Dividing Central and Eastern Europe

An exploratory analysis into the clustering of Central and Eastern European countries based on Employee Representation characteristics.

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1. Introduction

The history of employee representation in companies and legislation around it in Europe differs per country (Oesingmann, 2015). Where Germany and Austria had its first legislations on works councils as early as 1919, many other Western European countries did only form legislations in the second half of the 20th century (Oesingmann, 2015). For most Central and Eastern European (CEE) countries, similar types of regulation were only started to be implemented after the collapse of the Soviet regime (Hyman, 2018). Despite the differences in history, the effects present day Employee Representation can have on employees and on firm performance is theorised and studied thoroughly (Wigboldus et al., 2008; Lahovary, 2000; Mueller, 2012; FitzRoy and Kraft, 1995).

1.1 The effect of Employee Representation on firm performance

The influence of employee representation on firm performance can be explained through a direct and an indirect effect. To formulate the different ways employee representation can influence firm performance, we will use the three-channel model by Wigboldus et al. (2008). In their model, Wigboldus et al. (2008) postulate three channels to explain the positive effects. The first channel shows the direct influence, while the second and third explain the indirect effects.

In this first channel of the model (Wigboldus et al., 2008), it is argued that institutions for employee representation, such as works councils, have a direct influence on the organisation by being able to have more communication with management (Lahovary, 2000). As a result of the better communication, the representatives can provide management with new ideas and advice to come to better policies and to resolve problems within the organisation. This contributes directly to the performance of the company in a positive way. The relation has been studied by several academics and evidence can be found for a positive effect of the presence of works councils on firm performance (Mueller, 2012; Wigboldus et al., 2008; Addison, Schnabel & Wagner, 2001).

Despite these findings, it should be noted there has also been theoretically and empirically argued a direct relation between employee representation and firm performance to be non-existing or even negative (FitzRoy & Kraft, 1995; Fairris & Askenazy, 2010). One model explaining this expectation is the managerial competence model by FitzRoy and Kraft (1995). This model hypothesises that management will be held back by discussing their executive decisions with employee representatives. This will decrease the managerial freedom

and will cause productivity to drop. This theory is supported by several studies (FitzRoy & Kraft, 1990; Schnabel & Wagner, 1994). Due to the contradictory evidence on the direct effect of employee presentation on firm performance, it is still questionable whether this relation exists and if so, in which direction.

Because of the uncertainty on the direct effects, it is important to additionally focus on the indirect relation employee representation can have on firm performance. This can be done by following the lines of thought of the second and third channel of the three-channel model (Wigboldus et al., 2008). First, there is argued in the second channel that the attitudes and behaviours of employees is an important moderating effect. An explanation for this phenomenon can be found in mechanisms provided in the framework of Freeman and Lazear (1995). By having employee representation, such as works councils, with the right to information, to give advice and to co-decide, employees will feel heard and will have more trust in management. This will in turn affect their productivity and motivation, which will lead to a better firm performance. Additionally, the voice giving to the employee representation will have a positive effect on job security, causing employees to have a more long-term vision on the company. This as well has a positive effect on firm performance (Freeman & Lazear, 1995).

Lastly, the third channel focusses on the controlling factor works councils hold on management (Wigboldus et al., 2008). Due to the close connection between management and the employee representation, representatives can intervene at moments where management would only take into account their own interests. This intervention of employee representatives on management causes a better firm performance, as shown in several studies (Wever, 1994; Falkum, 2003; Van den Berg, 2004).

Although a positive effect, whether it be direct or indirect, can be expected of Employee Representation on firm performance, more research on this needs to be conducted. When looking at prior studies in this field, it can be seen most research stems from Germany (an overview is presented in Addison, 2009), and a few studies from other Western European countries, such as France, Belgium and the Netherlands (Van den Berg et al., 2011a; Van den Berg et al., 2017; Fairris & Askenazy, 2010). However, there can be found many differences between European countries on the implementation and execution of employee representation (Oesingmann, 2015). This could suggest the results from studies focussing on one country can not be generalised to other countries. To get a better understanding of whether country-specific results can be generalised to other countries, it is of great importance to understand how Employee Representation is organised in these countries. This will give an opportunity to

divide the European countries in several clusters. With the help of these clusters, prior and coming studies on the effects of Employee Representation on firm performance can be better generalised to the correct population.

1.2 Clustering countries on Employee Representation characteristics

Dividing European countries into clusters has already been done based on different topics (Brewster, 2004). However, not every form of division will work in this line of study. For understanding the effects of Employee Representation on firm performance, a division centred on the type and impact of the Employee Representation needs to be made. Such a division has already been proposed by Altmeyer (2005). Altmeyer (2005) created four clusters of countries. His division is based on the main type of representation, the secondary type of representation and the amount of information, consultation and co-decision rights these representations have. The clusters are named the Germanic, the French, the Anglo-Saxon and the Scandinavian cluster. In the first cluster, Austria, Germany and the Netherlands are included. The French cluster consists of Belgium, France, Luxembourg, Spain, Portugal, Italy and Greece. The Anglo-Saxon cluster represents Ireland and the United Kingdom. Finally, the Scandinavian cluster consists of Denmark, Finland and Sweden.

While Altmeyer's clustering is useful for understanding and generalising outcomes from certain studies, a complication has risen in the last two decades when more countries started to join the European Union. Many of these transition countries stem from a communistic regime, causing their Employee Representation to have changed rigorously with their transition to democracy (Prouska et al., 2022). Although this transition took place in the same time period for these countries, there can be found many differences between the transition countries on their current execution of democracy and with that capitalism. These differences are well theorised in the clustering done by Bohle and Greskovits (2007). Here, three different clusters are proposed of Central and Eastern European (CEE) countries based on their market type. A first cluster consisting of merely Slovenia has a neocorporatist form of capitalism. The second cluster has a neoliberal type and includes Estonia, Lithuania and Latvia. The last type is an embedded neoliberal cluster which contains the Czech Republic, Hungary, Poland and Slovakia. With these differences in market type, differences in Employee Representation can be found as well (European Commission, 2008). It is important to note that not all transition countries are covered in the clustering by Bohle and Greskovits (2007). Furthermore, their clustering does not include the type and influence of Employee Representation, but merely the type of capitalism the countries have adopted. Thus, although this clustering provides insights

into the differences and similarities between certain CEE countries, it is not enough to use them in studies with a focus on the effects of Employee Representation. For these reasons, it is important to understand how and if these (former) transition countries can be divided based on the same Employee Representation characteristics as used by Altmeyer (2005).

1.3 Relevance

As a result of the late development of Employee Representation organisations in the Central and Eastern European countries, little research has been conducted on if and how these countries can be clustered based on their employee representation characteristics. With this study, the aim is to narrow this gap in literature. By providing the possibilities of clustering CEE countries based on Employee Representation characteristics, future research will be able to generalise their findings to the right population. Furthermore, a possibility to cluster the CEE countries, will create an opportunity to compare the effects of different types of Employee Representation on firm performance, instead of merely conducting country specific research.

In addition, this study will contribute to creating a better understanding of differences that can be found in Employee Representation across countries for both employees and companies in CEE countries. Being aware of these disparities and the effect certain types of rights can have on the performance of the company, can lead to companies and/or employees to revise their Employee Representation for the better.

1.4 Research

1.4.1 Research question

As discussed in the above paragraphs, finding a clustering of the transition countries based on characteristics of Employee Representation is beneficial. Therefore, the aim of this study is to find an answer to the following research question:

How can the (former) transition countries of the European Union be divided into clusters based on the characteristics of Employee Representation within establishments?

1.4.2 Characteristics of Employee Representation

To create a workable clustering, it is important to understand which factors play a part in the division of countries based on Employee Representation. A first important feature is the main form of Employee Representation (European Commission, 2008). This can either be a Union or a Works Council (European Commission, 2008). A Works Council is defined as a body within a company which represents the interests of all employees (Rogers & Streeck, 1995). In this study, European Works Councils are included in this definition. A (trade) Union is widely

known as a body with a bargaining function (European Commission, 2008). Because of these different types of influence, it is useful to involve this distinction in the segmentation of countries.

Second, the involvement of the Employee Representation needs to be assessed. This involvement can be divided in three types of rights Employee Representatives may have: information rights, consultation rights and co-decision rights (Freeman & Lazear, 1995). The amount of information Employee Representatives receive on the situation of the company and the decisions that are made have a positive influence on the trust of employees and can therefore have a positive indirect effect on firm performance (Van den Berg et al., 2011b). With consultation and co-decision rights, employees will have more influence on the organisational structure of the company (Van den Berg et al., 2011b). This will give employees a sense of involvement, resulting in a bigger commitment to the company (Freeman & Lazear, 1995). Including to what extent these rights are present in companies will give an indication on how involved Employee Representation are in different companies and countries. Therefore, the types of rights, and to what extent they are present, need to be included when attempting to cluster countries.

As a last characteristic, the attitudes of Employee Representatives on the collaboration between the Employee Representation and management will be included. Prior research shows a positive relation between the attitudes of Employee Representatives and firm performance (Van den Berg, 2011a; Nienhüser, 2009; Bryson et al., 2006). These studies show that a constructive and non-hostile attitude of Employee Representation results in a better firm performance. For this reason, these attitudes need to be included when clustering countries based on Employee Representation characteristics.

1.5 Reading guide

In the previous paragraphs, a literature overview is giving. This regards literature on the effects of Employee Representation on firm performance and literature on the segmentation of European countries based on Employee Representation characteristics. Following this overview, the research question is given. In the following section, we explain how this data will be used for the clustering analysis with an emphasis on the treatment of the missing values. In this study, we will use the survey data available from the second wave of the European Company Survey (ECS, 2009). The third section of this paper discusses the methods that are used in this study. After this the results of the cluster analyses will be discussed in the *Results* section. Lastly, in the *Conclusion and Discussion* section, trends and similarities are drawn

from these results, resulting in a definitive answer on the research question. In addition, the implications are discussed and recommendations for further research are made.

2. Data

2.1 Data

For this study, the data collected in the second wave of the European Company Survey (ECS), which took place in 2009 (ECS, 2009), is used. The survey is conducted in companies with 10 or more employees across 30 European countries, of which 27 were European Union Member States at the time. For each establishment, the manager responsible for human resources was interviewed. If this company also had an employee representative that was willing to be interviewed, an interview was held with them as well. In these interviews, several topics are discussed, namely: working time arrangements, flexibility measures and social dialogue practice. The dataset consists of n=27160 manager respondents. Of these respondents, approximately 24% includes an interview with an employee representative (n=6569).

Because of the focus of this research, only a subset of the ECS data will be used. This subset includes data from the transition countries where both a manager and an employee representative interview has been conducted. At the time of the survey, there were ten countries included which just became a part of the EU. These countries are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. The total amount of observations in this subset is n=1657. The distribution of observations per country can be found in Table 1.

2.2 Variables

2.2.1 Employee Representation Bodies

For measuring what type of Employee Representation is present in the establishment, three questions from the management interview have been used (MM650_1, MM650_2 and MM650_3). Each question asks whether or not a specific employee representation type is present in the establishment. The employee representation types discussed in these questions differ per country. The reason for this, is that the interviews were conducted in the native language of the country and because the country specific legislations concerning employee representation were taken into account. The country specific composition of the questions can be found in Appendix A. Despite the differences in phrasing and language, it shows that question MM650_1 concerns the presence of a Union, while questions MM650_2 and MM650_3 cover different types of Information and Consultation (I&C) bodies within the company. For each question, the respondent could answer 1=Yes, 2=No, 3=Not Applicable. With this in mind, two variables can be created, where one indicates the presence of a Union and one variable which indicates the presence of an I&C body.

Table 1.

Distribution of observations per country.

Country	Sample N
Bulgaria	128
Czech Republic	242
Estonia	72
Hungary	147
Latvia	128
Lithuania	183
Poland	367
Romania	137
Slovakia	153
Slovenia	100
Total	1657

Note: Only observations where both manager and employee representative interview were conducted are used. Data adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1

For creating the Union variable, question MM650_1 was used. There are no missing values on this question. Therefore, the original variable could be recoded. This has been done in other to create a binary variable where 0=No Union Present and 1=Union Present. The category 'No Union Present' contains the observations where the answer to question MM650_1 was 'No' or 'Not Applicable'. The category 'Union Present' consists of the respondents who answered 'Yes' on question MM650_1.

To create the I&C body variable, questions MM650_2 and MM650_3 are used together. Question MM650_2 contains 76 missing values. The reason for these missing values can be found in the country specific composition of the questions. Upon further investigation, it is shown that question MM650_2 is only asked to non-public establishments in Hungary. For question MM650_3, 995 missing values can be found. These missing values are a result from the country specific composition as well. First, the question was not asked to non-public establishments in Hungary. Second, the questionnaire did not include question MM650_3 in Bulgaria, Czech Republic, Lithuania, Romania, Slovenia and Slovakia. This results in the respondents of these countries not being asked the question and therefore have a missing value

of this variable. However, the reason for not being asked the question lies in the fact that these countries do not have more than two options in employee representation organisation, making MM650_3 irrelevant. On the grounds that the missing values stem from knowing beforehand the establishment does not have the asked employee representation, these observations can be set to 3=Not Applicable. In order to arrive at a binary variable representing the presence of an I&C body, both questions were used together. If a respondent answered 'Yes' to either MM650_2 or MM650_3 or both, the I&C body variable is coded to 1=I&C Body Present. In all other cases, the variable is coded 0=No I&C Body Present.

The descriptive statistics after treating the missing values of MM650_1, MM650_2 and MM650_3 can be found in Appendix B.

2.2.2 Information rights

To measure the amount of information Employee Representatives receive from management, one question consisting of three issues was asked in the ECS Employee Representative Questionnaire. The question is as follows: "*Please tell me for each of the following issues whether the employer provides the employee representation with relevant data on it at least once a month (1), several times a year (2), once a year (3), less than once a year (4) or never (5).*" If the respondent did not answer, it is coded as 6. The issues that were asked about are: "*The economic and financial situation of the establishment*", "*The employment situation*", "*The number of overtime hours*".

All answers coded as 6=No Answer are set as a missing value. This results in 35 missing values for issue 1, 62 for issue 2 and 178 for the last issue. For the last issue, the percentage of missing values is 10.74% of the total data. As this percentage is above 10%, the variable will not be used in the analysis. See Appendix B for an overview of all descriptive statistics. The treatment of the missing values of the included variables is discussed in section 2.3.

2.2.3 Consultation and negotiation rights

Measuring the effect of the Employee Representation on management decisions is done by one question on 9 different areas, producing 9 variables, named ER207_1 through ER207_9. The question is phrased as follows: "*How large is the influence of the employee representation on management decisions in this establishment? Please tell me for each of the following areas whether you rate this influence as very strong (1), quite strong (2), quite weak (3) or very weak (4). How would you rate the influence on ...*". The respondents were asked to rate the influence on the following areas: "*Employment and human resources planning*", "*Equal opportunities*

policies and diversity management", "*Changes in working time regulations*", "*The determination of pay*", "*Health and safety matters*", "*Changes in the organisation of work processes and workflow*", "*The impact of structural changes such as restructurings, relocations or takeovers*", "*Career management (selection, appraisal, training)*" and "*Disciplinary or hierarchical problems*".

