performance of the EU28 countries with regard to Flexicurity Dimension 2 is presented in

Table 2. The values shown in the table correspond to the normalised average for the five indicators considered over the period 2011-2015. Coloured circles next to the score indicate country scores included in the lower half of the set of all values for that indicator (red), between 50% and 75% of all the country scores (yellow), or included in the upper quartile (green).

Table 5: Relative performance of countries in Flexicurity Dimension 2 (normalised values, average 2011-2015)

Country	pshm	trng_lfse_01	edat_lfse_03	isoc_sk_cskl_i	isoc_sk_iskl_i
Austria	47.38	40.89	36.02	59.56	34.96
Belgium	55.57	18.53	70.58	35.74	34.21
Bulgaria	17.99	1.85	40.47	41.22	73.98
Croatia	19.36	5.69	24.50	37.57	61.26
Cyprus	68.15	19.68	81.11	56.46	64.50
Czech Republic	25.69	28.31	25.26	29.10	51.01
Denmark	96.08	97.12	69.36	75.42	60.67
Estonia	39.56	35.02	75.50	58.14	75.40
Finland	66.05	74.89	85.09	76.49	59.69
France	52.48	38.02	59.24	48.90	51.39
Germany	32.85	21.28	47.19	37.61	20.05
Greece	17.10	5.94	45.38	66.89	74.03
Hungary	37.34	8.31	32.05	52.44	65.94
Ireland	42.40	18.53	84.62	63.76	42.88
Italy	25.82	17.51	13.57	69.88	72.81
Latvia	45.14	15.46	53.33	47.46	82.39
Lithuania	41.39	13.87	70.00	67.58	86.88
Luxembourg	21.18	43.90	84.97	73.30	61.41
Malta	54.19	18.79	19.47	54.02	57.19
Netherlands	49.76	52.78	64.44	49.12	48.96
Poland	38.92	9.07	40.82	31.87	63.52
Portugal	42.75	28.43	24.04	68.98	74.28
Romania	6.08	0.83	11.75	37.97	67.49
Slovakia	18.64	6.45	23.68	28.60	51.17
Slovenia	48.31	38.21	46.61	60.67	59.49
Spain	29.31	30.22	64.03	68.25	56.19
Sweden	76.92	84.86	74.56	60.12	51.51
United Kingdom	43.93	47.73	81.11	50.55	41.89

Slovakia is the only country with all the indicator values of Flexicurity Dimension 2 positioned in the lower half of the distribution. Conversely, Denmark is the only country with scores above the median for all the indicators included in Table 5.

The variable trng_lfse_01 ('Life-long learning') is the key overall indicator included in the second flexicurity policy dimension. Figure 2 compares performance across countries over time (2011-2015) with respect to this overall indicator. The horizontal axis represents the relative position of each country (first, second, third or fourth quartile) according to the normalised values calculated for the indicator in 2015. The vertical axis represents the change (positive or negative) in the normalised scores from year 2011 to year 2015.

Figure 2: Levels (2015) and changes (2011-2015) in normalised scores for 'Life-long learning'

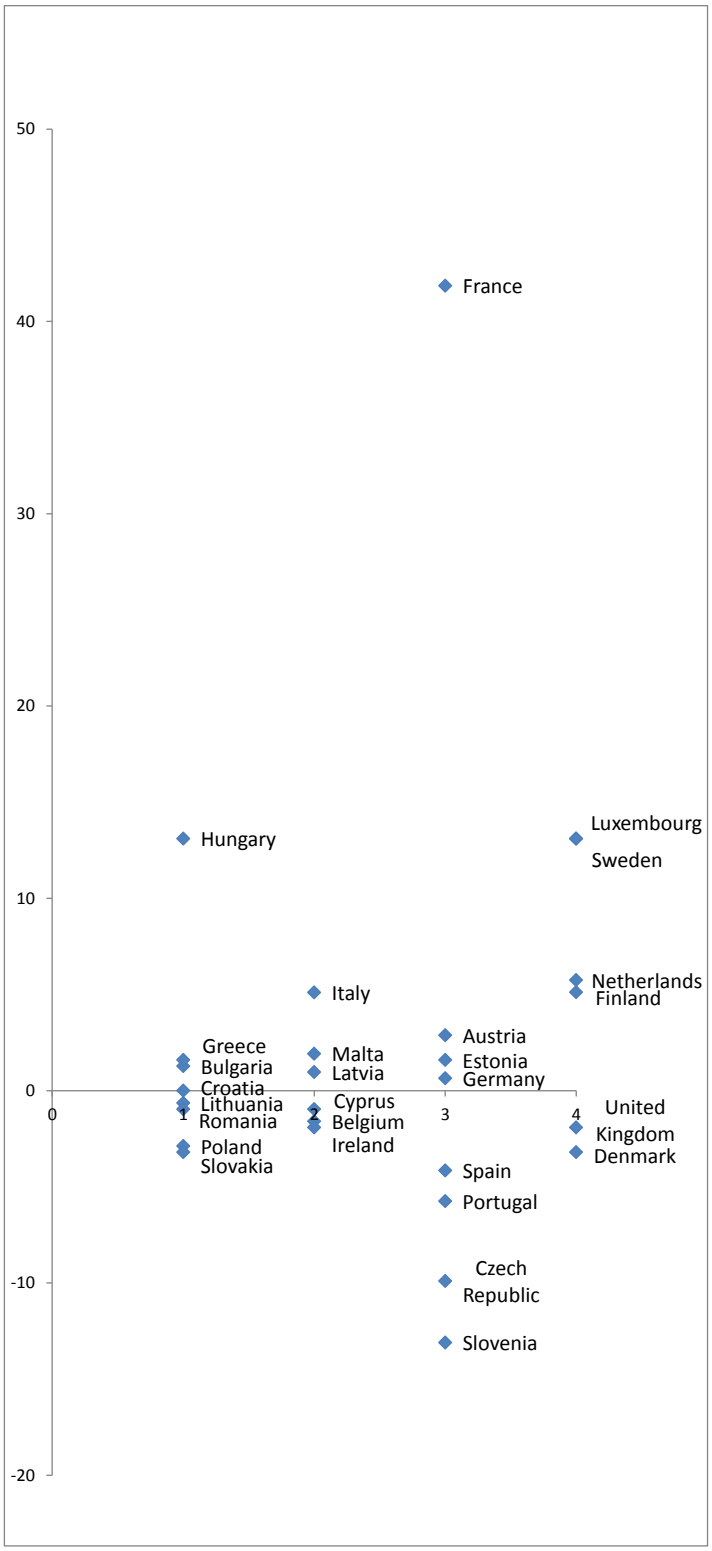


Figure 2 shows that, amongst those countries with the lowest scores, Hungary is the country with the best track record (i.e. highest positive change in normalised values) over the period. However, Poland and Slovakia seem to be falling behind with respect to the best performers. Amongst the countries included in the fourth quartile in 2015, Luxembourg is the one with the best performance over the period, whilst United Kingdom and Denmark show lower normalised values at the end of the period. The country with the largest drop in performance over the period is Slovenia, whilst the highest improvement in performance corresponds to France.