If a respondent did not answer one of areas, it is coded as 5=No Answer. Therefore, these values are set to a missing value. This causes the number of missing values per question to range between 45 and 245. For two variables, the percentage of missing values exceeds 10% of the total data and these will therefore be disregarded. This concerns issue 7 and 9 ("*The impact of structural changes such as restructurings, relocations or takeovers*" & "*Disciplinary or hierarchical problems*"). An overview of the number of missing values and descriptive statistics per variable can be found in Appendix B. In section 2.3, the handling of the remaining missing data is explained.

2.2.4 Attitudes of Employee Representative on cooperation

Lastly, the attitude of the employee representative on the cooperation between the employee representation and the management is taken into account. To measure the attitude, the answers to the following two statements are used: (1) "*The relationship between management and employee representation can best be defined as hostile*" and (2) "*Management and employee representation make sincere efforts to solve common problems*". The variable names of these questions are ER151_3 and ER151_4. The respondent could choose one of the following answers: 1=strongly agree, 2=agree, 3=neither agree nor disagree, 4=disagree or 5=strongly disagree. If the respondent chose to not answer the question, it is coded as 6=no answer.

When an observation was coded with a 6 (no answer), it is been set to a missing value. This resulted in the first statement having 6 and the second statement having 4 missing values (see Appendix B for an overview of the descriptive statistics). The treatment of these missing values is discussed in section 2.3.

2.3 Missing data analysis

After altering the variables, nearly each variable that is to be used, contains missing values. For this reason, a missing data analysis is performed. First, it is important to understand the structure of the missing data. This is done by analysing the missing data patterns. First, it shows a non-monotone missingness pattern. Second, it can be concluded that 998 complete observations (60.2%) are available in the dataset. Only making use of the complete cases would

therefore not be a viable option, as this might produce bias in the results of the cluster analysis. Furthermore, analyses on the percentage of missing values per country shows that certain countries have larger numbers of missing values in comparison to other countries.

Therefore, it is expected that the missing data is Missing At Random (MAR), which assumes the missingness is the result of other observed values for the same respondent (Rubin, 1976). One indicator for this are the correlations that can be found between different variables. We will look at the correlations between variables regarding information rights and consultation and negotiation rights, using Spearman correlation for ordinal variables. All variables are correlated to one another with a correlation value between -0.379 and 0.573 (see Appendix C for correlations table). This indicates these variables have a small to moderate correlation and the value of one variable can therefore indicate the value for another variable to some extent. High correlations are not optimal in the case of Missing Data Imputation, as these could suggest collinearity, which is not desirable (Van Buuren, 2018).

With these correlations in mind, the missing data will be imputed using Multivariate Imputation by Chained Equations (MICE). By using this method, the missing values will be simulated multiple times based on the values of other variables. This is done by relating the observed values to the missing values. By understanding the patterns, a distribution of possible values is calculated for each missing value. With Multiple Imputation, one value per missing value is drawn from this distribution per Imputation. These values are added to the original dataset and create a complete dataset. However, the strong case of Multiple Imputation is that this Imputation step is done repeatedly, as many times as set by the user. Therefore, it results in multiple complete datasets, with each time slightly different values on the places which were previously missing. A more extensive explanation on Multiple Imputation can be found in the work of Van Buuren (2018).

To obtain imputations with minimal bias and maximal efficiency, as many predictors as possible need to be included in the model which are likely to have an influence on the missing values (Collins, Schafer, & Kam, 2001). However, including more than 25 variables, will not lead to a significantly higher performance, while increasing the computation time (Van Buuren, 2018). For these reasons, the following 22 variables are included in the dataset used for the Multiple Imputation (see Table 2). First, this data contains all variables to be used in the cluster analysis, as suggested by literature (Van Buuren, 2018). These are the variables measuring the rights and attitudes of the Employee Representatives and the presence of I&C bodies and Unions. Second, the country code, company size and sector are included, as these variables

contain information about the companies is question. Last, six variables of the Employee Representative Questionnaire are added (see Table 2). These variables are chosen based on the influence and importance they have on the occurrence of missing values. As a starter, variables with more than 10% missing values were not looked at to be included. Next, the correlations between the dependent variables and the possible predictors are analysed. From these correlations, the six variables with the highest correlation with the dependent variables are chosen as predictors for the Missing Data Imputation.

Table 2.
Variables used for the Missing Data Imputation

Variable	Question	Percentage missing values
ER200_1	The economic and financial situation of the establishment	2.11%
ER200_2	The employment situation	3.74%
ER207_1	Employment and human resources planning	4.40%
ER207_2	Equal opportunities policies and diversity management	9.17%
ER207_3	Changes in working time regulations	8.87%
ER207_4	The determination of pay	7.06%
ER207_5	Health and safety matters	2.72%
ER207_6	Changes in the organisation of work processes and workflow	6.46%
ER207_8	Career management	5.97%
ER151_3	The relationship between management and employee representation can best be defined as hostile	0.36%
ER151_4	Management and employee representation make sincere efforts to solve common problems	0.24%
I&C	Altered from questions MM650_2 and MM650_3 as discussed in section 2.2.1	0%
Union	Altered from question MM650_1as discussed in section 2.2.1	0%
Country	Country code	0%
Sector	Work sector of company in three categories	0%
Size	Company size in 10 categories	0%
ER151_1	Employees support the work of the employee representation	1.14%
ER151_2	Employees rarely express interest in the outcome of consultations or negotiations	1.39%
ER202	If you think about the business information you get from the employer: Does it frequently, sometimes or practically never happen that this information is classified as confidential so that you can not disseminate it to the workforce?	7.24%
ER203	Do you usually receive the information timely and unrequested?	8.33%

ER304	Do the employee representatives on a regular basis get training on issues specific to their role as employee representatives?	1.57%
ER501	How many years of experience do you have as employee representative in the establishment?	1.51%

N = 1657

Note: ER151_1 & ER151_2 are measured on a 5-point scale. ER202 is measured on a 3-point scale. ER304 are binary variables. ER501 is a continuous variable. Information retrieved and adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

With these variables, the Multiple Imputation has been performed. The number of imputed datasets to be created is set to ten, as suggested by literature (Rubin, 2004). For each imputed dataset, several iterations are run, since this will cause the imputed values to converge, resulting in more realistic and stable outcomes (Wilson, 2021). The model used for this study will run five iterations, as more iterations will not improve the outcomes significantly (Wilson, 2021). The imputation method that is used to predict the missing values of the variables regarding the Employee Representative's rights and attitudes is Proportional Odds Model ('polr'). This method is recommended for ordinal variables (Van Buuren, 2018). Finally, the predictor matrix needs to be formulated to specify which variables have an influence on the imputations of which variables. To arrive at this matrix, a single function was used ('quickpred'). First, this function creates all predictor-target pairs and calculates two correlations per pair. One of which is the direct correlations between the two variables, while the other uses the target's response indicator and the predictor's values. If both these correlations are higher than 0.1, the predictor variable is included as a predictor in the final imputation model. A more extensive explanation on this function can be found in Van Buuren et al. (2011). The predictor matrix can be found in Appendix D.

The result of the Multiple Imputation model gives ten complete datasets. To evaluate the imputations, first there will be looked at the convergence of the mean and standard deviation of the imputed values per iteration (Appendix E). Here we see the imputations to not converge over the iterations to the same value, which indicates the sequence the variables have been imputed causes no problems. Next, the distributions of the simulated values are compared to each other and to the distribution of the actual values (Appendix F). These plots show some variation in distribution between the different imputations, which is expected. However, looking at the trends of the imputed values, we see a similar trend for the distribution of the

original data for each variable. Furthermore, when compared to the descriptive statistics of the original data with missing values, the descriptive statistics of the datasets with the imputed values included show little to no change. This shows that the imputed values do not cause a change in the variance of the variables. See Appendix G for a comparison of the original data and the data after values from Imputation 1 are included. For these reasons, it can be concluded that the simulated values can be treated as regular values.

For further analysis, ten datasets are created with the use of the simulated values, as Multiple Imputation requires the analysis to be performed once on each complete dataset. After this, the results can be compared and similar trends can be found to arrive at a definitive answer on the research question of this study. Each of the complete datasets consist of the original data with the missing values replaced by one of the imputations.

2.4 Descriptive statistics

2.4.1 Complete datasets

With the simulated values, ten complete datasets can be created with the variables to be used in the cluster analysis. As discussed in the previous section, the values and distribution of values do not change drastically across the different imputed datasets. For this reason and for the sake of readability, we will only discuss the descriptive statistics of the averaged imputed data. For this averaged dataset, the mean is taken from the I&C and Union variable. This causes them to remain the same as in the individual datasets, as these variables do not contain any imputed values. For the ordinal variables concerning the Employee Representative rights and attitudes the mode is taken, which shows the most occurring value. With this combined dataset, the descriptive statistics are calculated. These are displayed in Table 3.

For the continuous variables, I&C and Union, the mean, standard deviation and range is showed. The variable I&C has a lower mean with a higher standard deviation than Union ($M = .589$, $SD = 0.492$; $M = .772$, $SD = .420$). This indicates that more establishments have a Union than an I&C body.

For the ordinal variables, the median, precent distribution and range are displayed. Looking at the variables concerning the amount of information Employee Representatives receive, it shows a non-normal distribution for each variable. For both variables, the distribution is skewed to the left, showing the majority of establishments receive information on these topics several times a year (43%; 40%) or at least once a month (31%; 34%).

Next, the variables on negotiation and consultation rights are more normally distributed with the one exception being '*Healthy and safety matters*', which is leftly skewed. For all other variables in this category, the middle two answers ('*Quite strong*' & '*Quite weak*') have the largest percentage of the percent distributions.

Last, the variables concerning the attitudes of the Employee Representatives on the collaboration with management show highly skewed distributions. For variable '*Relation is hostile*', a strong skewed distribution to the right with the last two categories making up 85% of all observations. However, the other variable on attitudes, '*Effort to solve common problems*', has a distribution skewed to the left. Here, the category '*Strongly agree*' contains 34% percent of the data and 50% of all respondents answered '*Agree*'. These distributions show the majority of Employee Representatives have positive attitudes towards the collaboration between the Employee Representation and the Management.

Table 3.
Descriptive Statistics of data averaged over imputations.

	Mean	SD	Median	Distribution	Min	Max
I&C	0.589	0.492			0	1
Union	0.772	0.420			0	1
Information rights						
Economic and financial			2		1	5
At least once a month (1)				0.31		
Several times a year (2)				0.43		
Once a year (3)				0.18		
Less than once a year (4)				0.02		
Never (5)				0.07		
Employment			2		1	5
At least once a month (1)				0.34		
Several times a year (2)				0.39		
Once a year (3)				0.15		
Less than once a year (4)				0.02		
Never (5)				0.09		
Negotiation and consultation rights						
Employment and human resources			3		1	4
Very strong (1)				0.05		
Quite strong (2)				0.46		
Quite weak (3)				0.36		
Very weak (4)				0.13		
Equal opportunities			2		1	4
Very strong (1)				0.05		
Quite strong (2)				0.46		
Quite weak (3)				0.46		
Very weak (4)				0.13		

Changes in working time	2		1	4
Very strong (1)		0.12		
Quite strong (2)		0.55		
Quite weak (3)		0.22		
Very weak (4)		0.12		
Determination of pay	3		1	4
Very strong (1)		0.08		
Quite strong (2)		0.40		
Quite weak (3)		0.28		
Very weak (4)		0.24		
Healthy and safety matters	2		1	4
Very strong (1)		0.23		
Quite strong (2)		0.59		
Quite weak (3)		0.13		
Very weak (4)		0.06		
Organisation of work processes	2		1	4
Very strong (1)		0.07		
Quite strong (2)		0.45		
Quite weak (3)		0.34		
Very weak (4)		0.14		
Career management	3		1	4
Very strong (1)		0.08		
Quite strong (2)		0.38		
Quite weak (3)		0.33		
Very weak (4)		0.21		
Attitudes				
Relation is hostile	4		1	5
Strongly agree (1)		0.02		
Agree (2)		0.06		
Neither agree nor disagree (3)		0.07		
Disagree (4)		0.42		
Strongly disagree (5)		0.43		
Effort to solve common problems	2		1	5
Strongly agree (1)		0.34		
Agree (2)		0.50		
Neither agree nor disagree (3)		0.11		
Disagree (4)		0.04		
Strongly disagree (5)		0.01		

2.4.2 Data grouped by country

To perform the clustering of countries, a final step is needed. In this step the observations of each dataset need to be averaged by country. By doing this, each imputed dataset will be

transformed into a dataset with ten observations, one for each country. This will therefore result in ten datasets with each ten observations.

The averaging of the data is done individually for each imputed dataset in the same manner. For the variables 'I&C' and 'Union', the mean of all observations is taken per country. For all ordinal variables, the median is taken. By doing this, ten new datasets are formed with each ten observations. The descriptive statistics of these datasets can be found in Appendix H. There can only be found small differences between the descriptive statistics for a few variables. First, a small difference between datasets can be found for the variable '*Employment*' of the Information Rights. Second, some dissimilarities can be seen for two Negotiation and Consultation variables, namely '*Employment and human resources*' and '*Equal opportunities*'. The averaged dataset as described in 2.2.6 is also grouped by country in the same manner as described above. Because of the small differences between the values of the imputed datasets and for the sake or readability, only the averaged dataset will be discussed in the following paragraphs. The descriptive statistics of this dataset can be found in Table 4.

First the continuous variables show a clear difference between countries. For I&C bodies, the range is .107 - .889 ($M = .620$, $SD = .236$). With Union, this range is .458 - .974 ($M = .747$, $SD = .172$). This range can be interpreted as the ratio of establishments having an I&C body or Union in a specific country. Furthermore, no country can be seen an outlier on these variables, as they all fall within 3 standard deviations away from the mean (Howell, 1998).

Second, some variation between countries can be found in the variables concerning the Information Rights of the Employee Representation. For both variables in this category, the range is 1 - 3. Therefore, these variables clearly indicate differences between countries.

Third, little to no variation can be found in the values for the Negotiation and consultation rights variables with ranges of 2-2 and 2-3. This indicates the amount of influence Employee Representation have on certain decisions differs little between countries.

Finally, the ranges of the variables measuring the attitudes of Employee Representatives on the collaboration with management show little variation as well. With both a range of 1 (*range* = 4-5; *range* = 1-2), countries differ from each other to a small extent on the average attitude of Employee Representatives of establishments.

Table 4.

Descriptive Statistics of variables on data grouped by country.

	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889
Union	0.735	0.172		0.458	0.974
Information rights					
Economic and financial			2	1	3
Employment			2	1	3
Negotiation and consultation rights					
Employment and HR			3	2	3
Equal opportunities			2.75	2	3
Changes in working time			2	2	2
Determination of pay			3	2	3
Healthy and safety matters			2	2	2
Organisation of work processes			2	2	3
Career management			3	2	3
Attitudes					
Relation is hostile			4	4	5
Solve common problems			2	1	2

N = 10.

Note: The dataset that is used is the averaged data of all imputed dataset. This data is then grouped by country. For grouping the data by country, the mean was taken for the variables I&C and Union. The median is used for all the other variables. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1

3. Methods

3.1 Data

To obtain an answer to the research question of this study; '*How can the (former) transition countries of the European Union be divided into clusters based on the characteristics of the Employee Representation within establishments?*', a cluster analysis will be performed. As a result of the imputation of missing data, ten datasets with imputed values have been formed. On all datasets, the cluster analysis will be performed separately. For each dataset, the methods follow the same procedure.

3.2 Clustering method

3.2.1 Dissimilarity measure

The data that are to be used in the cluster analysis consist of both continuous and ordinal variables, while most clustering methods/algorithms can only account for one data type. A possibility could be to treat the ordinal variables as continuous. This is however not a viable option as the distance between two values is not the same for each step. For this reason, a dissimilarity measure will be used. By calculating such a measure, cluster algorithms which are distance-based can be used. The distance measure that is used in this study is the Gower's similarity coefficient (Gower, 1971). This similarity coefficient is calculated for each pair of observations. See Van de Velden et al. (2019) for a thorough explanation of the mathematics behind this coefficient. With this measure, different weights can be set on variables to express their importance. However, because there is no prior knowledge of certain variables to be of greater importance, all weights are set equal. Next, a matrix is made of the dissimilarity of all possible pairs, which will be used in the clustering algorithm.

3.2.2 Clustering algorithm

To explore the option of clustering the different countries, the Partitioning Around Medoids (PAM) algorithm is used on each dataset with imputed values separated. There are two main reasons for choosing this algorithm. First, it is more robust in comparison to other clustering algorithms, resulting in a better clustering performance (Li et al., 2017). Second, the algorithm allows the user to input an arbitrary dissimilarity measure, such as a matrix of Gower's similarity coefficients (Van de Velden et al., 2019). The PAM algorithm consists of two phases and it works as follows (Li et al., 2017):

1. BUILD
   1. Select k of points of the data as medoids which minimise the cost.
   2. For each observation, link it to the closest medoid.

2. SWAP
    1. Compute the cost change for each swap of each medoid with each non-medoid.
    2. Keep swapping medoids and non-medoids until the cost function is at minimised.

The cost function for PAM is the sum of dissimilarities between observations and the medoid (Li et al., 2017).

3.2.3 Amount of clusters

To run the PAM algorithm, the number of clusters within the data needs to be given by the user. For this reason, the right number of clusters needs to be examined first. This is done by calculating the total silhouette width for PAM with k varying from 2 to 10 clusters. Calculating the silhouette width for $k=1$ is not possible and will therefore not be done. The total silhouette width indicates how well each observation is clustered. The higher this value, the better the countries are clustered. Therefore, the number of clusters where the total silhouette width is highest, indicates the number of clusters with optimal clustering results. The result from this analysis for each of the imputed datasets can be found in Figure 1 through 10. The number of clusters with the highest total silhouette width should be used in the final PAM algorithm. The optimal clustering for nine of the ten datasets can be done with $k=2$. The only exception on this is found for dataset 8, where the optimal number of clusters is 3.

3.2.4 Clustering analysis

As a final step, the PAM algorithm is run for each dataset with the optimal number of clusters as discussed in 3.2.3. As the input data, the Gower's dissimilarity coefficients matrix is taken. The results of the algorithm are discussed in the next section.
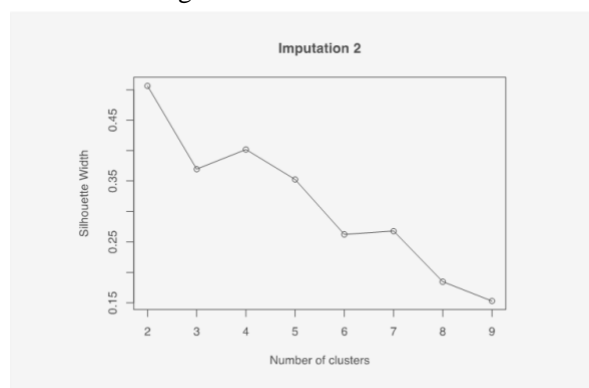
Figure 1
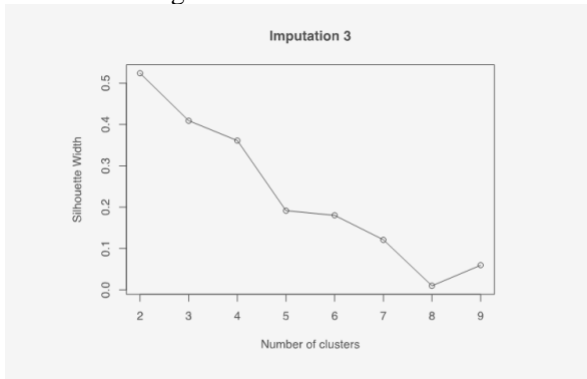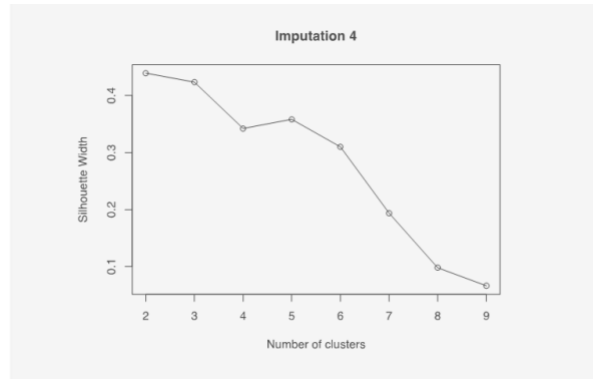Plot of total silhouette widths for Imputation 1 with $k=2$ through $k=10$.
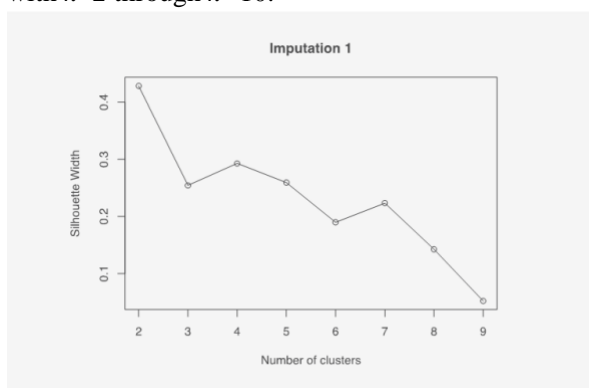
Figure 2
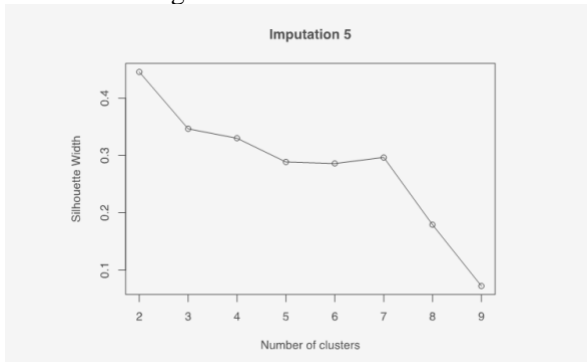Plot of total silhouette widths for Imputation 2 with $k=2$ through $k=10$.

Figure 3
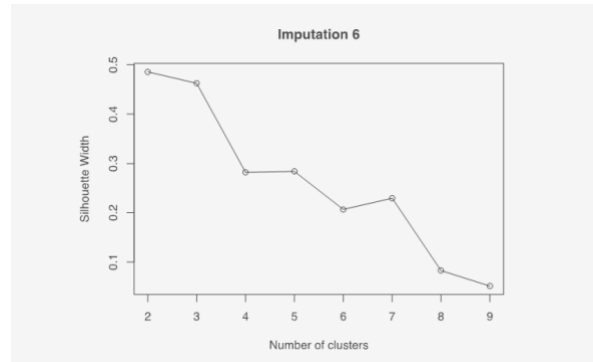Plot of total silhouette widths for Imputation 3 with $k=2$ through $k=10$.

Figure 4
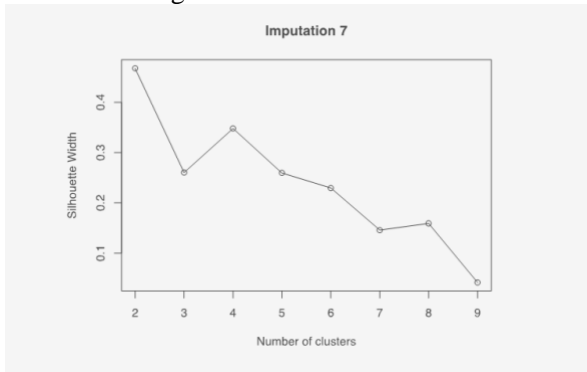Plot of total silhouette widths for Imputation 4 with $k=2$ through $k=10$.

Figure 5
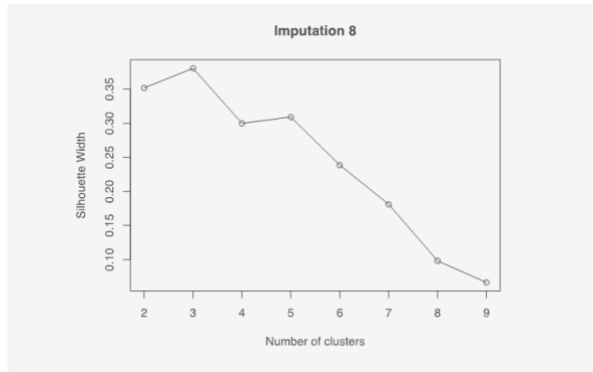Plot of total silhouette widths for Imputation 5 with $k=2$ through $k=10$.

Figure 6
Plot of total silhouette widths for Imputation 6 with $k=2$ through $k=10$.

Figure 7
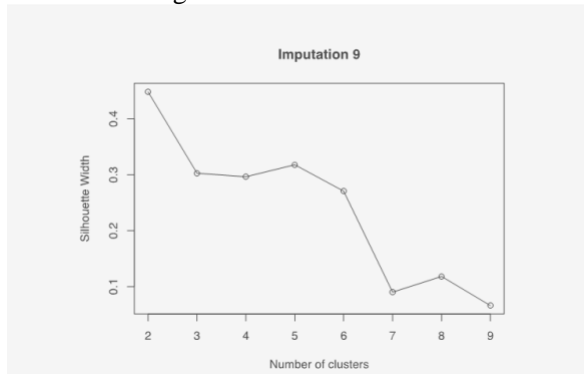Plot of total silhouette widths for Imputation 7 with $k=2$ through $k=10$.

Figure 8
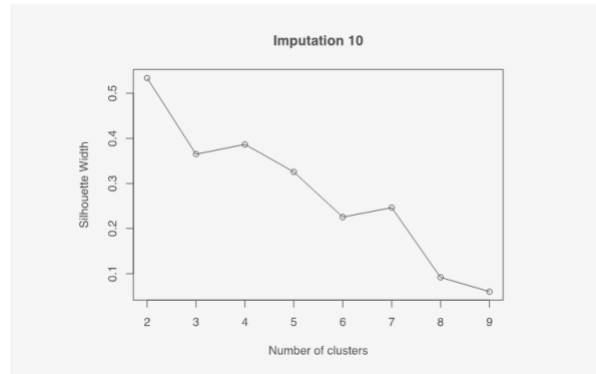Plot of total silhouette widths for Imputation 8 with $k=2$ through $k=10$.

Figure 9

Plot of total silhouette widths for Imputation 9 with $k=2$ through $k=10$.

Figure 10

Plot of total silhouette widths for Imputation 10 with $k=2$ through $k=10$.

Note for Figure 1-10: Plots are made with data adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

4. Results

After multiple imputation, the outcomes are often averaged to produce final estimates. With the results of the cluster studies, however, this will not be achievable, thus 10 clustering outcomes will be examined and contrasted in this section.

A distinct clustering is discovered from each cluster analysis. The results of these cluster analyses can be found in Table 5 and Table 6. Furthermore, the silhouette width of each clustering is showed per country in the plots found in Appendix I. Last, in order to visualise the clusters, a dimension reducing is performed on the Gower's dissimilarity matrix. This results in two dimensions containing as much information about the data as possible. On these two dimensions, the countries are plotted and grouped by their cluster. These visualisations can be found in Appendix J.

From the results of the different cluster analyses, certain patterns can be inferred. The results will be discussed per number of clusters that was used for the analysis. After this, the medoids from the clusters are discussed.

4.1 Distribution of countries

4.1.1 Analyses with k=2

A segmentation into two clusters was carried out for nine out of ten datasets. Although the division of countries share many characteristics, it is also clear that Imputations do not follow the exact same line of clustering.

First, there are three datasets which produced the same outcome in terms of the division of countries over clusters. This is the case for Imputation 3, 6 and 10. For these datasets, the first cluster contains three countries: Bulgaria, Romania and Hungary. The other seven countries – Czech Republic, Poland, Slovenia, Slovakia, Latvia and Lithuania – make up Cluster 2.

Second, we observe that Imputations 2 and 9 divide countries in a manner that is somewhat comparable to the clusterings that were previously addressed. In these two cluster analyses, however, Estonia is placed in Cluster 1 instead of Cluster 2. This results in Cluster 1 consisting of Bulgaria, Romania, Hungary and Estonia. The second cluster contains the remaining six countries: Czech Republic, Poland, Slovenia, Slovakia, Latvia and Lithuania.

Table 5.
Clustering of countries per dataset with imputed values.

Country	Imputation 1	Imputation 2	Imputation 3	Imputation 4	Imputation 5	Imputation 6	Imputation 7	Imputation 8	Imputation 9	Imputation 10
Bulgaria	1	1	1	1	1	1	1	1	1	1
Czech Republic	2	2	2	2	2	2	2	2	2	2
Estonia	1	1	2	1	2	2	2	1	1	2
Latvia	2	2	2	1	2	2	2	2	2	2
Lithuania	2	2	2	2	2	2	2	3	2	2
Hungary	2	1	1	1	2	1	2	1	1	1
Poland	2	2	2	2	2	2	2	2	2	2
Romania	1	1	1	1	1	1	1	1	1	1
Slovenia	2	2	2	2	2	2	2	2	2	2
Slovakia	2	2	2	2	2	2	2	2	2	2
k	2	2	2	2	2	2	2	3	2	2

Table 6. Division of countries per cluster.