Correlation coefficients calculated for the selected variables in 2015 are shown in Table 6 below. The overall indicator trng_lfse_01 ('Life-long learning') is significantly correlated to pshm ('Public spending on human resources') and edat_lfse_03 ('Educational attainment'). However, pairwise correlations between the two variables related to computer and internet skills (isoc_sk_cskl_i ('E-skills computer') and isoc_sk_iskl_i ('E-skills internet')) and the other indicators in the flexicurity dimension are either poor and nonsignificant (5% significant level) or negative—which is precisely the case for the correlation between isoc_sk_iskl_i and the overall indicator trng_lfse_01.

Table 6: Pearson correlation coefficients of indicators (year 2015) in Flexicurity Dimension 2

	pshm	trng_lfse_01	edat_lfse_03	isoc_sk_cskl_i	isoc_sk_iskl_i
pshm	**1.000 (.000)**	**.733 (.000)**	**.499 (.007)**	.315 (.103)	-.250 (.200)
trng_lfse_01		**1.000 (.000)**	**.564 (.002)**	.368 (.054)	**-.394 (.038)**
edat_lfse_03			**1.000 (.000)**	.238 (.223)	-.355 (.064)
isoc_sk_cskl_i				**1.000 (.000)**	.316 (.101)
isoc_sk_iskl_i					**1.000 (.000)**

Note: Significant correlations (at 5% significance level) highlighted in bold.

PCA applied to the second flexicurity dimension indicators (normalised scores, year 2015) identifies two principal components with eigenvalues above 1.00, which are able to explain 77.3% of the total variance in the scores. The loadings (i.e. correlation coefficients) of the variables on the principal components after varimax rotation are presented in

Table 7. Three of the variables load mainly on the first component, whilst the other two are loading on the second component. The latter two variables are once again the two indicators related to IT skills. Furthermore, analysis based on Cronbach's alpha confirms that the reliability scores for the first flexicurity dimension would increase considerably in case the indicator isoc_sk_iskl_i were excluded from the dataset. All in all, the results presented herein point towards a latent problem of multidimensionality and heterogeneous patterns of behaviour across the indicators in the dataset.

Table 7: Component matrix for indicators (year 2015) in Flexicurity Dimension 2

	Component	
	1	2
trng_lfse_01	**.908**	.020
pshm	**.846**	.094
edat_lfse_03	**.779**	-.089
isoc_sk_cskl_i	.416	**.821**
isoc_sk_iskl_i	-.465	**.796**

4.3 Statistical assessment of Dimension 3: Effective active labour market policies

Relative performance of the EU28 EU28 countries with regard to Flexicurity Dimension 3 is presented in Table 8. The values shown in the table correspond to the normalised averages of the four indicators considered over the period 2011-2015. Coloured circles next to the score indicate country scores included in the lower half of the set of all values for that indicator (red), between 50% and 75% of all the country scores (yellow), or included in the upper quartile (green).

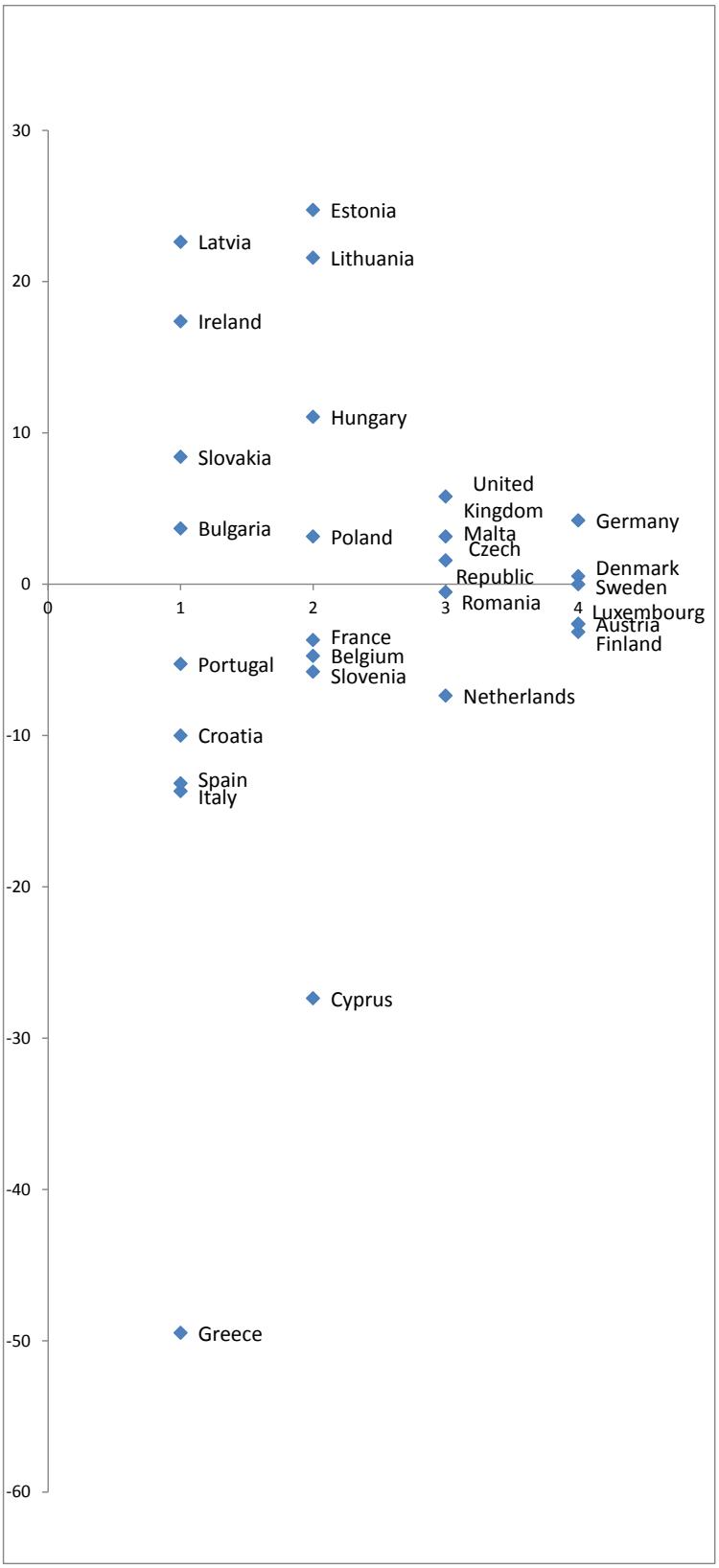
Table 8: Relative performance of countries in Flexicurity Dimension 2 (normalised values, average 2011-2015)

Country	lmp_ind_exp	lmp_ind_exp_gdp	lmp_ind_actsup	une_ltu_a
Austria	21.50	39.21	18.59	95.37
Belgium	24.67	38.05	36.14	82.11
Bulgaria	1.81	14.11	2.97	67.89
Croatia	2.87	11.09	4.61	50.00
Cyprus	3.97	14.04	4.10	75.47
Czech Republic	6.95	11.20	9.04	88.11
Denmark	53.74	94.21	34.58	93.05
Estonia	2.24	7.49	3.19	79.37
Finland	28.70	58.95	21.90	92.95
France	27.84	46.60	31.35	81.79
Germany	18.43	25.41	24.06	90.32
Greece	1.28	13.31	0.57	18.95
Hungary	10.76	41.00	23.74	79.58
Ireland	23.17	48.01	17.23	63.37
Italy	5.74	21.74	14.22	69.58
Latvia	2.17	13.56	4.35	69.58
Lithuania	3.83	12.19	5.67	72.74
Luxembourg	44.60	32.69	45.05	93.90
Malta	1.39	2.71	7.18	87.79
Netherlands	29.15	43.17	25.30	90.11
Poland	5.75	26.99	13.26	82.74
Portugal	8.97	32.23	15.48	61.79
Romania	0.82	0.55	1.97	86.95
Slovakia	3.92	11.87	12.78	54.74
Slovenia	4.48	15.96	7.19	78.32
Spain	7.74	39.04	29.82	42.42
Sweden	40.78	69.95	28.43	94.95
United Kingdom	1.28	1.63	0.60	90.11