	Imputation 1	Imputation 2	Imputation 3	Imputation 4	Imputation 5	Imputation 6	Imputation 7	Imputation 8	Imputation 9	Imputation 10
Cluster 1	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria	Bulgaria
	Romania	Romania	Romania	Romania	Romania	Romania	Romania	Romania	Romania	Romania
		Hungary	Hungary	Hungary		Hungary		Hungary	Hungary	Hungary
	Estonia	Estonia		Estonia				Estonia	Estonia	
				Latvia						
	Hungary									
Cluster 2	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic	Czech Republic
	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland	Poland
	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia	Slovenia
	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia	Slovakia
	Latvia	Latvia	Latvia		Latvia	Latvia	Latvia	Latvia	Latvia	Latvia
	Lithuania	Lithuania	Lithuania	Lithuania	Lithuania	Lithuania	Lithuania		Lithuania	Lithuania
			Estonia		Estonia	Estonia	Estonia			Estonia
	Hungary				Hungary		Hungary			
Cluster 3								Lithuania		
k	2	2	2	2	2	2	2	3	2	2

Next, there are two more datasets which had the same clustering outcome. For both Imputation 5 and 7, the first cluster consists of merely two countries, which are Bulgaria and Romania. The other eight countries are part of Cluster 2.

Last, the final two datasets with k=2 both display a somewhat different clustering. In Imputation 1, Bulgaria, Romania and Estonia are included in Cluster 1. Cluster 2 contains the remaining seven countries, namely Czech Republic, Poland, Slovenia, Slovakia, Latvia, Lithuania and Hungary. For Imputation 4, there are five countries represented in each cluster. In the first, these are Bulgaria, Romania, Hungary, Estonia and Latvia. The second cluster includes Czech Republic, Poland, Slovenia, Slovakia and Lithuania.

4.1.2 Analyses with k=3

The only cluster analysis where *k*=3 was ideal was on Imputed Dataset 8. This segmentation shows a first cluster consisting of four countries: Bulgaria, Romania, Hungary and Estonia. Cluster 2 contains five countries, namely Czech Republic, Poland, Slovenia, Slovakia and Lativa. As for the third and final cluster, Lithuania is the sole member.

4.2 Medoids

As the Partitioning Around Medoids algorithm is used, each cluster has one medoid. This is the most central observation in the cluster with the least distance to the other observations in the cluster. The medoids per cluster for each dataset can be found in Table 6. It shows that each dataset has the same medoid for Cluster 1. In all cases this medoid is Romania. This demonstrates that Romania is the most central observation of Cluster 1 across all datasets. The central location can also be seen when inspecting the visualisations of the clusterings as shown in Appendix J.

Furthermore, the datasets share the same medoid for Cluster 2 in all cases except one. As can be seen in Table 6, this medoid is Poland. However, when looking at the clustering on Imputation 4, we see that the medoid for its second cluster is Slovenia. This suggests that in most cases, Poland is the most central observation in Cluster 2. Nevertheless, this is not always the case.

Last, Imputation 9 has one more medoid to account for, as three clusters were formed in the analysis of this dataset. For this third cluster, its medoid is Lithuania as this cluster is a single-country cluster.

Table 6.

Medoids of clusters for each analysis.

	Cluster 1	Cluster 2	Cluster 3
Imputation 1	Romania	Poland	
Imputation 2	Romania	Poland	
Imputation 3	Romania	Poland	
Imputation 4	Romania	Slovenia	
Imputation 5	Romania	Poland	
Imputation 6	Romania	Poland	
Imputation 7	Romania	Poland	
Imputation 8	Romania	Poland	Lithuania
Imputation 9	Romania	Poland	
Imputation 10	Romania	Poland	

Note: Medoids are retrieved from cluster analysis. Only Imputation 8 has three medoids, as this analysis is performed with $k=3$. Data adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

5. Conclusion and Discussion

5.1 Summary

The influence of Employee Representation on firm performance is a thoroughly discussed in Wigboldus et al., 2008; Lahovary, 2000; Mueller, 2012; FitzRoy and Kraft, 1995). However, this literature stems mainly from Western European countries (Addison, 2009; Van den Berg et al., 2011; Van den Berg et al., 2017; Fairris & Askenazy, 2010). This causes an uncertainty on the generalisability of these findings. For this reason, understanding how countries can be grouped together based on Employee Representation characteristics is of the essence.

Such clustering is already available from theory for Western European countries (Altmeyer, 2005). Yet, a possible grouping of Central and Eastern European countries has not been studied in depth before. This might be due to the countries' change from communism to democracy in the late 20th century and later their transition into the European Union (Prouska et al., 2022). With these changes, their Employee Representation and the legislations around it changed as well, with differences per country (Prouska et al., 2022). For these reasons, grouping these countries based on certain features of Employee Representation is useful for understanding the differences and similarities between these countries. In addition, this clustering gives insights on how country-specific research can be generalised to other countries. Therefore, the aim of this study was to create a clustering on the transition countries based on Employee Representation Characteristics.

In the study, there has been made use of the European Company Survey data from 2009 (ECS, 2009). By first performing Multiple Imputation on missing values of Employee Representation characteristics, ten datasets were created to be used in the clustering algorithm. The Partitioning Around Medoids (PAM) algorithm was used with the optimal number of clusters per dataset. This results in ten different clusterings of the transition countries.

In the coming paragraphs, these different clusterings will be compared. This allows for the discovery of specific patterns that help explain how the transition nations can be grouped. These tendencies also result in a final recommendation on the grouping of the transition countries.

5.2 Conclusion

5.2.1 Proposed clustering

To arrive at a final grouping of the transition countries, it is important to understand the trends regarding the division of countries across different datasets. From these trends, a proposed clustering of the transition counties can be formulated.

A first observation is the group of countries which remain together in Cluster 1 across different datasets. In the first cluster for each dataset, Bulgaria and Romania are consistently present. In addition, Hungary is part of Cluster 1 in 7 of the 10 analyses. For this reason, it is reasonable to assume Hungary should be clustered with Bulgaria and Romania.

Second, a consistent group of countries can be found in Cluster 2 as well. Four countries are included in this cluster across all datasets without exception: Czech Republic, Poland and Slovenia and Slovakia. Furthermore, we see Latvia and Lithuania being part of this group in all but one dataset (Imputation 4; Imputation 8). The consensus among the different datasets regarding these countries indicates that all these countries should be grouped together.

Last, an uncertainty on the clustering of Estonia can be concluded. In five cluster analyses, the country is part of Cluster 1, while for the other five datasets, Estonia is categorised under Cluster 2. Regarding the clustering of this final nation, it is helpful to review the various cluster analyses that apply the proposed grouping of the other nine countries, as discussed in the previous two paragraphs. Here it can be seen that five datasets - Imputation 2, 3, 6, 9 and 10 - proposed the same division of these countries. In these clusterings, Estonia was grouped in Cluster 2 three out of five times. Considering the majority of these datasets categorising Estonia in Cluster 2, it is advised to follow the segmentation as proposed by Imputation 3, 6 and 10.

Following the above stated trends leads to a final proposition on the clustering of the transition countries into two clusters as shown in Table 7. Nine out of 10 transition countries could be grouped together with a decent amount of certainty for the final clustering. The only nation to be assigned to a cluster with a significant amount of uncertainty is Estonia. The following four nations are grouped together in Cluster 1: Bulgaria, Estonia, Hungary, and Romania. The remaining six nations make up Cluster 2: Czech Republic, Latvia, Lithuania, Poland, Slovakia and Slovenia.

Table 7.

Proposed clustering of transition countries.

Country	Cluster
Bulgaria	1
Czech Republic	2
Estonia	2
Hungary	1
Latvia	2
Lithuania	2
Poland	2
Romania	1
Slovakia	2
Slovenia	2

Note: Clustering is acquired from trends in and similarities between the cluster analyses. Data adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

5.2.2 Geographical location of clusters

As a last addition to the proposed clustering, it is useful to compare the clustering with the geographical location of the countries. In Figure 11, the transition countries are coloured based on their clustering. This figure demonstrates how the suggested clusters are divided geographically across Central and Eastern Europe. This geographical division of countries reveals a considerable clustering across Europe. It, however, also exhibit one small irregularity. The country of Slovenia, which is part of Cluster 2, is geographically separated from the other countries in Cluster 2, while the other countries of Cluster 1 are connected. Slovenia does however share a border with Hungary, which is grouped in Cluster 1. Although Slovenia is not connected to any countries of its own cluster, Slovenia is located geographically close to the other countries of Cluster 2. Therefore, this geographical location of the clusters does not lead to any major concerns on the clustering as proposed in the previous section.

5.3 Discussion

Although the outcomes of this study provide a practical and conclusive clustering of the transition countries based on Employee Representation characteristics, there are a few limitations to be mentioned.

Figure 11.

Map of transition countries coloured by proposed clustering.

A first limitation is the time the original data was collected. The survey was carried out in 2009, which is 13 years prior to this study. Given the lapse in time, it is probable that employee representation practises in some nations have evolved. This may have the effect of making the research findings out of date. For this reason, future research should concentrate on grouping the transition countries based on more recent data.

Second, it is important to note that the majority of variables used in the analyses are subjective questions. This is not consistent with clusterings done in past research, where mainly objective factors were taken into account. Therefore, there is still some uncertainty to what extent the cluster analysis provided in this paper and other clusterings on the same topic can be compared. Therefore, it is recommended that future study perform a cluster analysis similar to

the one done in this paper, for every nation in Europe at once. By doing this, it would be possible to compare the Western European country clusters to those that earlier studies had suggested. If these groups overlap with each other, there is reason to assume the clusterings proposed in this study are viable as well.

Next, the most important limitation of this study regards the averaging of the data per country. This caused all heterogeneity within countries to be disregarded and much information to be lost. Unfortunately, it was not possible to identify a solution that did not require the averaging by country within the timeframe of this study. Therefore, future research should focus on developing an alternative approach that enables a cluster analysis without the necessity for data to be averaged by country.

Even though this study comes with its limitations, this paper provides a suitable clustering of Eastern and Central European countries based on characteristics of Employee Representation in companies. By understanding this segmentation and applying it in future research, studies on the effects of Employee Representation on firm performance will be better generalisable.

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Appendix A

Table A1

Country specific composition of MM650_1, MM650_2 and MM650_3 for Bulgaria

Question	Native Language	English translation
MM650_1	Синдикална организация	Trade union organisation
MM650_2	Представители за информиране и консултиране на работниците и служителите	Representatives for informing and consulting employees
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A2

Country specific composition of MM650_1, MM650_2 and MM650_3 for Czech Republic

Question	Native Language	English translation
MM650_1	odborová organizace	Labor union
MM650_2	rada zaměstnanců	Staff Council
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A3

Country specific composition of MM650_1, MM650_2 and MM650_3 for Estonia

Question	Native Language	English translation
MM650_1	Ametiühing	Trade union
MM650_2	Töötajate usaldusisik	Employee representative
MM650_3	Euroopa Töönõukogu	European Works Council

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A4

Country specific composition of MM650_1, MM650_2 and MM650_3 for Hungary

Question	Native Language	English translation
MM650_1	Szakszervezet (bizalmi)	Trade union (trust)
MM650_2	"Üzemi megbízott" respectively "Üzemi tanács"	Works Council
MM650_3	"Közalkalmazotti képviselö" respectively "Közalkalmazotti Tanács"	"Civil Service Representative" respectively "Civil Service Council"

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A5

Country specific composition of MM650_1, MM650_2 and MM650_3 for Lithuania

Question	Native Language	English translation
MM650_1	Profesinė sąjunga	Trade union
MM650_2	Darbo taryba	Labor council
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A6

Country specific composition of MM650_1, MM650_2 and MM650_3 for Latvia

Question	Native Language	English translation
MM650_1	arodbiedrība	Trade union
MM650_2	Darbinieku pilnvarotie pārstāvji	Authorised employees' representatives
MM650_3	Darba padome	Works Council

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A7

Country specific composition of MM650_1, MM650_2 and MM650_3 for Poland

Question	Native Language	English translation
MM650_1	zakladowa organizacja zwiazkowa	Trade union organisation
MM650_2	Rady pracowników	Worker's councils
MM650_3	Przedstawiciele zalóg w radach nadzorczych	Crew representatives in supervisory boards

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A8

Country specific composition of MM650_1, MM650_2 and MM650_3 for Romania

Question	Native Language	English translation
MM650_1	Sindicat	Union
MM650_2	Reprezentanţii salariaţilor	Employee representatives
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A9

Country specific composition of MM650_1, MM650_2 and MM650_3 for Slovenia

Question	Native Language	English translation
MM650_1	Sindikalni zaupnik	Union
MM650_2	"Delavski zaupnik" respectively "Svet delavcev"	"Workers Trustee" respectively "Workers' Council"
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table A10

Country specific composition of MM650_1, MM650_2 and MM650_3 for Slovakia

Question	Native Language	English translation
MM650_1	Základná organizácia odborového zväzu	Basic organisation of the trade union
MM650_2	"Zamestnanecký dôverník" respectively "Zamestnanecká rada"	"Employee Trustee" respectively "Employee Board"
MM650_3		

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix B

Table B1. Descriptive statistics employee representation types

	Mean	SD	Range	Missing values
MM650_1	1.229	0.423	1-3	0
MM650_2	1.544	0.595	1-3	0
MM650_3	2.482	0.701	1-3	0

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table B2. Descriptive statistics information rights

	Mean	SD	Range	Missing values	Percentage missing
Economic and financial situation of the establishment	2.105	1.078	1-5	35	2.11%
Employment situation	2.144	1.190	1-5	62	3.74%
Number of overtime hours	2.738	1.626	1-5	178	10.74%

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table B3. Descriptive statistics consultation and negotiation rights

	Mean	SD	Range	Missing values	Percentage missing
Employment and human resources planning	2.658	0.831	1-4	73	4.40%
Equal opportunities policies and diversity management	2.574	0.792	1-4	152	9.17%
Changes in working time regulations	2.343	0.841	1-4	147	8.87%
Determination of pay	2.690	0.927	1-4	117	7.06%
Health and safety matters	2.004	0.765	1-4	45	2.72%
Changes in the organisation of work processes and workflow	2.550	0.822	1-4	107	6.46%
Impact of structural changes	2.850	0.886	1-4	245	14.79%
Career management	2.658	0.905	1-4	99	5.97%
Disciplinary or hierarchical problems	2.340	0.832	1-4	171	10.32%

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table B4. Descriptive statistics employee representative attitudes on cooperation between employee representation and management.

	Mean	SD	Range	Missing values	Percentage missing
The relationship between management and employee representation can best be defined as hostile	4.177	0.948	1-5	6	0.36%
Management and employee representation make sincere efforts to solve common problems	1.893	0.852	1-5	4	0.24%

N = 1657

Note: Data are from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix C

Table C1. Spearman correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ER200_1 (1)	1													
ER200_2 (2)	0.573	1												
ER200_3 (3)	0.364	0.407	1											
ER207_1 (4)	0.276	0.268	0.264	1										
ER207_2 (5)	0.220	0.208	0.229	0.641	1									
ER207_3 (6)	0.199	0.227	0.165	0.409	0.434	1								
ER207_4 (7)	0.254	0.251	0.202	0.461	0.455	0.459	1							
ER207_5 (8)	0.196	0.236	0.144	0.332	0.345	0.404	0.363	1						
ER207_6 (9)	0.207	0.179	0.176	0.524	0.497	0.407	0.435	0.314	1					
ER207_7 (10)	0.222	0.184	0.228	0.546	0.464	0.397	0.453	0.293	0.487	1				
ER207_8 (11)	0.202	0.175	0.172	0.499	0.475	0.319	0.420	0.300	0.511	0.479	1			
ER207_9 (12)	0.204	0.217	0.171	0.353	0.386	0.396	0.385	0.408	0.437	0.378	0.428	1		
ER151_3 (13)	-0.130	-0.160	-0.118	-0.129	-0.168	-0.111	-0.088	-0.119	-0.149	-0.061	-0.117	-0.057	1	
ER151_4 (14)	0.146	0.184	0.114	0.302	0.283	0.220	0.176	0.183	0.281	0.189	0.233	0.211	-0.379	1
ER151_1	0.091	0.093	0.064	0.212	0.194	0.124	0.108	0.084	0.199	0.160	0.180	0.153	-0.220	0.372
ER151_2	-0.006	-0.063	-0.056	-0.090	-0.114	-0.060	-0.055	0.0080	-0.016	-0.024	-0.020	-0.020	0.108	-0.097
ER202	0.065	0.063	0.086	0.007	-0.028	-0.006	0.007	0.020	-0.012	-0.017	-0.018	0.027	0.074	-0.068
ER203	0.229	0.216	0.175	0.326	0.328	0.170	0.209	0.159	0.295	0.240	0.319	0.184	-0.185	0.274
ER304	0.124	0.120	0.088	0.102	0.086	0.144	0.163	0.153	0.098	0.120	0.114	0.088	-0.043	0.048
ER501	-0.097	-0.069	-0.054	-0.017	-0.002	-0.133	-0.136	-0.078	0.047	-0.063	0.053	-0.042	0.044	-0.003
I&C	-0.075	-0.035	-0.061	-0.116	-0.097	-0.034	-0.062	0.093	-0.115	-0.076	-0.093	-0.009	-0.020	-0.044
Union	0.064	0.103	0.059	0.176	0.103	0.013	0.017	-0.002	0.164	0.041	0.149	0.000	-0.037	0.123
Sector	0.097	0.177	0.140	-0.011	-0.024	0.0929	0.091	0.080	-0.101	-0.026	-0.109	-0.019	0.041	-0.036
Size	-0.025	-0.043	-0.010	0.152	0.104	-0.067	-0.055	-0.065	0.178	0.052	0.203	0.027	-0.056	0.139

N = 1657

Appendix D

Table D1.

Predictor matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
ER200_1 (1)	0	1	1	1	1	1	1	1	1	1	1
ER200_2 (2)	1	0	1	1	1	1	1	1	1	1	1
ER207_1 (3)	1	1	0	1	1	1	1	1	1	1	1
ER207_2 (4)	1	1	1	0	1	1	1	1	1	1	1
ER207_3 (5)	1	1	1	1	0	1	1	1	1	0	1
ER207_4 (6)	1	1	1	1	1	0	1	1	1	0	1
ER207_5 (7)	1	1	1	1	1	1	0	1	1	0	1
ER207_6 (8)	1	1	1	1	1	1	1	0	1	1	1
ER207_8 (9)	1	1	1	1	1	1	1	1	0	0	1
ER151_3 (10)	1	1	1	1	0	0	0	1	0	0	1
ER151_4 (11)	1	1	1	1	1	1	1	1	1	1	0
Union	0	0	1	0	0	0	0	1	1	0	1
IC	0	0	1	0	0	0	0	0	0	0	1
Country	0	0	0	0	0	0	1	0	0	1	1
Size	0	0	1	0	0	1	0	1	1	0	1
Sector	0	1	0	0	1	1	0	0	1	0	0
ER501	1	0	0	0	1	1	0	0	0	0	0
ER202	0	0	0	0	0	0	0	0	0	1	0
ER151_1	1	0	1	1	1	1	0	1	1	1	1
ER151_2	0	1	0	0	0	0	0	0	0	1	0
ER203	1	1	1	1	1	1	1	1	1	1	1
ER304	1	1	1	0	1	1	1	1	1	0	0

Note: The left column shows the predictor variables, the top row shows the target variables. A one means the predictor will contribute to the imputation of the target variable. If a zero is placed, the predictor will not be used in the list of predictors for the missing values of that target variable. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix E

Figure E1

Convergence of Mean and Standard Deviation of Multiple Imputation

Figure E2

Continuing of convergence of Mean and Standard Deviation for Multiple Imputation
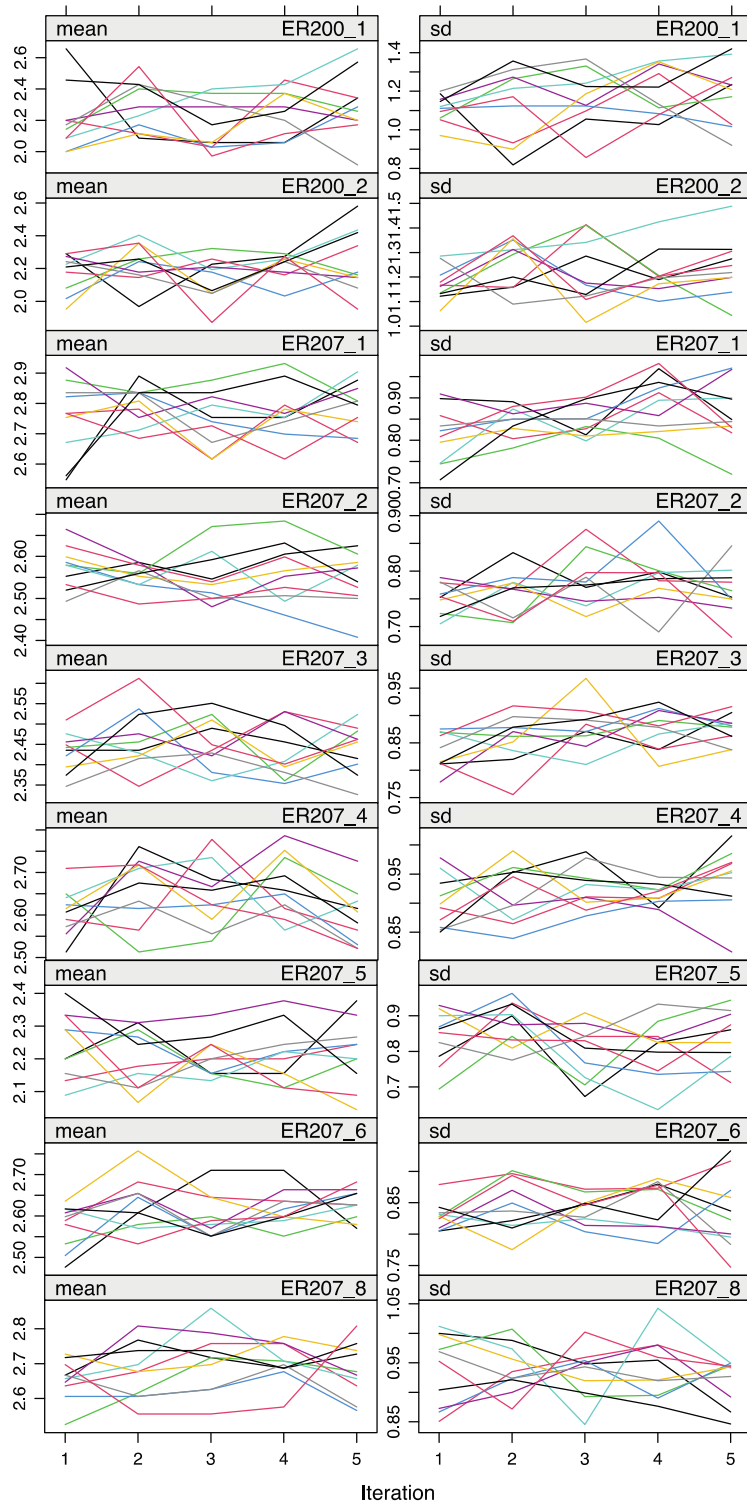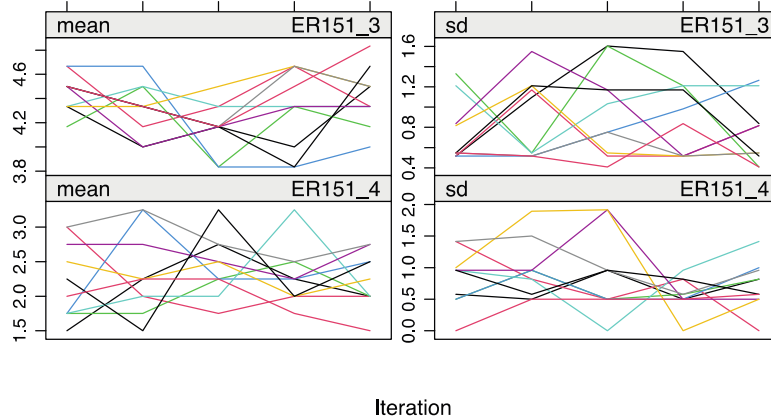
Note: Explanation of variable names can be found in Table 2. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.
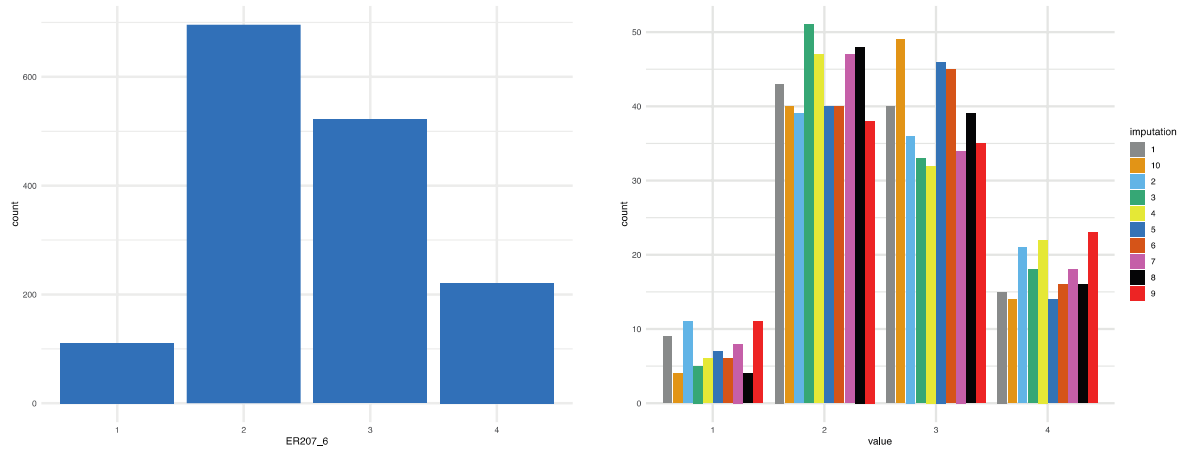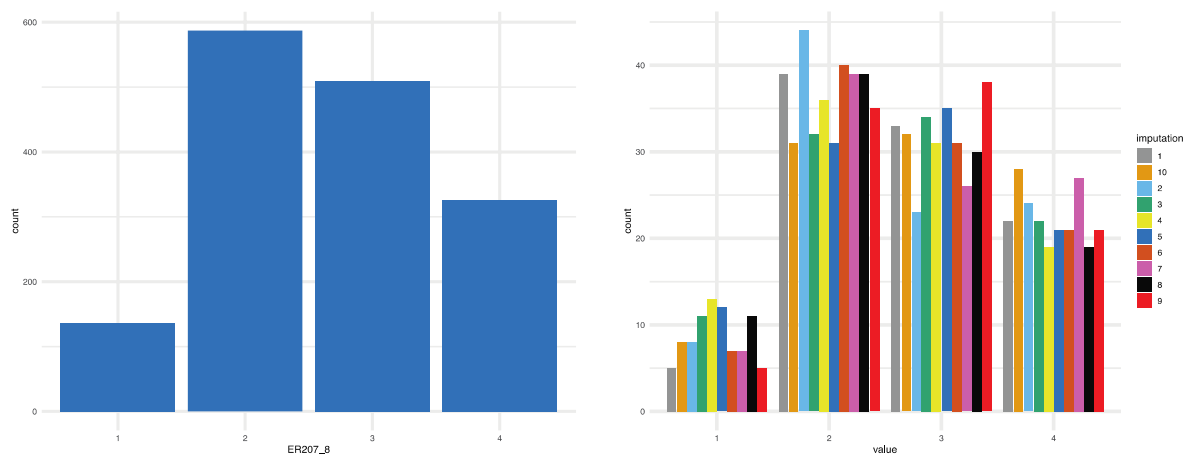
Appendix F

Figure F1

Comparison of distribution original data versus distribution imputed values variable ER200_1.
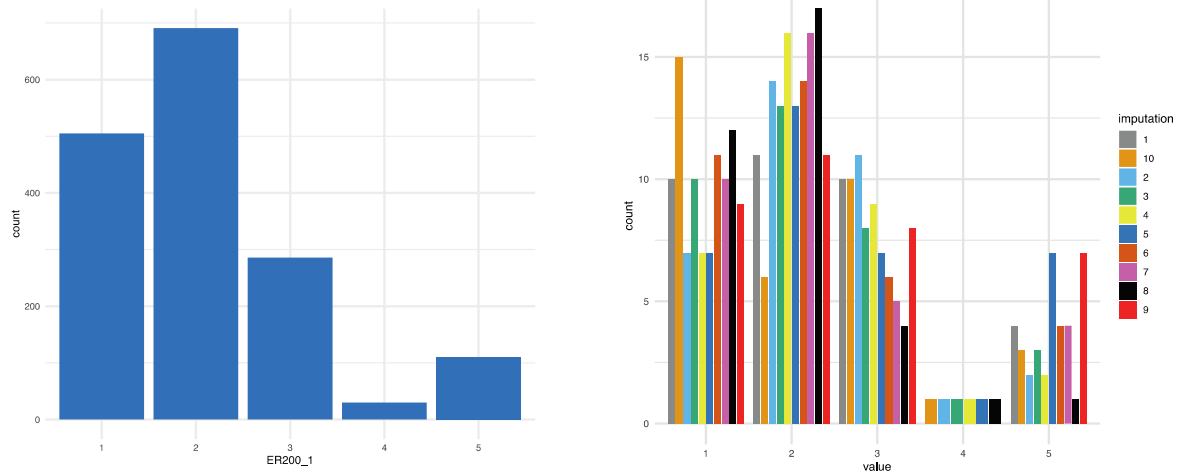
Figure F2