The group of low performance countries with regard to Flexicurity Dimension 3 comprises Bulgaria, Croatia, Cyprus, Estonia, Greece, Latvia, Lithuania, Slovakia and Slovenia. For the latter countries, each indicator lies in the lower half of the range of normalised scores. On the other hand, countries such as Denmark, Netherlands and Sweden perform significantly better than the rest of the countries in the dataset. More precisely, their relative performance in each indicator lies in the upper quartile of the normalised values shown in Table 8.

The variable une_ltu_a ('Long term unemployment rate') is the key overall indicator proposed for the third flexicurity dimension. Figure 3 compares performance across countries over time (2011-2015) with respect to this overall indicator. The horizontal axis represents the relative position of each country (first, second, third or fourth quartile) according to the normalised values calculated for the indicator in 2015. The vertical axis represents the absolute change in the normalised scores over the period considered. Figure 3 shows that Portugal, Croatia, Spain and Italy are increasingly lagging behind the top performers. Conversely, Latvia, Ireland, but also Slovakia and Bulgaria, are slowly catching up. Amongst the countries with the higher normalised scores, Germany and Denmark have experienced improvements over the period. Overall, the largest increases in performance from 2011 to 2015 have occurred in the three Baltic countries (Estonia, Latvia and Lithuania), whilst the biggest reductions correspond to Cyprus and Greece.

Figure 3: Levels (2015) and changes (2011-2015) in normalised scores for 'Long term unemployment rate'



Correlation coefficients calculated for the selected variables in 2015 are shown in Table 9 below. One first result to be highlighted is that the overall indicator une_ltu_a ('Long term unemployment rate') is not significantly correlated to any of the other indicators in

the dimension. The remaining indicators have strong and significant positive pairwise correlations with each other.

Table 9: Pearson correlation coefficients of indicators (year 2015) in Flexicurity Dimension 3

	lmp_ind_exp	lmp_ind_exp_gdp	lmp_ind_actsup	une_ltu_a
lmp_ind_exp	**1.000 (.000)**	**.831 (.000)**	**.810 (.000)**	.366 (.056)
lmp_ind_exp_gdp		**1.000 (.000)**	**.703 (.000)**	.189 (.335)
lmp_ind_actsup			**1.000 (.000)**	.171 (.383)
une_ltu_a				**1.000 (.000)**

Note: Significant correlations (at 5% significance level) highlighted in bold.

Results from the PCA confirm the existence of a single underlying latent dimension in the data. In addition, the component loadings (see Table 10) are high and of similar magnitude, with the only exception of une_ltu_a. This result is in line with those from the reliability analysis, since Cronbach-alpha scores suggest that the internal consistency of the variables included in the third flexicurity dimension would increase considerably in case une_ltu_a was excluded from the dataset.

Table 10: Component matrix for indicators (year 2015) in Flexicurity Dimension 3

	Component
	1
lmp_ind_exp	.962
lmp_ind_exp_gdp	.896
lmp_ind_actsup	.884
une_ltu_a	.403

4.4 Statistical assessment of Dimension 4: Modern social security systems

Relative performance of the EU28 countries with regard to Flexicurity Dimension 4 is presented in detail in Table 11 and Table 12. Table 11 shows the results for the sub-group of indicators related to social security systems, and Table 12 presents those indicators related to reconciliation of work and private life. Both tables display the normalised average values for the indicators considered over the period 2011-2015. Coloured circles next to the score indicate country scores included in the lower half of the set of all values for that indicator (red), between 50% and 75% of all the country scores (yellow), or included in the upper quartile (green).

Table 11: Relative performance of countries in Flexicurity Dimension 4 - Sub-dimension social security systems (normalised values, average 2011-2015)

Country	NRRUBHBSA	NRRUBHBSA2	earn_nt_unemtrp	earn_nt_lowwtrp.	Imp_ind_actsup2	Imp_ind_exp2	Imp_ind_exp2_gdp	ilc_li04
Austria	63.49	35.42	50.05	50.19	24.06	45.65	39.19	54.69
Belgium	91.78	24.55	3.79	25.13	78.28	60.32	45.00	60.82
Bulgaria	88.45	78.34	23.86	75.75	4.47	3.16	10.04	40.69
Croatia	43.81	63.26	19.93	58.20	4.44	2.79	9.16	55.67
Cyprus	46.30	38.12	63.34	99.20	7.41	20.67	32.54	74.17
Czech Republic	55.91	41.24	28.10	40.86	9.98	8.95	6.61	50.53
Denmark	96.23	4.90	6.47	3.63	22.98	52.36	42.01	80.57
Estonia	53.46	58.90	58.04	75.10	4.09	7.42	11.80	33.71
Finland	78.03	24.63	33.37	31.97	38.80	49.84	48.46	56.57
France	80.60	37.39	31.55	39.66	42.41	56.86	46.60	72.64
Germany	66.63	42.36	39.25	28.74	37.25	47.35	31.30	5.70
Greece	45.34	100.00	78.85	72.56	8.94	9.22	15.04	50.90
Hungary	36.75	67.12	29.09	56.49	14.78	7.10	10.96	38.04
Ireland	80.65	13.50	37.52	39.91	54.55	67.73	68.97	72.08
Italy	71.00	99.56	29.92	54.30	8.68	26.13	44.75	48.55
Latvia	50.04	54.88	7.57	62.65	3.88	3.44	8.72	34.86
Lithuania	32.87	74.55	51.83	70.67	3.42	3.75	4.41	25.48
Luxembourg	90.19	26.59	13.70	29.11	17.27	56.45	21.11	38.76
Malta	58.61	36.06	72.94	78.56	15.20	7.77	8.29	45.35
Netherlands	82.07	15.87	19.49	7.08	39.57	79.34	56.50	72.61
Poland	76.37	60.64	27.04	22.39	3.45	2.59	3.61	55.88
Portugal	78.94	71.85	27.42	74.84	16.56	22.17	45.16	63.02
Romania	56.77	85.31	79.71	65.47	2.72	1.56	2.59	42.36
Slovakia	36.86	62.35	95.09	71.89	3.87	4.51	6.25	53.20
Slovenia	77.74	45.22	8.07	40.63	7.81	16.39	20.88	50.49
Spain	70.23	62.54	22.69	69.04	19.03	37.22	89.90	52.37
Sweden	76.13	24.94	39.01	49.97	22.08	26.65	21.76	62.90
United Kingdom	63.09	34.33	56.77	37.34	9.18	4.15	3.30	40.97

Table 12: Relative performance of countries in Flexicurity Dimension 4 - Sub-dimension reconciliation of work and private life (normalised values, average 2011-2015)