Comparison of distribution original data versus distribution imputed values variable ER200_2.
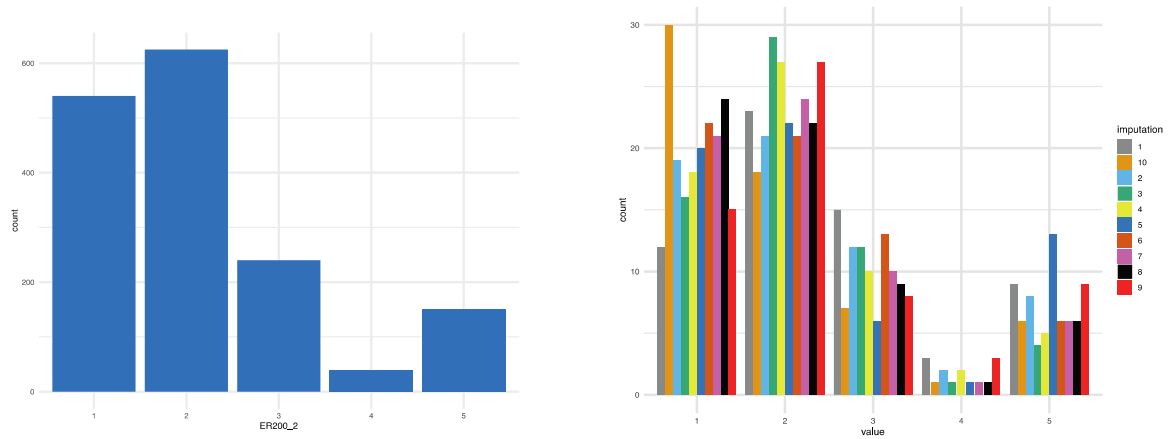
Figure F3

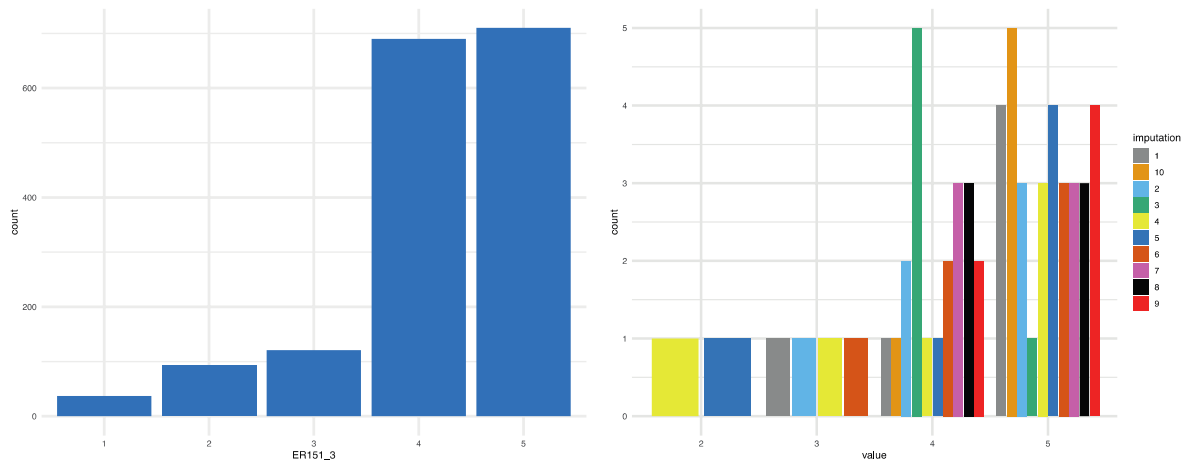Comparison of distribution original data versus distribution imputed values variable ER207_1.
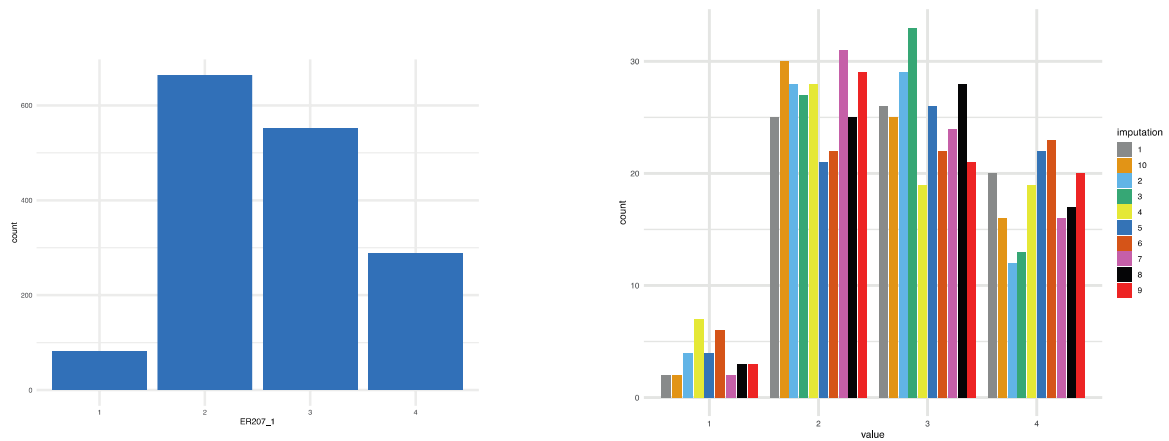
Figure F4
Comparison of distribution original data versus distribution imputed values variable ER207_2.
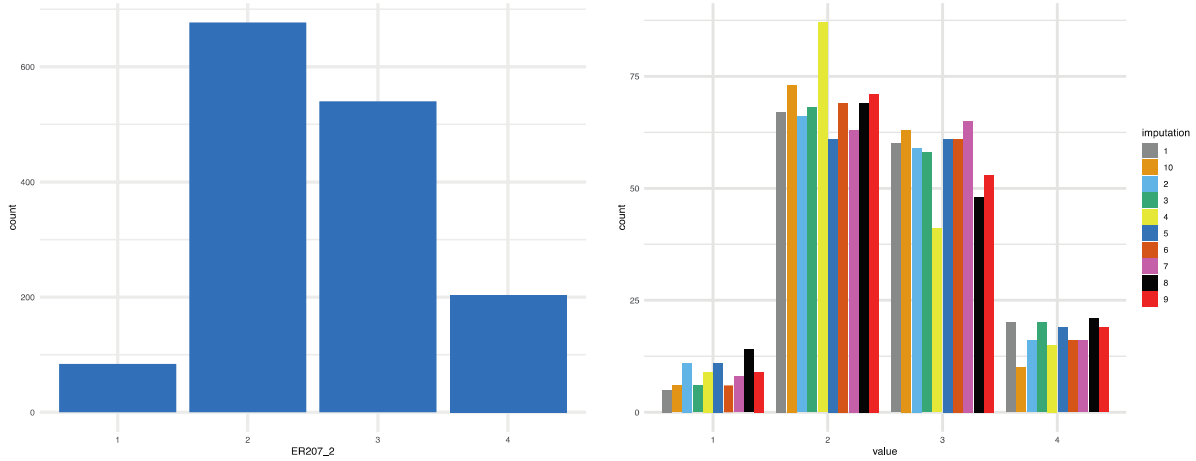
Figure F5
Comparison of distribution original data versus distribution imputed values variable ER207_3.
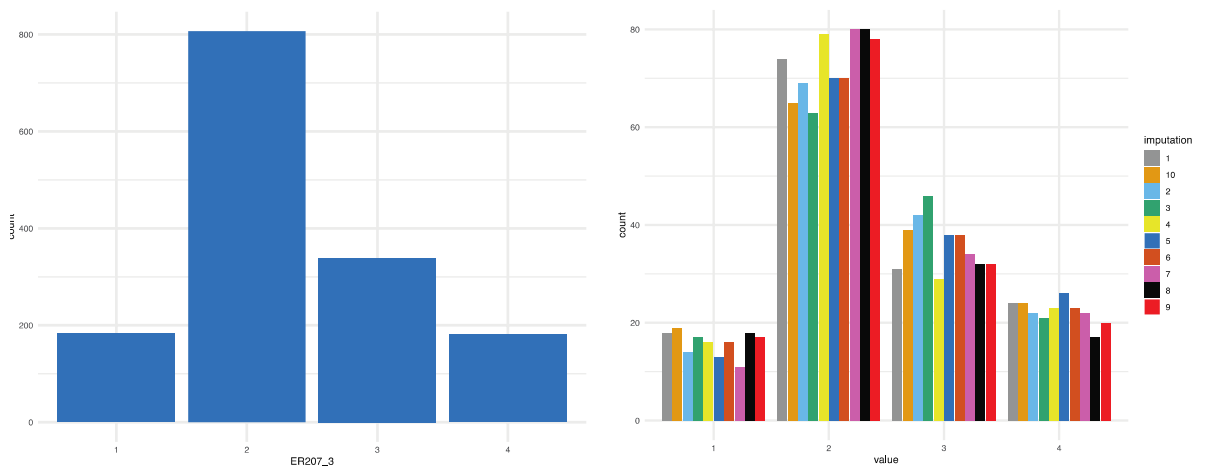
Figure F6
Comparison of distribution original data versus distribution imputed values variable ER207_4.
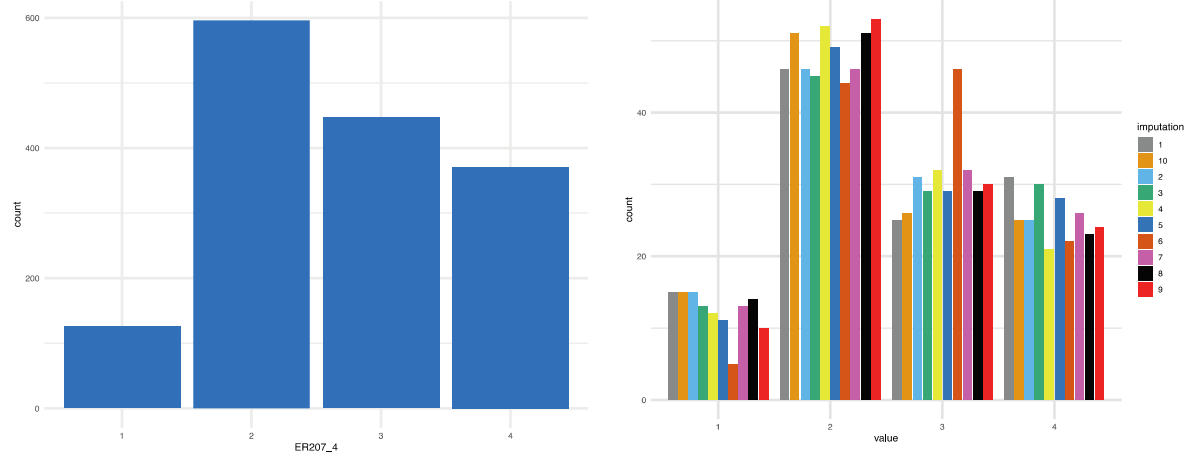
Figure F7

Comparison of distribution original data versus distribution imputed values variable ER207_5.
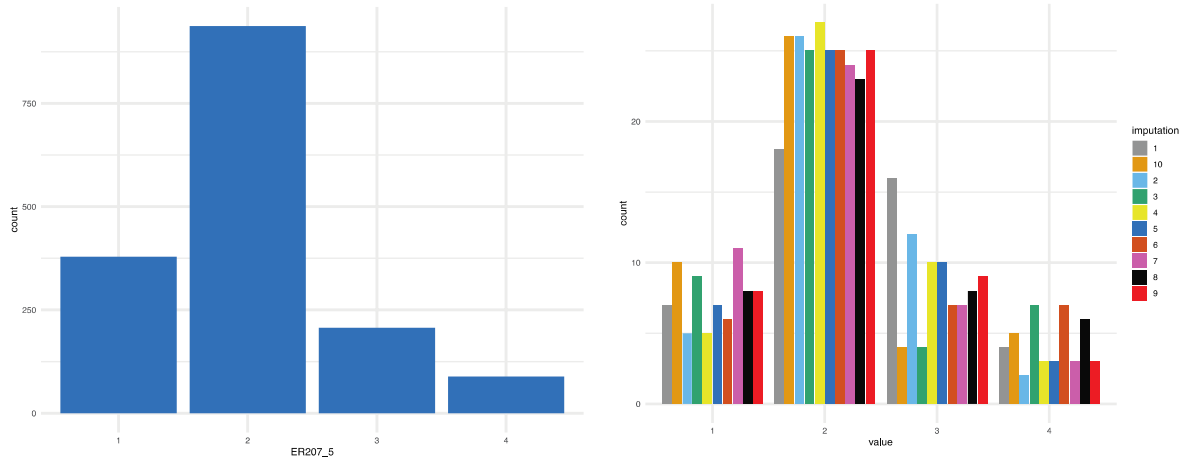
Figure F8

Comparison of distribution original data versus distribution imputed values variable ER207_6.

Figure F9

Comparison of distribution original data versus distribution imputed values variable ER207_8.

Figure F10

Comparison of distribution original data versus distribution imputed values variable ER151_3.

Figure F11

Comparison of distribution original data versus distribution imputed values variable ER151_4.
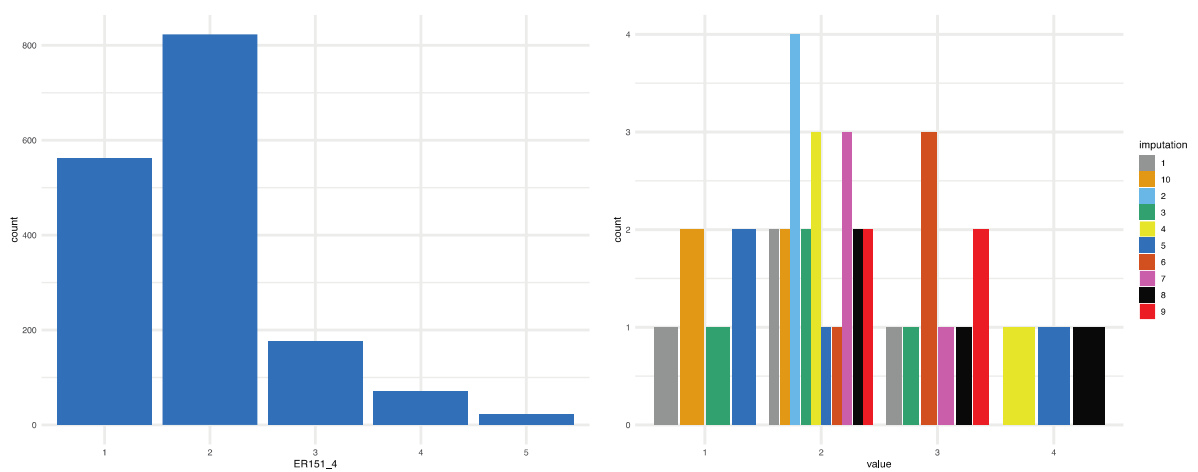
Note for all figures in Appendix F: The left figure represents the distribution of the real values. The right figure represents the distribution of the simulated values for each imputation. Data are (adapted) from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix G

Table G1.
Descriptive statistics original data and data with values of Imputation 1

	Original data						Imputation 1					
	Mean	SD	Median	Distr.	Min	Max	Mean	SD	Median	Distr.	Min	Max
I&C	0.589	0.492			0	1	0.589	0.492			0	1
Union	0.772	0.420			0	1	0.772	0.420			0	1
Information rights												
Economic and financial			2		1	5			2		1	5
At least once a month (1)				0.31						0.31		
Several times a year (2)				0.43						0.43		
Once a year (3)				0.18						0.17		
Less than once a year (4)				0.02						0.29		
Never (5)				0.07						0.07		
Employment			2		1	5			2		1	5
At least once a month (1)				0.34						0.34		
Several times a year (2)				0.39						0.39		
Once a year (3)				0.15						0.15		
Less than once a year (4)				0.03						0.03		
Never (5)				0.09						0.09		
Negotiation and consultation rights												
Employment and human resources			3		1	4			2		1	4
Very strong (1)				0.05						0.05		
Quite strong (2)				0.42						0.42		

Table G2.

Continuation of descriptive statistics of original data and data with values of Imputation 1

Category	Original			Imputation 1		
		1	4		1	4
Quite weak (3)	0.35			0.35		
Very weak (4)	0.18			0.19		
Equal opportunities	2	1	4	2	1	4
Very strong (1)	0.06			0.05		
Quite strong (2)	0.45			0.45		
Quite weak (3)	0.36			0.36		
Very weak (4)	0.14			0.13		
Changes in working time	2	1	4	2	1	4
Very strong (1)	0.12			0.18		
Quite strong (2)	0.54			0.53		
Quite weak (3)	0.23			0.23		
Very weak (4)	0.12			0.12		
Determination of pay	3	1	4	2	1	4
Very strong (1)	0.08			0.08		
Quite strong (2)	0.39			0.39		
Quite weak (3)	0.29			0.29		
Very weak (4)	0.24			0.243		
Healthy and safety matters	2	1	4	2	1	4
Very strong (1)	0.24			0.23		
Quite strong (2)	0.58			0.58		
Quite weak (3)	0.13			0.13		
Very weak (4)	0.06			0.06		
Organisation of work processes	2	1	4	2	1	4
Very strong (1)	0.07			0.07		

Table G3.

Continuation of descriptive statistics of original data and data with values of Imputation 1

	Original				Imputation 1			
	M	Min	Max	Prop.	M	Min	Max	Prop.
Quite strong (2)				0.45				0.45
Quite weak (3)				0.34				0.34
Very weak (4)				0.14				0.14
Career management	3	1	4		2	1	4	
Very strong (1)				0.09				0.09
Quite strong (2)				0.38				0.38
Quite weak (3)				0.33				0.33
Very weak (4)				0.21				0.21
Attitudes								
Relation is hostile	4	1	5		5	1	5	
Strongly agree (1)				0.02				0.02
Agree (2)				0.06				0.06
Neither agree nor disagree (3)				0.07				0.07
Disagree (4)				0.42				0.42
Strongly disagree (5)				0.43				0.43
Effort to solve common problems	2	1	5		2	1	5	
Strongly agree (1)				0.34				0.34
Agree (2)				0.50				0.50
Neither agree nor disagree (3)				0.11				0.11
Disagree (4)				0.04				0.04
Strongly disagree (5)				0.01				0.01

Appendix H

Table H1

Descriptive statistics of variables used in cluster analysis for Imputation 1 and Imputation 2

	Imputation 1					Imputation 2				
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889	0.620			0.107	0.889
Union	0.735	0.172		0.458	0.974	0.735			0.458	0.974
Information rights										
Economic and financial			2	1	2			2	2	3
Employment			2	1.5	3			2	1	3
Negotiation and consultation rights										
Employment and HR			2.75	2	3			2.75	2	3
Equal opportunities			2.75	2	3			2.75	2	3
Changes in working time			2	2	2			2	2	2
Determination of pay			3	2	3			3	2	3
Healthy and safety matters			2	2	2			2	2	2
Organisation of work processes			2	2	3			2	2	3
Career management			3	2	3			3	2	3
Attitudes										
Relation is hostile			4	4	5			4	4	5
Solve common problems			2	1	2			2	1	2

N = 10

Table H2

Descriptive statistics of variables used in cluster analysis for Imputation 3 and Imputation 4

	Imputation 3					Imputation 4				
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889	0.620			0.107	0.889
Union	0.735	0.172		0.458	0.974	0.735			0.458	0.974
Information rights										
Economic and financial			2	1	3			2	2	3
Employment			2	1	3			2	1	3
Negotiation and consultation rights										
Employment and HR			3	2	3			3	2	3
Equal opportunities			3	2	3			2	2	3
Changes in working time			2	2	2			2	2	2
Determination of pay			3	2	3			3	2	3
Healthy and safety matters			2	2	2			2	2	2
Organisation of work processes			2	2	3			2	2	3
Career management			3	2	3			3	2	3
Attitudes										
Relation is hostile			4	4	5			4	4	5
Solve common problems			2	1	2			2	1	2

N = 10

Note: The data that are used are first grouped by country. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table H3

Descriptive statistics of variables used in cluster analysis for Imputation 5 and Imputation 6

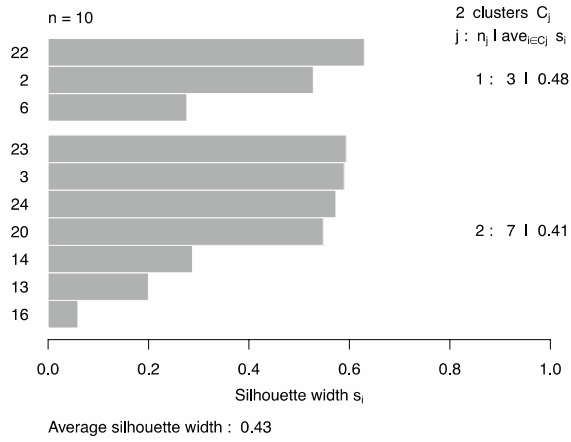|	Imputation 5					Imputation 6				
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889	0.620			0.107	0.889
Union	0.735	0.172		0.458	0.974	0.735			0.458	0.974
Information rights										
Economic and financial			2	1	3			2	2	3
Employment			2	1	3			2	1	3
Negotiation and consultation rights										
Employment and HR			3	2	3			3	2	3
Equal opportunities			2.75	2	3			3	2	3
Changes in working time			2	2	2			2	2	2
Determination of pay			3	2	3			3	2	3
Healthy and safety matters			2	2	2			2	2	2
Organisation of work processes			2	2	3			2	2	3
Career management			3	2	3			3	2	3
Attitudes										
Relation is hostile			4	4	5			4	4	5
Solve common problems			2	1	2			2	1	2

N = 10

Note: The data that are used are first grouped by country. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table H4

Descriptive statistics of variables used in cluster analysis for Imputation 7 and Imputation 8

	Imputation 7					Imputation 8				
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889	0.620			0.107	0.889
Union	0.735	0.172		0.458	0.974	0.735			0.458	0.974
Information rights										
Economic and financial			2	1	3			2	2	3
Employment			2	1	3			2	1	3
Negotiation and consultation rights										
Employment and HR			3	2	3			2.75	2	3
Equal opportunities			3	2	3			2	2	3
Changes in working time			2	2	2			2	2	2
Determination of pay			3	2	3			3	2	3
Healthy and safety matters			2	2	2			2	2	2
Organisation of work processes			2	2	3			2	2	3
Career management			3	2	3			3	2	3
Attitudes										
Relation is hostile			4	4	5			4	4	5
Solve common problems			2	1	2			2	1	2

N = 10

Note: The data that are used are first grouped by country. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Table H5

Descriptive statistics of variables used in cluster analysis for Imputation 9 and Imputation 10

	Imputation 9					Imputation 10				
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max
I&C	0.620	0.236		0.107	0.889	0.620			0.107	0.889
Union	0.735	0.172		0.458	0.974	0.735			0.458	0.974
Information rights										
Economic and financial			2	2	3			2	2	3
Employment			2	1	3			2	1	3
Negotiation and consultation rights										
Employment and HR			2.75	2	3			2.75	2	3
Equal opportunities			2.75	2	3			3	2	3
Changes in working time			2	2	2			2	2	2
Determination of pay			3	2	3			3	2	3
Healthy and safety matters			2	2	2			2	2	2
Organisation of work processes			2	2	3			2	2	3
Career management			3	2	3			3	2	3
Attitudes										
Relation is hostile			4	4	5			4	4	5
Solve common problems			2	1	2			2	1	2

N = 10

Note: The data that are used are first grouped by country. Data are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix I

Figure I1.
Silhouette plot of cluster analysis on Imputation 1.

Average silhouette width : 0.43

Figure I2.
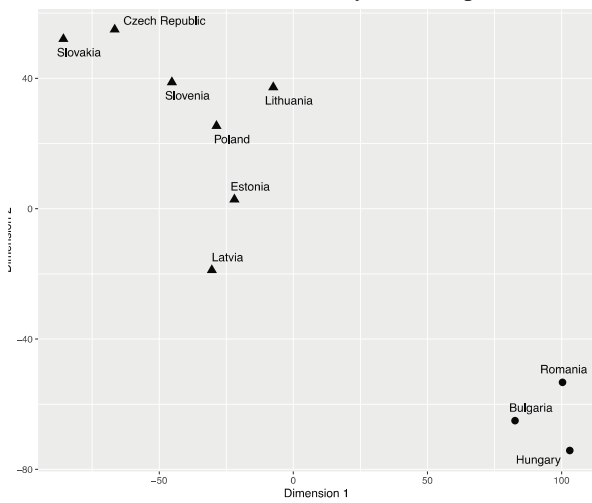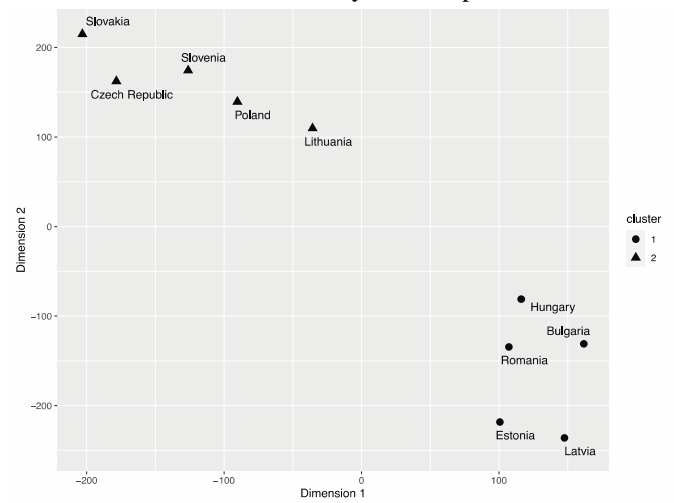Silhouette plot of cluster analysis on Imputation 2.

Average silhouette width : 0.51
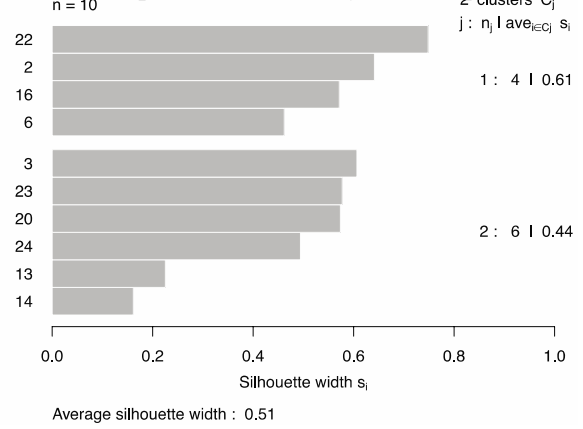
Figure I3.
Silhouette plot of cluster analysis on Imputation 3.

Average silhouette width : 0.52
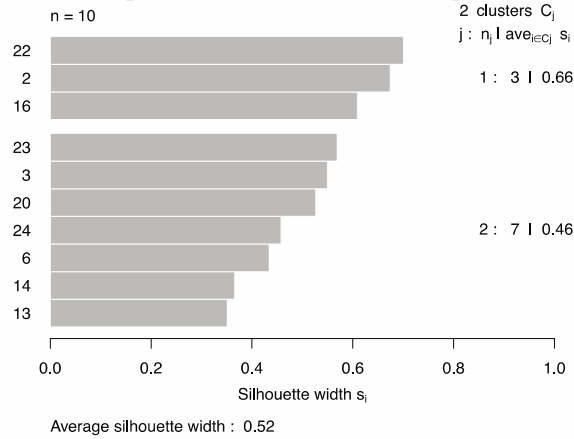
Figure I4.
Silhouette plot of cluster analysis on Imputation 4.

Average silhouette width : 0.44
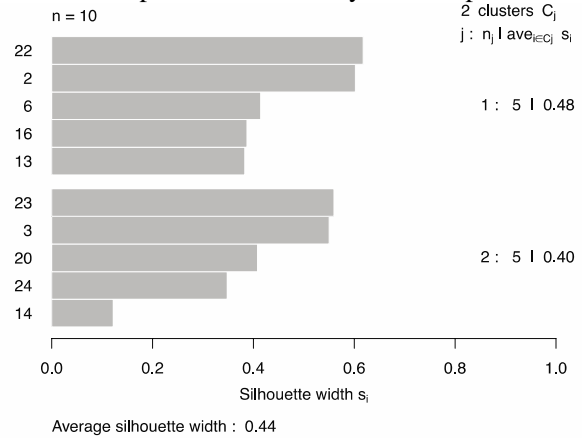
Figure I5.
Silhouette plot of cluster analysis on Imputation 5.

Average silhouette width : 0.45
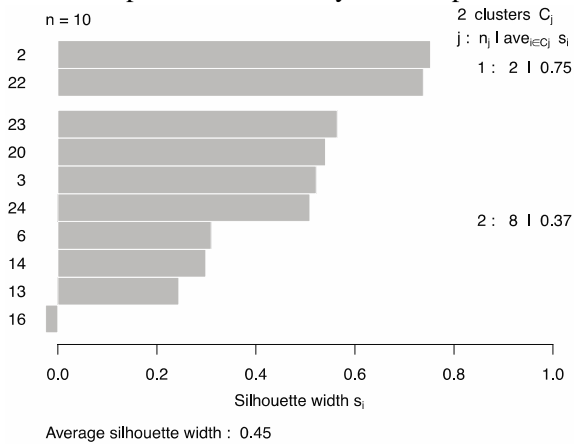
Figure I6.
Silhouette plot of cluster analysis on Imputation 6.