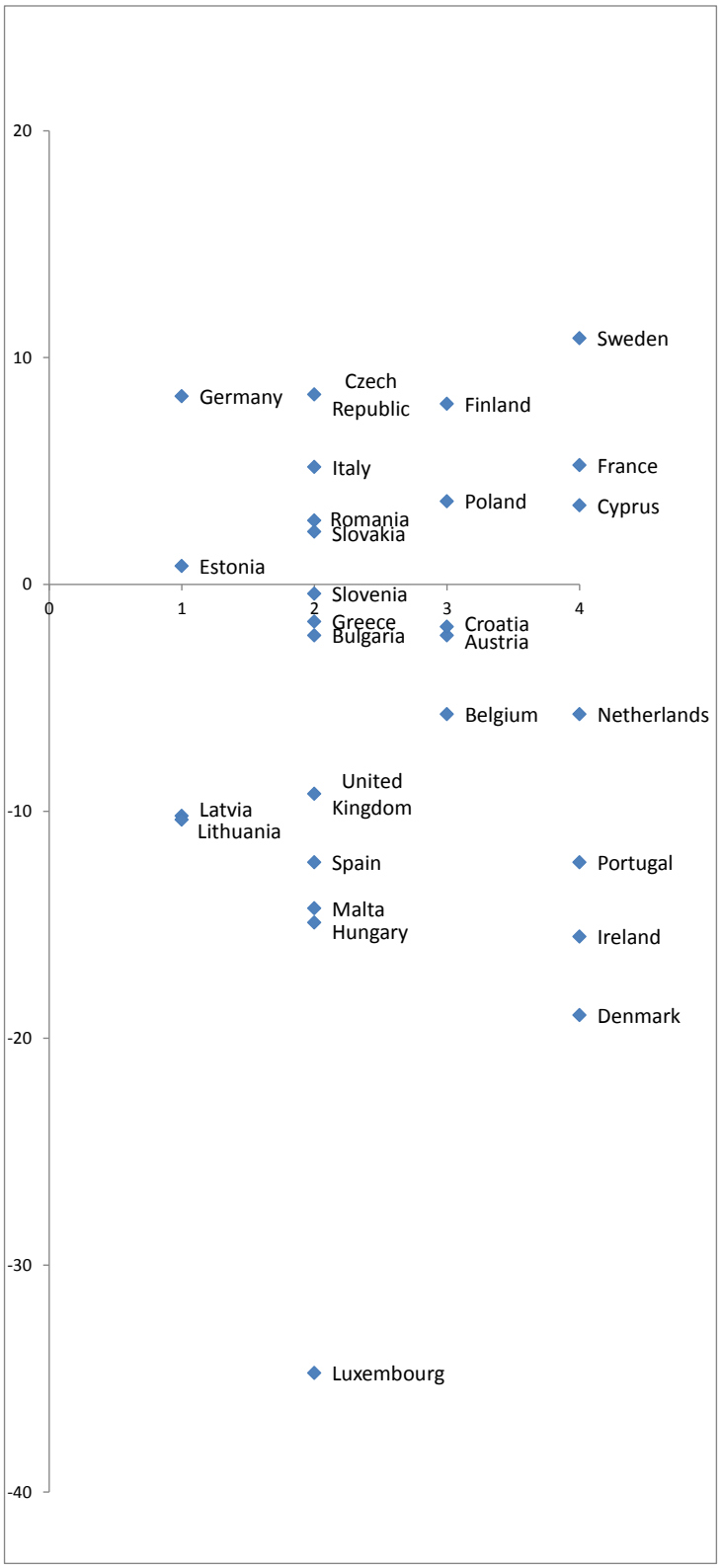
Country	Inact_single	Inact_couple	ilc_caindformal	lfsa_epgar	lfsa_epgar2	lfsa_igar	lfsa_igar2
Austria	19.72	64.32	68.29	25.00	84.10	23.52	36.62
Belgium	26.55	42.88	29.94	40.13	45.36	25.71	15.18
Bulgaria	73.26	76.26	1.90	14.97	30.81	24.11	32.31
Croatia	38.98	59.93	7.30	13.73	8.91	33.33	12.10
Cyprus	36.33	90.83	36.27	15.63	22.79	47.84	39.69
Czech Republic	31.44	59.26	29.23	18.32	43.77	1.17	78.15
Denmark	17.95	3.77	6.41	32.12	2.08	6.40	0.82
Estonia	47.71	72.19	8.51	5.82	21.37	7.68	71.59
Finland	33.50	62.78	22.42	36.01	20.71	3.89	39.69
France	41.09	57.11	52.45	21.17	64.43	25.42	38.91
Germany	28.06	43.69	47.70	29.11	59.56	16.91	42.97
Greece	75.34	91.94	42.09	8.10	6.83	30.88	18.26
Hungary	58.06	60.03	15.60	4.81	17.49	2.45	56.92
Ireland	54.83	47.09	83.48	28.86	40.11	40.75	62.44
Italy	92.88	53.44	22.53	4.91	42.95	18.35	42.26
Latvia	47.83	60.10	4.29	18.29	5.08	24.05	26.26
Lithuania	36.03	55.79	6.02	18.32	14.39	10.45	20.21
Luxembourg	29.72	64.35	45.32	54.02	59.62	36.80	22.15
Malta	42.31	67.63	34.12	43.01	40.11	63.73	42.15
Netherlands	41.15	56.43	89.54	3.58	77.81	6.35	34.36
Poland	43.63	46.38	7.01	2.85	12.35	22.40	40.41
Portugal	51.80	75.60	2.78	5.79	5.46	15.04	17.54
Romania	67.54	63.12	44.43	8.20	1.64	35.25	6.15
Slovakia	88.33	76.84	12.01	1.58	4.15	4.05	72.62
Slovenia	32.84	41.50	9.15	1.04	20.93	16.21	2.56
Spain	52.74	73.98	58.67	4.49	25.25	44.64	28.31
Sweden	42.11	71.54	31.35	16.08	41.80	0.00	14.87
United Kingdom	32.09	45.56	64.67	26.14	85.79	8.32	97.03

There is a huge variability in performance across the indicators included in Flexicurity Dimension 4. Within the Sub-dimension of social security systems (Table 11), Czech

Republic is the only country with all the indicator values included in the lower half of the distribution of normalised scores. No country in the latter sub-dimension has all indicators in the upper half of the distribution. In the Sub-dimension related to reconciliation of work and private life (Table 12), Malta is the only country featuring all the indicator scores in the upper half of the distribution of normalised values, whilst the opposite is true for Slovenia.

The variable ilc_li04 ('At-risk-of-poverty rate of unemployed aged 18+') has been proposed as the overall indication of the Sub-dimension of social security systems. Figure 4 compares performance across countries over time (2011-2015) with respect to this indicator. The horizontal axis represents the relative position of each country (first, second, third or fourth quartile) according to the normalised values calculated for the indicator in 2015. The vertical axis represents the absolute change in the normalised scores over the period considered. Figure 4 shows a very negative trend for Latvia and Lithuania: their performance in 2015 is low—they are included in the first quartile of values—and the evolution of their normalised scores has been negative over the period. At the other end of the scale, Sweden, France and Cyprus are in a much better situation: they are located in the upper quartile of the distribution of normalised values, and they have experienced significant rises in their scores within the period. Moreover, of all the countries, Sweden is the one which has experienced the largest increase in normalised scores. Conversely, Luxembourg has registered the most severe decline in its performance.

Figure 4: Levels (2015) and changes (2011-2015) in normalised scores for 'At-risk-at-poverty rate of unemployed aged 18+'



The variable lfsa_epgar2 ('Part-time work due to looking after children or incapacitated adults') has been selected herein as a representative indicator of the Sub-dimension of

reconciliation of work and private life.[3] Figure 5 compares performance across countries over time (2011-2015) with respect to this indicator. The horizontal axis represents the relative position of each country (first, second, third or fourth quartile) according to the normalised values calculated for the indicator in 2015. The vertical axis represents the absolute change in the normalised scores over the period considered.

[3] As explained in Nardo and Rossetti (2013), the overall indicator proposed for this sub-dimension is 'Inactivity and part-time work due to personal and family responsibilities'. However, since the latter indicator was not available in the data sources consulted, in the present analysis we have opted for using the indicator lfsa_epgar2 ('Part-time work due to looking after children or incapacitated adults').

Figure 5: Levels (2015) and changes (2011-2015) in normalised scores for 'Part-time work due to looking after children or incapacitated adults'

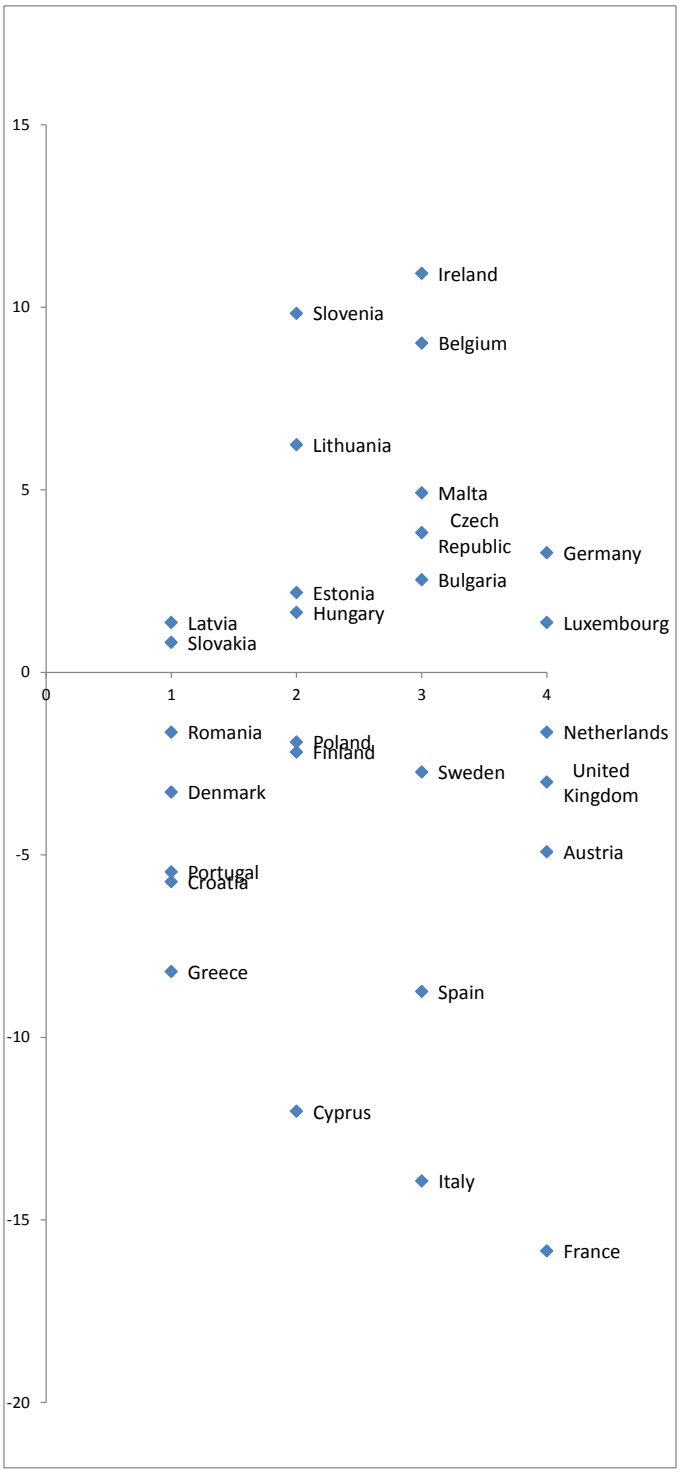


Figure 5 shows a highly positive trend in countries like Germany and Luxembourg, which present high scores coupled with significant rises in the indicator over the period. Strong improvements have also been registered for instance in Ireland, Belgium and Slovenia. On the other hand, a much more negative trend can be observed in countries such as Greece, Croatia, Portugal, Denmark and Romania, which not only are included in the lower quartile of the distribution of values, but have also experienced a drop in their

performance within the period. However, even more severe falls in performance over the period have been registered in France, Italy and Cyprus.

Correlation coefficients calculated for the variables included in the first sub-dimension of Flexicurity Dimension 4 are shown in Table 13 below. Most of the pairwise correlations shown in the table are significant; unfortunately, many of them are also significant but negative. Moreover, the overall indicator ilc_li04 ('At-risk-of-poverty rate of unemployed aged 18+') seems to be poorly correlated with most of the other variables in the sub-dimension.

Table 13: Pearson correlation coefficients of indicators (year 2015) in Flexicurity Dimension 4 - Sub-dimension social security systems

	NRRUBHBSA	NRRUBHBSA2	earn_nt_unemtrp	earn_nt_lowwtrp	lmp_ind_actsup2	lmp_ind_exp2	lmp_ind_exp2_gdp	ilc_li04
NRRUBHBSA	**1.000 (.000)**	**-.495 (.007)**	**-.499 (.007)**	**-.570 (.002)**	**.519 (.005)**	**.521 (.005)**	**.392 (.039)**	**.412 (.029)**
NRRUBHBSA2		**1.000 (.000)**	.294 (.128)	**.580 (.001)**	**-.592 (.001)**	**-.651 (.000)**	**-.393 (.039)**	-.373 (.051)
earn_nt_unemtrp			**1.000 (.000)**	**.545 (.003)**	-.334 (.082)	**-.386 (.042)**	-.298 (.124)	-.022 (.912)
earn_nt_lowwtrp				**1.000 (.000)**	**-.505 (.006)**	**-.565 (.002)**	-.216 (.271)	-.161 (.413)
lmp_ind_actsup2					**1.000 (.000)**	**.796 (.000)**	**.638 (.000)**	.307 (.111)
lmp_ind_exp2						**1.000 (.000)**	**.799 (.000)**	.313 (.105)
lmp_ind_exp2_gdp							**1.000 (.000)**	**.392 (.039)**
ilc_li04								**1.000 (.000)**

Note: Significant correlations (at 5% significance level) highlighted in bold.

Correlation coefficients calculated for the variables included in the second sub-dimension of Flexicurity Dimension 4 are shown in Table 14. According to the results, the pattern of correlations between the variables is not very strong. Two of the variables in the indicator framework (lfsa_igar ('Inactivity due to other family and personal responsibilities') and lfsa_igar2 ('Inactivity due to looking after children or incapacitated adults')) are not significantly correlated (5% significance level) with any of the other variables in the sub-dimension. Moreover, there seems to be an unexpected significantly negative correlation between Inact_single ('Inactivity trap _ Single parent with 2 children') and lfsa_epgar ('Part-time work due to other family and personal responsibilities').

Table 14: Pearson correlation coefficients of indicators (year 2015) in Flexicurity Dimension 4 - Sub-dimension social security systems

	Inact_single	Inact_couple	ilc_caindformal	lfsa_epgar	lfsa_epgar2	lfsa_igar	lfsa_igar2
Inact_single	**1.000 (.000)**	**.468 (.012)**	-.071 (.721)	**-.458 (.014)**	-.305 (.115)	.291 (.133)	.090 (.648)
Inact_couple		**1.000 (.000)**	.023 (.909)	-.289 (.136)	-.154 (.433)	.359 (.061)	.100 (.613)
ilc_caindformal			**1.000 (.000)**	.238 (.222)	**.729 (.000)**	.129 (.513)	.255 (.191)
lfsa_epgar				**1.000 (.000)**	**.430 (.023)**	.135 (.494)	.078 (.693)
lfsa_epgar2					**1.000 (.000)**	-.131 (.506)	.358 (.062)
lfsa_igar						**1.000 (.000)**	-.224 (.252)
lfsa_igar2							**1.000 (.000)**

Note: Significant correlations (at 5% significance level) highlighted in bold.

The results of the PCA analysis on the full set of indicators included in the fourth flexicurity dimension does not strongly support the conceptual grouping of the indicators in two distinct sub-dimensions. Instead, there seems to be up to four statistical groups, i.e. four principal components with eigenvalues higher than one, which are able to explain 74.2% of the total variance in the normalised scores. The component loadings on the (rotated) principal components are presented in

Table 15. As indicated above, the results are somewhat mixed, in the sense that although most of the indicators from the first sub-dimension load mainly on the first principal component, this is not the case for earn_nt_lowwtrp ('Low wage trap') and earn_nt_unemtrp ('Unemployment trap'). On the other hand, all of the indicators from the second sub-dimension load mostly on one of the remaining three principal components—with the exception of ilc_caindformal ('Formal childcare (1-29 hours) from 3 years to compulsory school age'), which loads mainly on the first principal component. Again, the results presented herein point towards a potential problem of multidimensionality and heterogeneous patterns of behaviour across the indicators included in the dataset.

Table 15: Component matrix for indicators (year 2015) in Flexicurity Dimension 4

	Component			
	1	2	3	4
lmp_ind_exp2[1]	**.877**	-.259	-.009	.190
lmp_ind_exp2_gdp[1]	**.867**	.037	-.155	-.012
lmp_ind_actsup2[1]	**.773**	-.270	-.036	.254
ilc_caindformal[2]	**.733**	.100	.496	.164
ilc_li04[1]	**.559**	-.121	-.137	-.522
NRRUBHBSA2[1]	**-.550**	.537	-.140	-.340
NRRUBHBSA[1]	**.549**	-.521	-.209	-.128
earn_nt_lowwtrp[1]	-.353	**.827**	-.056	-.097
Inact_couple[2]	-.062	**.822**	.145	-.168
lfsa_igar[2]	.177	**.730**	-.339	.276
Inact_single[2]	-.113	**.599**	.051	-.477
earn_nt_unemtrp[1]	-.201	**.584**	.531	-.155
lfsa_igar2[2]	-.102	.005	**.875**	.032
lfsa_epgar2[2]	.482	-.203	**.557**	.412
lfsa_epgar[2]	.241	-.153	.033	**.858**

[1] Indicator included in the sub-dimension 'Social security systems'

[2] Indicator included in the sub-dimension 'Reconciliation of work and private life'

5 Uncovering heterogeneity in flexicurity inputs and outputs across EU countries: results from cluster analysis

Data clustering is usually regarded as an important but extremely difficult problem (Fred and Jain 2002). However, cluster analysis is widely used as a statistical tool for classifying large amounts of information into manageable sets (OECD-JRC 2008). The aim of clustering is to define sensible methods and algorithms to find structure in the data, and is therefore exploratory in nature (Jain 2010). In practice, clustering techniques serve to put together objects sharing similar conditions with regards to the variables considered, while at the same time guaranteeing that the differences between the resulting groups are as large as possible. Data clustering has a long history in multiple fields. For instance, over the last years, a large number of studies have been carried out to discuss the grouping of EU Member States according to their underlying flexicurity models. A summary of some of the most relevant studies in this line of research can be found in Mandel and Celikel-Esser (2012).

A large number of clustering algorithms exist, and each one of them requires the definition of a similarity measure between patterns, with no prior knowledge about cluster shapes (Jain et al. 1999). Amongst them, the 'k-means algorithm'—as proposed for example by Hartigan and Wong (1979)—stands out as one of the simplest, computationally efficient and most frequently used partitional algorithms (Jain 2010). In addition, traditional cluster analysis such as k-means clustering is also found in the literature coupled with PCA/factor analysis in a sequential fashion. This combined technique is usually termed as 'tandem analysis' (Arabie and Hubert 1994, OECD-JRC 2008). Empirical examples of the use of tandem analysis to undertake cross-country comparisons of flexicurity frameworks can be found in Eamets et al. (2015), Philips and Eamets (2007) and European Commission (2007, 2006). However, some authors like Vichi and Kiers (2001) have suggested that tandem analysis might not be appropriate in recognizing the taxonomic information in the dataset, and have proposed alternative methods to the widely used tandem analysis. The 'factorial k-means analysis' (Vichi and Kiers 2001) combines aspects of cluster analysis with the search of a low-dimensional representation of the information in a dataset. A discrete clustering model and a continuous factorial one are fitted simultaneously, with the aim of identifying the best partition of the objects in the dataset.

In line with recent proposals from the literature on unsupervised learning, we have opted to combine the evidence accumulated from different clustering approaches (i.e. the resulting partitions) into an ensemble of clusters (Jain 2010, Fred and Jain 2002). Re-using as an input the existing partitions from the ensemble, a consensus cluster solution can be subsequently defined and calculated (Hornik 2007). As a starting point, three different techniques—simple non-hierarchical clustering (k-means clustering), tandem analysis and factorial k-means—have been applied to obtain the partitions populating the ensemble. The number of clusters in which to divide the dataset (k = 5) has been selected in line with previous studies and reports relating to the identification of flexicurity scenarios across EU countries (see e.g. European Commission 2006, European Commission 2007, European Commission 2012, ICF GHK 2012).

Additional insights are expected to be gained when making a distinction between flexicurity efforts (inputs) on the one hand and states and effects (outputs) on the other hand (Chung 2012). Flexicurity states are impacted and explained to a certain extent by flexicurity policy efforts. However, other (external) factors might also come into play in this relationship, such as the past institutional characteristics of a country (Chung 2012). Along the same lines, a broader picture of the implications of flexicurity policies might be derived by explicitly factoring the time dimension perspective in the analytical framework—due to the expected delay in the translation of flexicurity input conditions into flexicurity outputs. Accordingly, the full ensemble of country partitions considered herein (Table 16) has been defined and calculated taking into account not only different

cluster methodologies, but also the different nature of flexicurity indicators, as well as the timing of the recent policy and economic cycles.

Table 16: Criteria for defining the ensemble of partitions

Partition	Technique	Variables	Period
1	K-means	all variables	2015
2	K-means	all variables	2011-2015
3	K-means	all INPUT variables	2008-2010
4	K-means	all OUTPUT variables	2011-2015
5	Tandem	all variables	2015
6	Tandem	all variables	2011-2015
7	Tandem	all INPUT variables	2008-2010
8	Tandem	all OUTPUT variables	2011-2015
9	Factorial K-means	all variables	2015
10	Factorial K-means	all variables	2011-2015
11	Factorial K-means	all INPUT variables	2008-2010
12	Factorial K-means	all OUTPUT variables	2011-2015

5.1 Building an ensemble of partitions

Table 17 shows the partitions of the EU28 countries resulting from the different techniques, variables and time periods described above.

Table 17: Results of the ensemble of partitions - EU28 flexicurity indicators

Technique	*k*-means	*k*-means	*k*-means	k-means	Tandem	Tandem	Tandem	Tandem	Factorial *k*-means	Factorial *k*-means	Factorial *k*-means	Factorial *k*-means
Variables	All	All	Input	Output	All	All	Input	Output	All	All	Input	Output
Period	2015	2011-2015	2008-2010	2011-2015	2015	2011-2015	2008-2010	2011-2015	2015	2011-2015	2008-2010	2011-2015
Austria	1	1	3	1	4	3	4	3	2	2	4	2
Belgium	2	2	5	1	4	4	2	3	4	5	3	5
Bulgaria	4	4	2	4	4	4	1	1	5	4	4	4
Croatia	4	4	3	4	4	4	1	1	3	1	4	4
Cyprus	3	3	3	5	5	5	5	3	5	4	1	1
Czech Republic	1	4	3	2	1	3	1	1	3	1	4	3
Denmark	5	5	1	5	2	2	2	3	1	3	4	5
Estonia	4	4	2	2	1	3	1	5	3	1	2	1
Finland	2	5	3	5	2	2	5	3	1	3	3	2
France	2	2	5	1	3	1	3	3	4	5	5	1
Germany	1	1	4	1	4	4	4	1	2	2	3	2
Greece	3	3	2	4	4	4	3	1	5	4	2	4
Hungary	4	4	3	2	1	4	1	1	3	1	1	5
Ireland	2	2	4	5	4	5	4	2	2	5	3	5
Italy	3	3	2	1	4	4	3	1	5	4	2	4
Latvia	4	4	3	2	4	4	1	5	3	1	4	4
Lithuania	4	4	3	2	3	1	1	5	3	1	1	1
Luxembourg	2	2	5	1	3	1	3	3	4	5	5	5
Malta	4	4	3	1	5	5	5	4	3	1	4	3
Netherlands	2	2	4	1	1	3	4	3	2	5	3	1
Poland	4	4	3	1	4	4	2	1	3	1	1	1
Portugal	3	3	2	4	2	4	3	3	5	4	3	4
Romania	4	4	2	3	1	5	1	4	5	1	2	3
Slovakia	4	4	2	2	1	3	1	1	3	1	2	3
Slovenia	4	4	3	5	4	4	2	3	3	1	1	4
Spain	3	3	5	4	4	4	3	1	5	4	5	4
Sweden	5	5	3	5	2	2	5	3	1	3	4	5
United Kingdom	1	1	3	2	1	3	4	2	2	2	3	5

The fundamental problem of non-uniqueness and disagreement between the partitions obtained from different approaches is patent when looking at the results presented in the table above. The resulting partitions show a significant degree of variability across methodologies. In addition to the differences across methodologies, the heterogeneity in the results increases when looking alternately at input or output indicators in different time periods. By way of example, one of the most appealing partitions to be singled out is the one resulting from the k-means algorithm applied to all the variables (input and output) over the extended period 2011-2015. The first cluster in the partition comprises the two German speaking countries (Germany and Austria) together with the UK; the second includes Benelux, France and Ireland; the third cluster consists of the Mediterranean countries—except Malta, which is included in the fourth cluster; the fourth cluster puts together all the new Member States (EU13), with the only exception of Cyprus, which has been assigned to the Mediterranean cluster; finally, the Nordic cluster is made up of Denmark, Finland and Sweden. However, focusing on a single cluster from the ensemble would inefficiently disregard valuable information contained in the remaining partitions. To overcome this limitation, in a subsequent step we will compare all the partitions in the ensemble to detect affinities, and combine them to create a consistent consensus solution.

5.2 Defining consensus

In this section we aim to synthesise into a single clustering the information accumulated in the elements of the cluster ensemble. For that purpose, a measure of similarity between the partitions in the ensemble needs to be defined. Once the dissimilarity measure has been defined, a consensus solution is calculated by combining and merging the multiple clusterings into a single data partition (Fred and Jain 2002, Hornik 2007). For example, the consensus solution might be calculated by minimizing a criterion function which measures how dissimilar consensus candidates are from the actual elements of the ensemble. This approach is usually referred to as the "optimization approach" to consensus clustering.[4] The R package "CLUE" provides optimisation algorithms for computing soft (and hard) least squares Euclidean and median Manhattan consensus partitions.[5] In our study, the results obtained using both dissimilarity measures (Euclidean and Manhattan) have been found to be equivalent. The consensus solution is presented in Table 18 below.

[4] As detailed in Hornik (2007), alternative approaches to obtaining consensus clusterings include the constructive approach, in which one specifies a way to construct the consensus clustering, and the axiomatic approach, focused on the investigation of existence and uniqueness of consensus clusterings characterized axiomatically.

[5] https://CRAN.R-project.org/package=clue

Table 18: Consensus clustering - optimisation approach

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Luxembourg	Netherlands	Slovakia	Denmark	Cyprus
Belgium	Ireland	Estonia	Sweden	Portugal
France	Germany	Croatia	Finland	Greece
	United Kingdom	Hungary		Italy
	Austria	Latvia		Spain
		Lithuania		Bulgaria
		Poland		
		Slovenia		
		Czech Republic		
		Malta		
		Romania		

Alternative evidence on the quality and robustness of the consensus cluster solution can be obtained from the co-association matrix. The co-association matrix is defined as the number of times that two points (i.e. countries) co-occur in the same cluster in the different partitions considered in the ensemble. The underlying assumption behind the definition of a co-association matrix is that patterns belonging to a "natural" cluster will be very likely co-located in the same group in different clusterings (Fred and Jain 2002). Figure 6 maps the computed consensus cluster onto the evidence accumulated—in the form of co-occurrences—in the co-association matrix.

Figure 6: Co-association matrix of the cluster ensemble

	LU	BE	FR	NL	IE	DE	UK	AT	SK	EE	HR	HU	LV	LT	PL	SL	CZ	MT	RO	DK	SE	FI	CY	PT	EL	IT	ES	BG
LU	xxx	9	11	5	4	1	1	2	0	0	0	1	0	1	1	1	0	1	0	2	2	2	1	2	1	2	4	0
BE	9	xxx	8	6	5	3	2	2	0	0	1	2	1	0	3	3	0	1	0	3	2	3	1	3	1	2	3	1
FR	11	8	xxx	6	3	1	0	2	0	1	0	0	0	2	2	1	0	1	0	1	1	2	2	2	1	2	4	0
NL	5	6	6	xxx	8	6	4	5	1	2	0	0	0	1	2	1	1	1	0	1	1	3	2	2	0	1	0	0
IE	4	5	3	8	xxx	5	5	2	0	0	0	1	0	0	0	1	0	1	1	2	2	3	2	1	0	0	0	0
DE	1	3	1	6	5	xxx	6	7	1	0	2	2	1	0	3	1	2	1	0	0	0	2	0	2	2	3	2	2
UK	1	2	0	4	5	6	xxx	8	2	2	2	4	3	3	2	2	5	2	0	1	3	3	2	1	0	0	0	0
AT	2	2	2	5	2	7	8	xxx	1	1	3	2	3	2	3	3	5	4	0	2	4	4	3	1	0	1	0	1
SK	0	0	0	1	0	1	2	1	xxx	10	6	7	6	6	5	4	8	5	8	0	0	0	0	2	4	4	1	6
EE	0	0	1	2	0	0	2	1	10	xxx	5	6	7	8	5	4	6	4	7	0	0	0	1	2	3	3	0	5
HR	0	1	0	0	0	2	2	3	6	5	xxx	9	10	7	8	8	8	7	4	1	3	2	2	3	4	3	4	8
HU	1	2	0	0	1	2	4	2	7	6	9	xxx	9	9	9	8	8	6	4	1	3	2	3	1	2	2	2	5
LV	0	1	0	0	0	1	3	3	6	7	10	9	xxx	9	7	8	8	7	4	1	3	2	2	2	2	2	2	6
LT	1	0	2	1	0	0	3	2	6	8	7	9	9	xxx	8	7	7	6	4	0	2	2	4	0	0	0	0	3
PL	1	3	2	2	0	3	2	3	5	5	8	9	7	8	xxx	9	6	7	3	1	2	2	4	1	2	3	2	4
SL	1	3	1	1	1	1	2	3	4	4	8	8	8	7	9	xxx	5	6	3	3	4	4	5	3	2	2	2	4
CZ	0	0	0	1	0	2	5	5	8	6	8	8	8	7	6	5	xxx	7	4	1	3	2	2	0	1	1	1	4
MT	1	1	1	1	1	1	2	4	5	4	7	6	7	6	7	6	7	xxx	6	1	4	3	4	0	0	1	0	3
RO	0	0	0	0	1	0	0	0	8	7	4	4	4	4	3	3	4	6	xxx	0	0	0	2	3	4	4	1	6
DK	2	3	1	1	2	0	1	2	0	0	1	1	1	0	1	3	1	1	0	xxx	9	6	2	1	0	0	0	1
SE	2	2	1	1	2	0	3	4	0	0	3	3	3	2	2	4	3	4	0	9	xxx	9	5	1	0	0	0	1
FI	2	3	2	3	3	2	3	4	0	0	2	2	2	2	2	4	2	3	0	6	9	xxx	5	2	0	0	0	0
CY	1	1	2	2	2	0	2	3	0	1	2	3	2	4	4	5	2	4	2	2	5	5	xxx	5	4	4	4	2
PT	2	3	2	2	1	2	1	1	2	2	3	1	2	0	1	3	0	0	3	1	1	2	5	xxx	10	9	8	7
EL	1	1	1	0	0	2	0	0	4	3	4	2	2	0	2	2	1	0	4	0	0	0	4	10	xxx	11	9	8
IT	2	2	2	1	0	3	0	1	4	3	3	2	2	0	3	2	1	1	4	0	0	0	4	9	11	xxx	8	7
ES	4	3	4	0	0	2	0	0	1	0	4	2	2	0	2	2	1	0	1	0	0	0	4	8	9	8	xxx	6
BG	0	1	0	0	0	2	0	1	6	5	8	5	6	3	4	4	4	3	6	1	1	0	2	7	8	7	6	xxx

Note: The values in the matrix represent the total number of co-ocurrences (in the same cluster) of any two countries in all the partitions of the ensemble.

All in all, the robustness of the consensus cluster solution is reinforced when looking at the pair-wise similarity structure revealed by the co-association matrix. From a qualitative perspective, the co-association matrix underscores the links and similarities between the groups identified following the optimisation approach. The matrix thus serves as a visualisation tool of the consensus solution. It also sheds light on the strong links between the Nordic countries (Denmark, Finland and Sweden) on the one hand, and (most of) the New Member States on the other hand. However, at least two of the EU13 countries (Bulgaria and Cyprus) seem to belong together with the traditional Mediterranean countries (Portugal, Greece, Italy and Spain). The remaining EU Member States have been split into two groups. The first partition comprises France, Belgium and Luxembourg. The second encompasses Netherlands, Ireland, Denmark, United Kingdom and Austria.

6 Conclusions and discussion

Flexicurity concepts and dimensions, as well as flexicurity indicators, have been at the forefront of the EU policy agenda since the mid-200s. The time has come to revisit the whole flexicurity approach as a means to achieve a dynamic productive workforce and to help promote upward social convergence. In this regard, a statistical assessment of the current flexicurity indicator framework is needed to identify potential caveats and drawbacks embedded in the monitoring tools already available. In addition, lessons for benchmarking and effective policy making can also be learnt from the use of up to date clustering tools for the grouping the EU Member States according to their flexicurity performance.

The statistical assessment of the indicators included in the monitoring framework of the different flexicurity dimensions has revealed the lack of a sound and robust correlation structure. Interestingly, this result by itself would make a case against previous or future attempts to construct a flexicurity composite indicator—or an aggregate indicator for each one of the dimensions considered in the indicator framework—based on the currently available indicator framework.

Another relevant issue tackled in this paper is that of the grouping of EU28 countries according to their performance in flexicurity dimensions. Clustering analysis has the advantage of facilitating the setting of benchmarks and policy targets for homogeneous groups of countries. However, the problem of multiplicity of solutions is inextricably related to cluster analysis—alongside the risk of misplacing countries or benchmarking against the wrong group of peers. By singling out one of solutions while disregarding the rest, highly valuable information contained in the pool of candidates would be lost. A step-wise procedure that involves first building an ensemble of partitions and then combining the evidence accumulated in the individual elements is an efficient way to overcome the problems of non-uniqueness and disagreement between partitions. This paper can be seen as a 'proof-of-concept' with which to highlight the advantages of synthesising into a single clustering the information accumulated in the elements of the cluster ensemble. More precisely, we have followed the optimisation approach to arrive at a robust consensus clustering solution for the EU28 countries according to their performance in the different flexicurity dimensions.

Having said that, it is also worth noting that by no means we claim that the consensus clustering presented in this paper should be regarded as the ultimate grouping of EU28 countries in terms of flexicurity performance. Our results must be necessarily sensitive to both the methodologies selected and the way in which the individual partitions in the ensemble have been defined. Had other techniques, time frames or indicators been considered in the ensemble, different consensus solutions might have been obtained. Finally, results garnered from the different clustering methodologies trialed in this paper suggest that countries with similar flexicurity efforts (inputs) during the crisis might have differed significantly in terms of their outputs after the crisis. Accordingly, this finding would also support the argument in favour of the existence of other relevant factors beyond those already included in the flexicurity indicator framework which might be exerting a considerable influence on flexicurity results.

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