Average silhouette width : 0.49
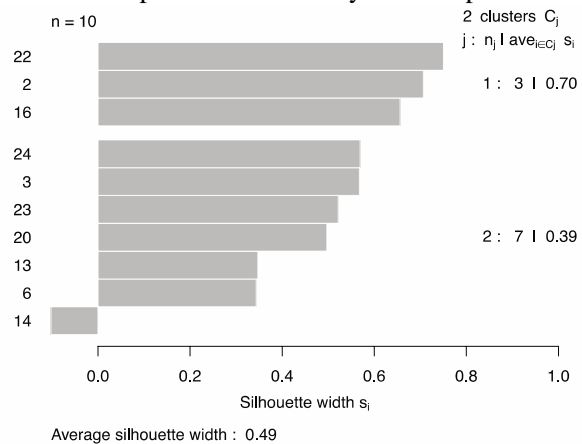
Figure I7.

Silhouette plot of cluster analysis on Imputation 7.
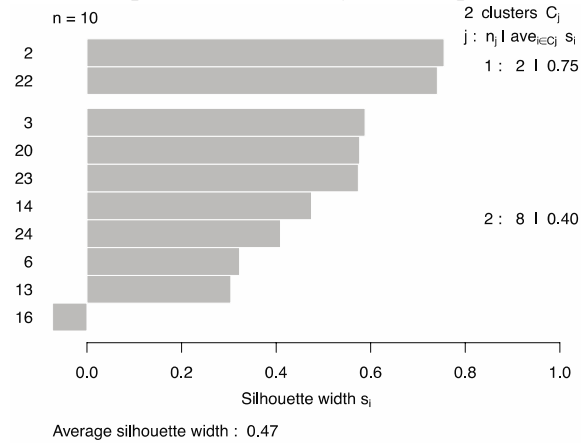
Figure I8.

Silhouette plot of cluster analysis on Imputation 8.
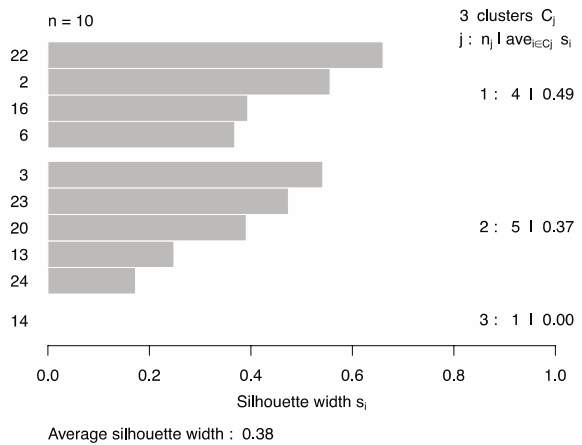
Figure I9.

Silhouette plot of cluster analysis on Imputation 9.
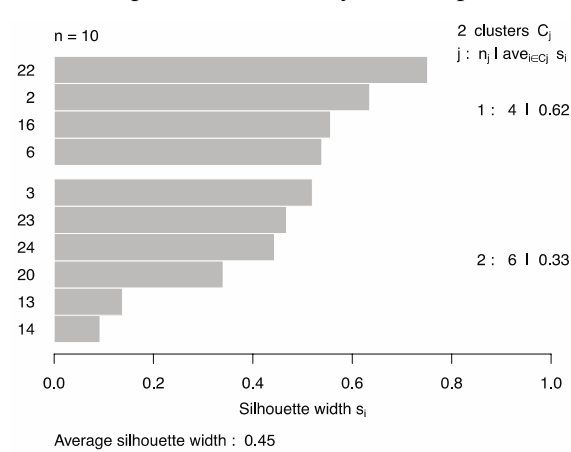
Figure I10.

Silhouette plot of cluster analysis on Imputation 10.
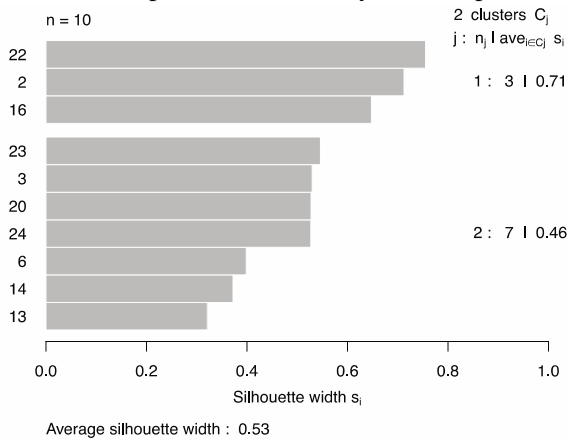
Note for all figures in Appendix I: The figures display the silhouette width of the cluster analysis with the optimal number of clusters for each imputed dataset. The silhouette width is showed per country; 2=Bulgaria, 3=Czech Republic, 6=Estonia, 13=Latvia, 14=Lithuania, 16=Hungary, 20=Poland, 22=Romania, 23=Slovenia, 24=Slovakia. Data for cluster analyses are adapted from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix J

Figure J1.

Visualisation of cluster analysis on Imputation 1.
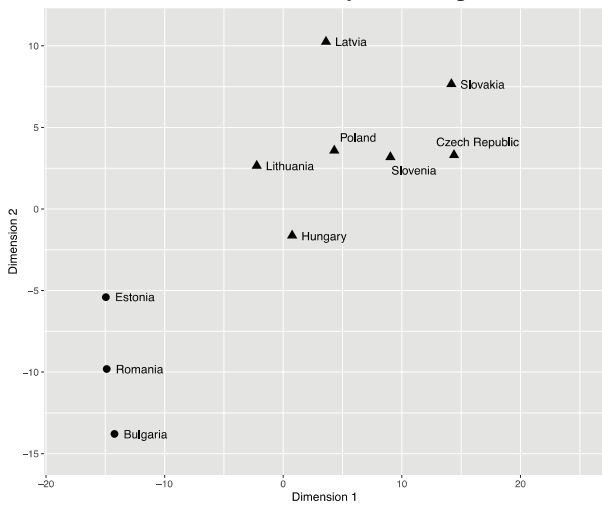
Figure J2.

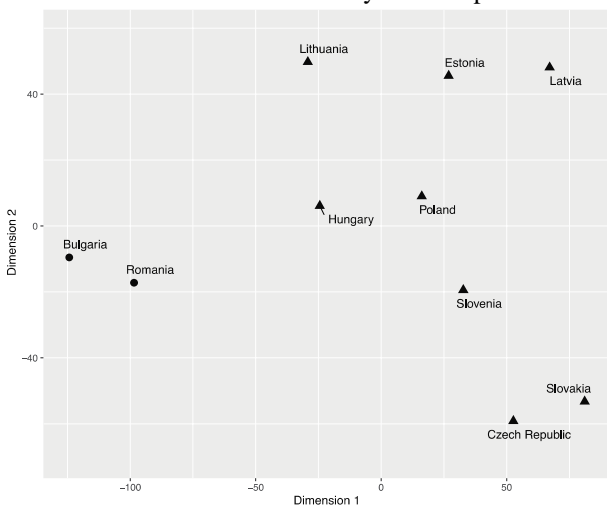Visualisation of cluster analysis on Imputation 2.
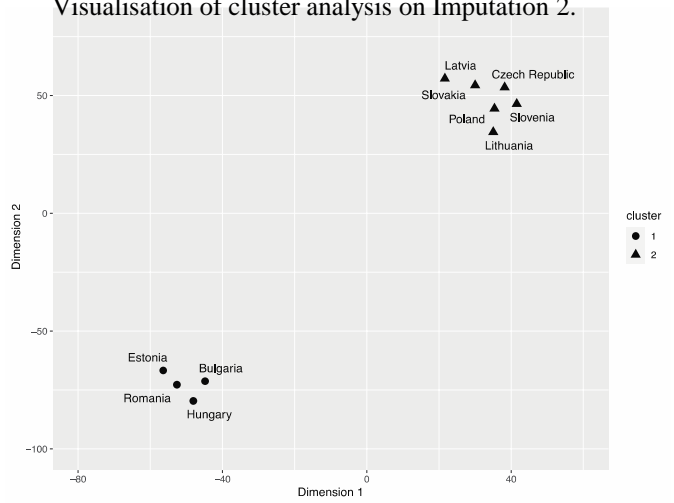
Figure J3.

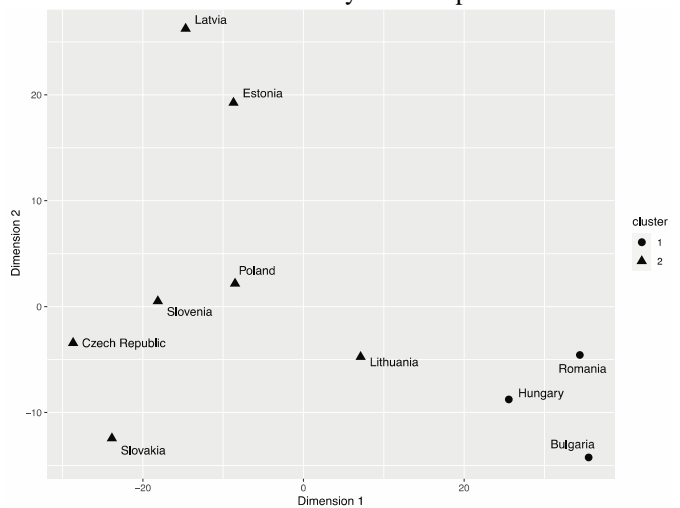Visualisation of cluster analysis on Imputation 3.

Figure J4.

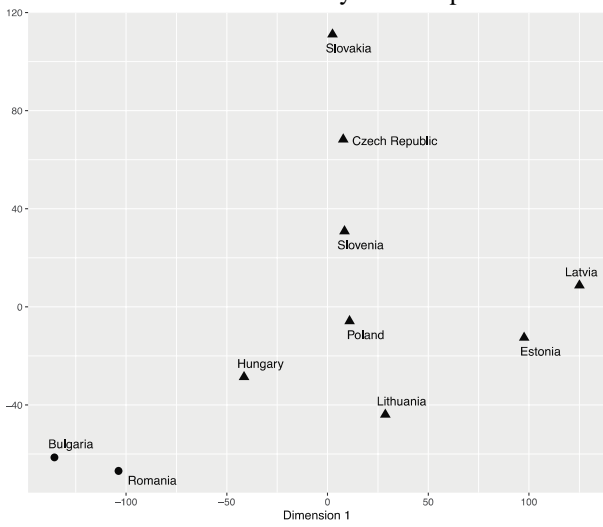Visualisation of cluster analysis on Imputation 4.

Figure J5.
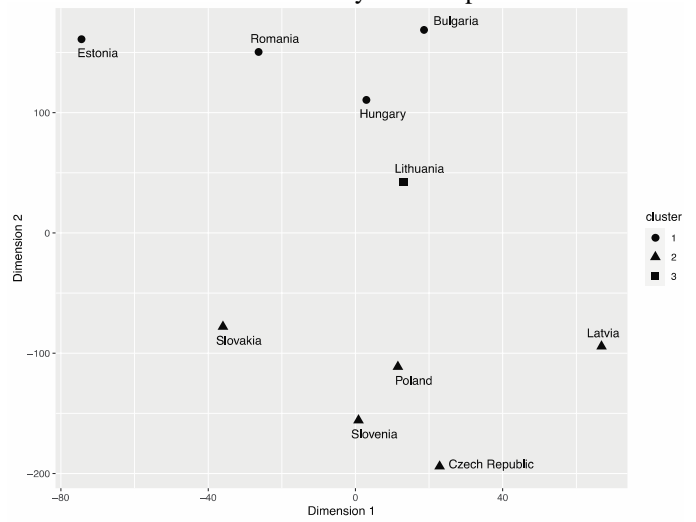
Visualisation of cluster analysis on Imputation 5.

Figure J6.

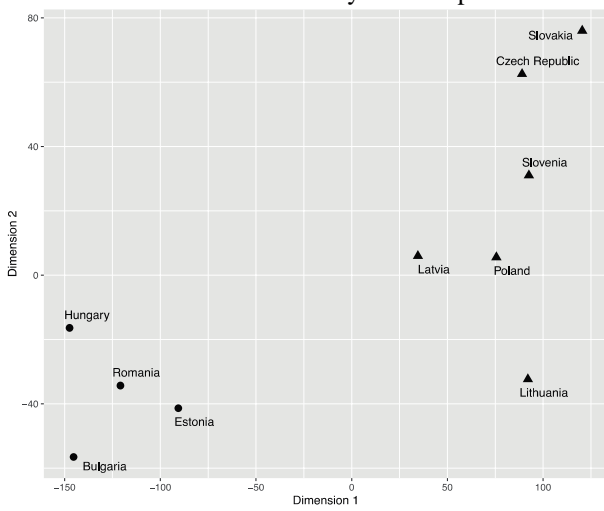Visualisation of cluster analysis on Imputation 6.

Figure J7.

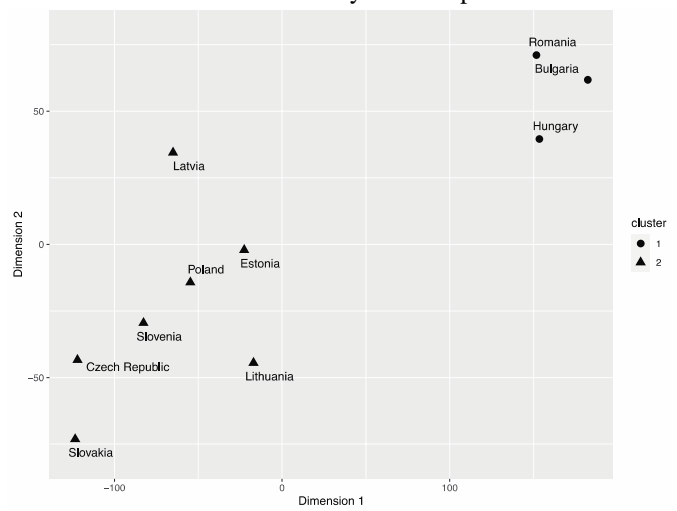Visualisation of cluster analysis on Imputation 7.

Figure J8.

Visualisation of cluster analysis on Imputation 8.

Figure J9.

Visualisation of cluster analysis on Imputation 9.

Figure J10.

Visualisation of cluster analysis on Imputation 10.

Note for all figures in Appendix J: All visualisations are shown on two dimensions. These dimensions are calculated through dimension reduction and contain as much information on all different variables as possible. The dimension reduction is done solely for the purpose of these visualisations. The visualisations are a product of the cluster analyses based on the adapted data from European Foundation for the Improvement of Living and Working Conditions, European Centre for the Development of Vocational Training. (2020). European Company Survey, 2009. [data collection]. UK Data Service. SN: 8691, DOI: 10.5255/UKDA-SN-8691-1.

Appendix K

The full code used for this Thesis can be found on GitHub through [this link](#) or by scanning the following QR-code: