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Service Trade Restrictions of the EEA Countries

A Multivariate Data Analysis for the European Business Services

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Abstract

This study uses a multidimensional approach to condense the information available in widely used service trade policy indicators and to describe the service trade restrictiveness of the European Economic Area (EEA) countries in five business service sectors (computer services and the four professional services) in a comparative way. Specifically, the study provides a multivariate data analysis of the sub-indices of the original OECD service trade restrictiveness index (STRI) applying to third countries without a Preferential Trade Agreement (PTA) and the same sub-indices of the OECD intra-EEA STRI. Additionally, the OECD FDI regulatory restrictiveness index is included in the analysis. The multivariate data analysis includes a correlation analysis, principal component analysis, and a cluster analysis. Briefly summarised, the following results are obtained: The correlation analysis shows that business services sectors of those EEA countries that are highly protected against third countries are also relatively highly protected against other EEA countries. Furthermore, there is a complementarity of the restrictions on foreign entry and movement of people with regard to their impact on trade of skilled labour-intensive professional services. The principal component analysis identifies for all business service sectors the overall service trade restrictiveness in the sector under consideration as the most important latent factor that accounts for between 35% (architecture services) and 45% (legal services) of the total variance of the included indicators. Finally, for each business service sector, the cluster analysis identifies clusters of countries that are among themselves relatively homogeneous in terms of their service trade restrictions. This allows deriving cluster-specific policy recommendations.

1 Introduction

Business services comprise a range of activities that supply services mainly, but not exclusively, to other businesses. According to the broadest categories of NACE Rev. 2, business services are divided into four sections: (J) information and communication, (L) real estate activities, (M) professional, scientific and technical activities, and (N) administrative and support service activities. In the countries of the European Economic Area (the 28 EU countries plus Iceland and Norway, in the following EEA) the value added at factor cost of these four sectors amounted to 2286 billion euro in 2017. This represents 30% of the value added of the total business economy (including repair of computers, personal and household goods; except financial and insurance activities) of the EEA. Similarly, in 2017 within the EEA, business services accounted for 27% of persons employed in the whole business economy, corresponding to 40 million persons in absolute terms. Furthermore, the total imports of business services of the EEA countries by all four GATS modes of trade in services amounted to 1652 billion euro in 2017.[1]

Competitive business services are considered an engine for growth and job creation within the sector itself but also as an enabling condition for the growth of other sectors, particularly manufacturing. The theory of industrial economics, which is increasingly linked to modern trade theory, suggests that a growing internationalisation of an industrial economy exercises positive effects on competitiveness in the domestic markets. Here the narrative is that foreign competition from foreign direct investment (FDI) and imports reduce the profit margins and increase the static and dynamic efficiency of domestic firms (Blind and Jungmittag, 2004). Thus, obstacles to the entry and operations of foreign business services suppliers are likely to impede competition and efficiency gains in the sector concerned, but also to raise the costs for downstream sectors using these services as important inputs (Nordås and Rouzet, 2017).

However, in contrast to trade in goods, most regulations hampering trade and FDI in services have a "behind the border" character. Nordås and Rouzet (2017) argue that, for instance, discriminatory licensing conditions applied to foreign investors, the non-recognition of qualifications acquired abroad or unnecessary red tape are all prominent obstacles to service trade, but that their identification often requires a comprehensive understanding of each country's law. In particular, for an important group of business services, the so-called professional services such as accounting, legal, architectural and engineering services, the country-of-destination principle applies to their trade both within the EEA internal market and with third countries (Recker, 2019). Thus, professionals providing these services have to comply with the regulations of the respective destination country of their service, even if their profession may be subject to different professional regulations in their home country.

Overall, the nature of restrictions on trade in services makes them more difficult to capture in a consistent and comparable manner across countries than when it comes to tariffs and other costs imposed on imports of goods at the border. To fill this data gap and to quantify the strength of service trade restrictions, the OECD releases on a yearly basis starting in 2014 the Service Trade Restrictiveness Index (STRI) for 22 service sectors in 44 countries. Among the 22 sectors are five business services sectors: computer services and the four professional services (accounting, legal, architectural and engineering services). For each sector, the STRI database covers five different kinds of service trade restrictions, which are quantified in five sub-indices and then summarised in one overall STRI index.

Originally, the OECD STRI methodology records restrictions with respect to countries that do not benefit from preferential treatment, and, therefore, does not reflect the relevant level of regulation of service trade between countries with a preferential trade agreement (PTA) in force. However, recently the OECD has released an additional version of the STRI ("Intra-EEA Services Trade Restrictiveness Index") specially designed for service trade between the 25 EEA countries (the 23 EU countries available in the original STRI database plus Island and Norway). The EEA constitutes a common market and thus a deeper integration than a normal PTA, and hence was not captured by the original STRI (Benz and Gonzales, 2019). Additionally, the OECD publishes also a FDI regulatory restrictiveness index for these five business sectors.

However, none of the ten sub-indices of the original and intra-EEA STRI or the FDI index, nor the simple sums of the five STRI sub-indices, alone can sufficiently capture a country's service trade restrictiveness. Therefore, this study uses a multidimensional approach to condense the information available in these indices and to

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[1] The data on value added and persons employed are from Eurostat's Structural Business Statistics. According to this database, the total business economy comprises the NACE Rev. 2 groups and sectors B to N and S95, but without the group K (financial and insurance activities). The calculation the total imports of business services of the EEA countries by all four GATS modes of trade in services is based on the TISMOS (Trade in services by GATS modes of supply) database of the WTO. Rueda- Cantuche et al. (2016) provide a description of this database.

describe the overall service trade restrictiveness of the EEA countries with respect to the five business services in a comparative way. Cerdeiro and Nam (2018) use the same argument to call for a multidimensional approach in the analysis of trade policy indicators, adding that the various restrictions could not be analysed in isolation, as restrictions in one area might hinder any potential gains from reducing barriers in another. For example, in the case of computer or professional services, a country with few statutory FDI restrictions (measured by the OECD FDI regulatory restrictiveness index) may not be able to increase imports of services and thus to realise static and dynamic efficiency gains if there are massive barriers to the movement of people (measured by the corresponding OECD STRI sub-index).

The multidimensional approach in this study is a multivariate data analysis in five steps. The first three steps are mainly concerned with descriptive statistics. They use statistical measures, data visualizations and correlation analyses to describe the indicators and the relationships between them. The fourth step applies principal component analysis to approximate the different restrictiveness indicators by a smaller number of "principal components" or "factors" that are as meaningful as possible. This analysis shows, for example, that the latent factor that can be interpreted as a country's overall sectoral service trade restrictiveness and accounts for the largest part of the overall variance of the individual restrictiveness indicators in the five business services sectors reviewed here.

In the terminology of modern data science, principal component analysis as well as cluster analysis applied in the fifth steps are methods of unsupervised learning, which implies that they seek to find relationships between the observations of the various variables without being trained by a response variable. Cluster analysis in the fifth step allows forming subgroups of EEA countries so that the members of a subgroup are as similar as possible in terms of the different facets of their service trade restrictiveness and, at the same time, the differences between the subgroups are as great as possible. This step is particularly important in order to derive targeted policy measures for the reduction of restrictions on trade in services in the various groups of countries.

The rest of the paper is organised as follows. Section 2 describes and discusses the selected indicators of service trade restrictiveness and the methodology of the multivariate data analysis. Sections 3 to 7 present the empirical results for the five business services sectors. Each of these sections also include a short discussion of the policy implications of the empirical results. Section 8 offers some summarising and concluding remarks.

2 Data and methodology

Restrictions on trade in services can be of varying nature, as this type of trade can take place through four different modes of supply according to the WTO definition:

1. cross-border provision, e.g. software produced in one country and shipped via internet to another country,

2. consumption abroad, e.g. a client travels to a foreign law firm,

3. commercial presence in the foreign region, e.g. an architecture firm opens a local branch to serve foreign demand,

4. temporary movement of natural persons, e.g. a consultant travels to foreign customers to deliver services.

In this study, different indicators are used to capture the business services trade restrictions imposed on the different modes of trade in services and to obtain an overall picture of the relevance of these restrictions for the five business services sectors of the EEA countries by means of multivariate statistical methods. In the following, the selected indicators are first presented and then the multivariate statistical methods used are discussed

2.1 Indictors of service trade restrictiveness

Our main indicators are from the OECD service trade restrictiveness index (STRI) database, which contains information derived from more than 16,000 laws and regulations for 22 service sectors in 44 countries (OECD 2017, 2020) on a yearly basis starting in 2014 up to 2019. For each sector, this database covers five policy areas:

- restrictions on foreign entry (entry),

- restrictions on the movement of people (people),

- other discriminatory measures (odis),

- barriers to competition (comp),

- regulatory transparency (trans).

The first three areas capture measures related to market access and national treatment, the first area being restrictions on market access via mode (3) and the second area restrictions on market access via mode (4). The fourth area comprises information on pro-competitive regulation (or lack thereof), and the fifth area provides information on transparency and administrative procedures. For each policy area and sector, the OECD converted the qualitative information into quantitative indices, initially with scores ranging from zero (absence of any regulation) to one (completely closed sector), but then rescaled, so that a composite STRI calculated as a simple sum of the sub-indices from the five policy areas also ranges from zero to one.

The OECD STRI methodology follows the principle of the most-favoured nation (MFN) by recording applied regimes with respect to countries that do not benefit from preferential treatment, and, therefore, does not reflect the relevant level of regulation of service trade between countries with a preferential trade agreement (PTA) in force. However, in the group of countries covered by the OECD STRI, around 50% of their cross-border services trade is with PTA partners. The share is highest for the member countries of the EEA, which usually export more than 70% of their services to PTA partners and most of these exports go to other EEA members. As the EEA constitutes a common market and thus a deeper integration than a normal PTA, which is not captured by the STRI, the OECD has recently released an additional version of the STRI called "Intra-EEA Services Trade Restrictiveness Index". It is designed on purpose for services trade between the 25 EEA countries (the 23 EU countries available in the original STRI database plus Island and Norway) (see Benz and Gonzales, 2019). This new Intra-EEA STRI covers the same five areas as the original STRI with respect to third countries without PTA. The report of Benz and Gonzales (2019) shows that services trade within the EEA is substantially more liberal than the multilateral policies applied by EEA member countries towards non-members, but a certain level of restrictiveness remains within the Single Market, demonstrating that there is potential for further market integration.

I use the five sub-indices of both STRI versions for the five business services sectors (computer services, accounting services, legal services, architecture services and engineering services) to capture all five areas of

restrictions separately. The composite STRI then contains no additional information because it is simply the sum of the five sub-indices. Although these data are already available for 2019, I have decided to use the data for 2018, as another indicator used is only available until 2018 and I want to ensure comparability. However, this choice of the year of investigation hardly affects the timeliness of the results obtained, as the STRI sub-indices only have changed little or not at all in recent years.

The other indicator used is the OECD FDI regulatory restrictiveness index. This index is used because foreign direct investment is often a prerequisite for using the mode (3) of trade in services. It is based on the following four measures:

- Limitations on foreign equity,

- Discriminatory screening and approval procedures applied to inward FDI,

- Restrictions on the employment of foreign key personnel,

- Other restrictions such as on land ownership, corporate organisation or repatriation of profits and capital.

According to Mistura and Roulet (2019, Box 1), the extent of discrimination between foreign and domestic private investors is the central criterion to decide whether a measure should be scored, but non-discriminatory measures are also covered when they are considered more burdensome for foreign investors. The index is updated on a yearly basis and covers 22 sectors in 62 countries (the OECD members and 22 other countries) for the period from 1997 to 2018.

The restrictions for each type of measures are based on expert judgements evaluated on a zero (open) to one (closed) scale. Foreign equity restrictions are given a higher score, followed by discriminatory screening measures, while restrictions on foreign key personnel and other measures receive relatively lower scores. The composite scores for the individual country-sector pairs reflect the sum of scores under each policy dimension, capped at one (Thomson and Mistura, 2017, Box 1; Mistura and Roulet, 2019, Box 1).

The information basis of the FDI regulatory restrictiveness index are statutory measures as reflected in official OECD instruments or identified in OECD Investment Policy Reviews and yearly monitoring reports. In contrast to the OECD STRI, the actual implementation of legal restrictions is not considered in the scoring process. Furthermore, other facets of the regulatory framework, such as the nature of corporate governance, the extent of state ownership, and institutional or informal restrictions, which may affect the FDI climate, are also not taken into account (Mistura and Roulet, 2019, Box 1; Kalinova, Palerm and Thomsen, 2010).

In the empirical analysis, I only use the composite FDI regulatory restrictiveness index because the sub-indices for the EEA countries often contain too many zeros, so that a meaningful analysis is not possible. For this group of countries, the composite index is most highly correlated with the sub-index for restrictions on foreign equity, while the other sub-indices are often of little or no importance. Furthermore, this index is only available for four business services sectors; it is not available for computer services.

2.2 Steps of the multivariate data analysis

To ensure as much comparability as possible, the multivariate data analysis of the services trade restriction indices for each of the five business services sectors in 2018 is performed in the same way.

First, some summary descriptive statistics are presented to give an idea of the magnitude and dispersion of each indicator across the 25 EEA countries. In order to look more closely at the details in the second step, the scores of each indicator are then displayed graphically. For the OECD STRI, the different versions of the sub-indices for service trade restrictiveness within the EEA and vis-à-vis the rest of the world are summarised in one graph. In the third step, the correlations between the included indicators are calculated and displayed in a matrix. In order to reveal the hidden structures and patterns among the multitude of correlation coefficients, hierarchical clustering with the complete linkage method is used to order the correlation coefficients in this matrix.

After having described the total number of indices of service trade restrictiveness graphically and by statistical measures in the first three steps, in the fourth step principal component analysis serves to approximate these indicators by a smaller number of linear combinations (the "principal components" or "factors") that are as meaningful as possible. This analysis has two purposes. On the one hand, it can help to better understand the latent factors behind the various types of restrictions. On the other hand, the principal

components identified also facilitate the graphical representation of the clusters of countries determined in the fifth step, which among them show great similarities in terms of their service trade restrictions.

More formally, the goal of principal component analysis is to find for p variables X_1, X_2, ..., X_p combinations of them, which determine the indices Z_1, Z_2, ..., Z_p such that they are uncorrelated and ordered such that their variances decrease, i.e. $\mathrm{Var}(Z_1) \geq \mathrm{Var}(Z_2) \geq ... \geq \mathrm{Var}(Z_p)$.[2] The absence of correlation between the indices implies that they measure different dimensions of the original data. If both properties are fulfilled, these indices are called principal components, and it is desirable that a few principal components explain most of the variation in the overall data and the rest of them can be neglected. This will be the case if at least some of the original variables are significantly correlated.

The first principal component is the linear combination of the original variables

$$Z_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1p}X_p \tag{1}$$

which subject to the condition

$$a_{11}^2 + a_{12}^2 + \cdots + a_{1p}^2 = 1 \tag{2}$$

maximises $\mathrm{Var}(Z_1)$.

The second principal component

$$Z_2 = a_{21}X_1 + a_{22}X_2 + \cdots + a_{2p}X_p \tag{3}$$

is then determined subject to the condition

$$a_{21}^2 + a_{22}^2 + \cdots + a_{2p}^2 = 1 \tag{4}$$

such that Z_2 has the maximal variance out of all linear combinations that are uncorrelated with Z_1. All further principal components are determined by continuing in the same way.

The coefficients a_{ij} of this linear system of equations (Z_1, Z_2, ..., Z_p) are called loadings of the principal components, because they indicate how strongly a principal component reacts to a certain variable, or in technical jargon, how strongly a variable loads on a principal component. For the original variables, the loadings and the variances of the principal components can be determined via the eigenvectors and eigenvalues of their variance-covariance matrix. However, it rarely makes sense to use the original values of the variables for a principal component analysis, because the variables with the greater variance then dominate the principal components.[3] Therefore, the original values are usually standardised before the analysis so that each variable has a mean of zero and a variance of one.

After standardisation, the variance-covariance matrix corresponds to the correlation matrix of the original (and of course the standardised) variables that has the form

$$\mathbf{C} = \begin{bmatrix} 1 & c_{12} & \cdots & c_{1p} \\ c_{21} & 1 & \cdots & c_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ c_{p1} & c_{p2} & \cdots & 1 \end{bmatrix} \tag{5}$$

where $c_{ij} = c_{ji}$ is the correlation between variables X_i and X_j. The variances of the principal components are given by the eigenvalues of matrix $\mathbf{C}$. There are p eigenvalues and assuming that they are ordered as $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_p$, then the eigenvalue λ_i refers to the principal component Z_i. In general, the sum of these eigenvalues is equal to the sum of the elements on the main diagonal of the matrix $\mathbf{C}$, thus in the case of a correlation matrix

$$\lambda_1 + \lambda_2 + \cdots + \lambda_p = p, \tag{6}$$

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[2] The following brief description of the principal component analysis is based on Manly and Navarro Alberto (2017), p. 103-107. An application-oriented description also can be found in James et al. (2017), p. 374-385.

[3] Only in a few cases, when it can be assumed that the variance of a variable reflects its importance, does it make sense not to standardise the original values.

i.e. the sum of the variances of the principal components is equal to the sum of the variances of the standardised variables.[4] For example, if the first eigenvalue is $\lambda_1 = 4$, the first principal component has the variance of four original variables, which each has a value of one after standardisation. For this reason, further analyses often only consider those principal components that have an eigenvalue greater than one. Finally, the loadings of the principal components are the corresponding eigenvectors $\mathbf{a}_1$, $\mathbf{a}_2$, ..., $\mathbf{a}_p$ of the eigenvalues λ_1, λ_2, ..., λ_p, i.e. the coefficients of the principal component Z_i are the elements of $\mathbf{a}_i$.

In a fifth step, cluster analysis is used to form subgroups of EEA countries so that the members of a subgroup are as similar as possible in terms of the different facets of their service trade restrictiveness and at the same time the differences between the subgroups are as great as possible.[5] K-means clustering is a simple and commonly used technique to divide a dataset into K subgroups (clusters). In this procedure, the number of clusters to be formed must be specified ex ante and each cluster is defined by its centre (centroid), which corresponds to the mean of the data points assigned to this cluster.

There are several k-means algorithms, but the basic idea is always to determine the clusters in such a way that within-cluster variation is minimised. The standard algorithm of Hartigan-Wong (1979) defines the total within-cluster variation as the sum of squared Euclidean distances (or simply the sum of the squares) between data point x_i and the corresponding centroid μ_k, $k = 1, ..., K$:

$$W(C_k) = \sum_{x_i \in C_k} (x_i - \mu_k)^2. \tag{7}$$

Each data point x_i is allocated to a given cluster such that the sum of square distances of the data points to their cluster centre μ_k is minimised. The k-means algorithm starts by randomly selecting K objects (e.g. countries) from the data set to serve as the initial centroids for the clusters. Next, each of the remaining objects is allocated to its closest centroid, where closest is defined using the Euclidean distance between the object and the cluster centroid. Then, the algorithm computes the new centroid of each cluster and afterwards each data point is checked again to see if it might be closer to a different cluster. All the objects are reassigned again using the updated cluster centroids. The cluster assignment and centroid update steps are iteratively repeated until the cluster assignments stop changing. This procedure minimises the total within-cluster sum of squares

$$\sum_{k=1}^{K} W(C_k) = \sum_{k=1}^{K} \sum_{x_i \in C_k} (x_i - \mu_k)^2. \tag{8}$$

However, there is a risk that this is only a local minimum. To reduce the risk of getting stuck in a local minimum, the algorithm can simply be run several times and only keep the result that has the lowest within-cluster sum of squares. In our case, each cluster analysis is performed twelve times.

As k-means clustering requires the number of clusters to be determined ex ante, it would be desirable to be able to select the optimum number of clusters according to a criterion. The first frequently used criterion is the elbow criterion. This is the (visual) identification of a "bend" (elbow) in the change of the total within-cluster sum of squares with increasing number of clusters. The number of clusters belonging to this "bend" is regarded as the appropriate one. The absence of a clear "bend" can be interpreted as an indication of a two-cluster solution.

A further criterion is provided by the average silhouette method, which allows the quality of the clustering to be assessed. The silhouette value measures how similar an object is to its own cluster compared to other clusters. They range from −1 to +1, where a high value indicates that the object is well matched to its own cluster and poorly matched to neighbouring clusters, and the selection criterion is based on the average silhouettes of the objects for different values of K. The optimal number of clusters K is the one that maximizes the average silhouette over a range of possible values for K.

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[4] In the case of non-standardised values, it would be the sum of the variances of the original variables. Thus, the principal components always capture the total variation in the original data.
[5] A comprehensive introduction to the methods of cluster analysis is provided by Kaufman and Rousseeuw (2008). A more application-oriented description can be found in James et al. (2017), 385-401.

3   Empirical results for computer services

According to the OECD STRI definition, computer services include computer programming, consultancy and related activities as well as information service activities (ISIC 62 and 63). These services are mainly traded business to business (OECD, 2018c). In 2017, the total imports of telecommunications, computer, information and audio-visual services of the EEA countries (27 EU countries plus Iceland, Norway and the United Kingdom) by all four modes of trade in services amounted to 643 billion euro.[6] 76% of these imports is traded by mode 3 (commercial presence in the foreign country), 20% is traded by mode 1 (cross border provision) and 4% is traded by mode 4 (temporary movement of people), while trade by mode 2 (consumption abroad) is negligible. Although imports of these services by mode 3 dominate in almost all EEA countries, the shares vary from 38% for Belgium to 95% for Ireland. Conversely, the shares for mode 1 imports range from 4% for Ireland to 51% for Belgium. Import shares for Mode 4 differ between 1% for Ireland and 11% for Luxemburg.

The descriptive statistics in Table 1 show that the restrictions on trade in computer services within the EEA are generally very low. This is true for the means and median values of foreign entry restrictions, barriers to competition and regulatory transparency, but also for the maximum values. With a possible range between zero and one, all three indicators have in 2018 maximum values below 0.1. For the other two STRI sub-indices (restrictions on the movement of people and other discriminatory measures), all scores are zero, so that they do not appear in Table 1.

Table 1. Descriptive statistics of STRI restrictions for computer services in 2018. Source: own elaboration based on OECD STRI data.[7]

Variable	Mean	Median	Std. Dev.	Min	Max
Foreign entry restrictions EEA (eea_entry)	0.001	0.000	0.004	0.000	0.014
Barriers to competition EEA (eea_comp)	0.015	0.016	0.009	0.000	0.032
Regulatory transparency EEA (eea_trans)	0.025	0.019	0.025	0.000	0.075
Foreign entry restrictions RoW (all_entry)	0.046	0.041	0.027	0.014	0.151
Movement of people RoW (all_people)	0.082	0.082	0.031	0.033	0.148
Other discriminatory meas. RoW (all_odis)	0.022	0.014	0.015	0.000	0.042
Barriers to competition RoW (all_comp)	0.015	0.016	0.009	0.000	0.032
Regulatory transparency RoW (all_trans)	0.056	0.056	0.029	0.018	0.131

Regarding restrictions vis-à-vis the rest of the world, the values of the descriptive statistics are higher for almost all indicators. The only exception are the barriers to competition, where for all EEA countries there is no difference between the restrictiveness within the EEA and with respect to the rest of the world. In terms of the means, the restrictions on the movement of people are the greatest, followed by the lack of regulatory transparency and restrictions on foreign entry. The same applies to the maximum values. OECD (2018c) points out that although computer services can easily be traded over the Internet, trading by mode 1 must be supported by visits from technical support and consultants. This complementarity between mode 1 trade and movement of individuals, together with the skilled labour intensity, would explain why restrictions on the movement of people are relatively popular in computer services. Nevertheless, the descriptive statistics in summary give the impression that the computer service trade restrictions for third countries are also relatively low.

The descriptive statistics can of course only give a very rough impression of the differences between the individual EEA countries via the standard deviations and the extreme values. Therefore, the individual indicators for the EEA countries are presented graphically. Figure 1 shows the STRI restrictions on foreign entry in 2018. Firstly, it is striking that only Germany and Latvia still have marginal restrictions on foreign entry of computer services firms from other EEA countries. As these are the only two countries with small non-zero scores for this index, it will not be considered in the further analysis of computer services trade

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[6] These and the following own calculations are based on the TISMOS (Trade in services by GATS modes of supply) database of the WTO. Rueda-Cantuche et al. (2016) provide a description of this database. The TISMOS database only contains information for all four modes of service trade for the broader aggregate "telecommunications, computer, information and audiovisual services".

[7] The source for all data in the following figures is the OECD. The calculations based on these data are own calculations. In order to save space, the following figures and tables do not repeat this information continuously.

restrictions. Regarding entry restrictions vis-à-vis the rest of the world, Iceland, but also Sweden and Finland have relatively high scores. The scores of the remaining countries are very moderate.

Figure 1. STRI restrictions on foreign entry for computer services within the EEA and with respect to the rest of the world (RoW) in 2018.
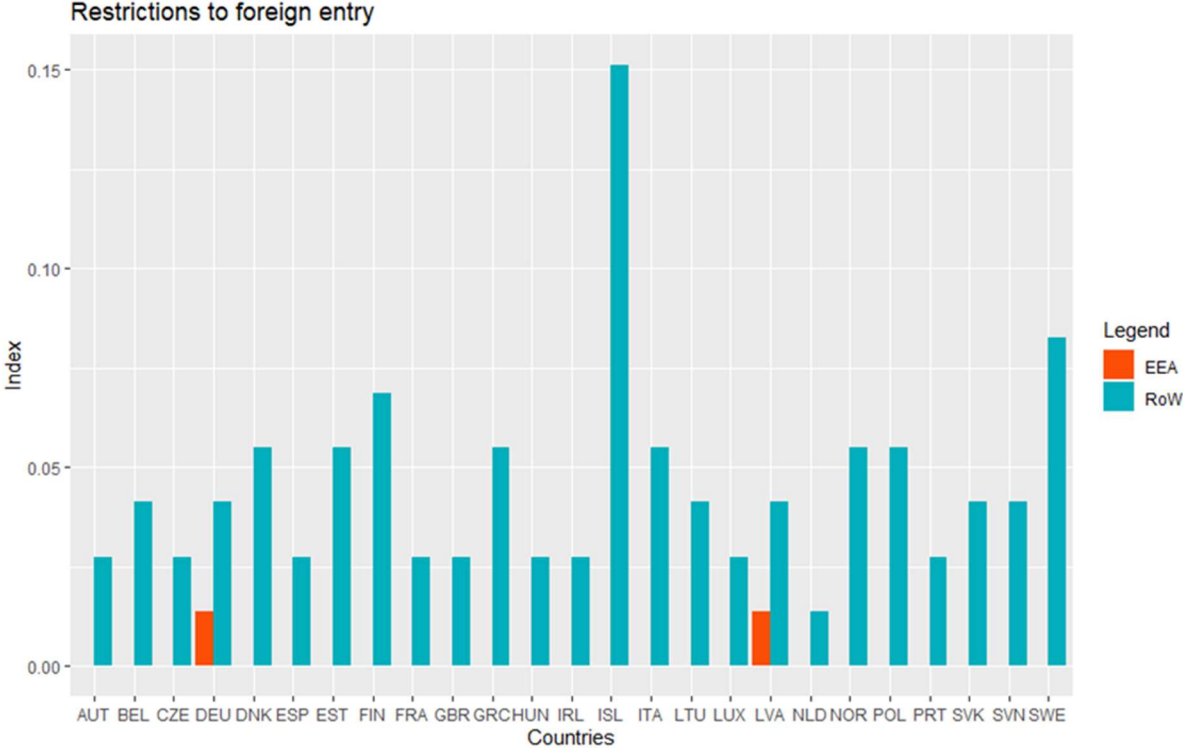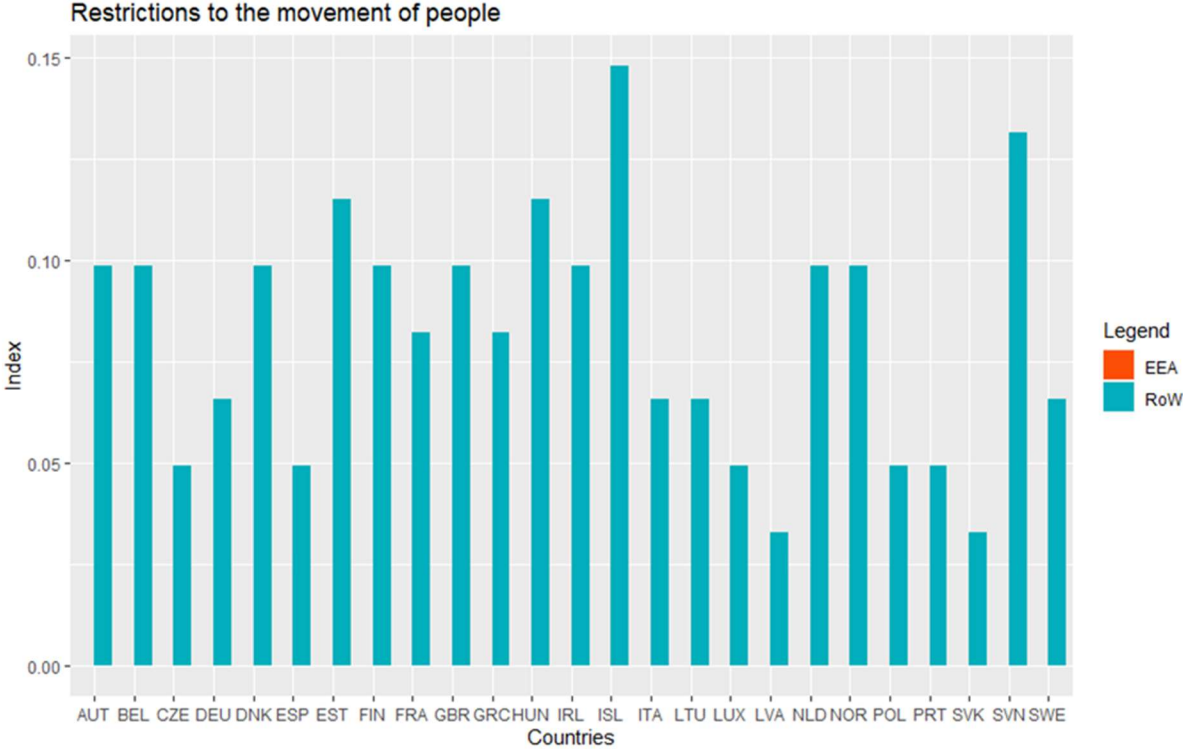

Figure 2. STRI restrictions on the movement of people for computer services within the EEA and with respect to the rest of the world (RoW) in 2018

In terms of restrictions on the movement of people, which only exist vis-à-vis the rest of the world, Iceland, Slovenia, Estonia and Hungary have the highest scores (see Figure 2). However, several other countries are also relatively restrictive in this area, although their index scores do not exceed 0.1. An index score of 0.05 or less is reported for seven EEA countries.

Figure 3. STRI other discriminatory measures for computer services within the EEA and with respect to the rest of the world (RoW) in 2018
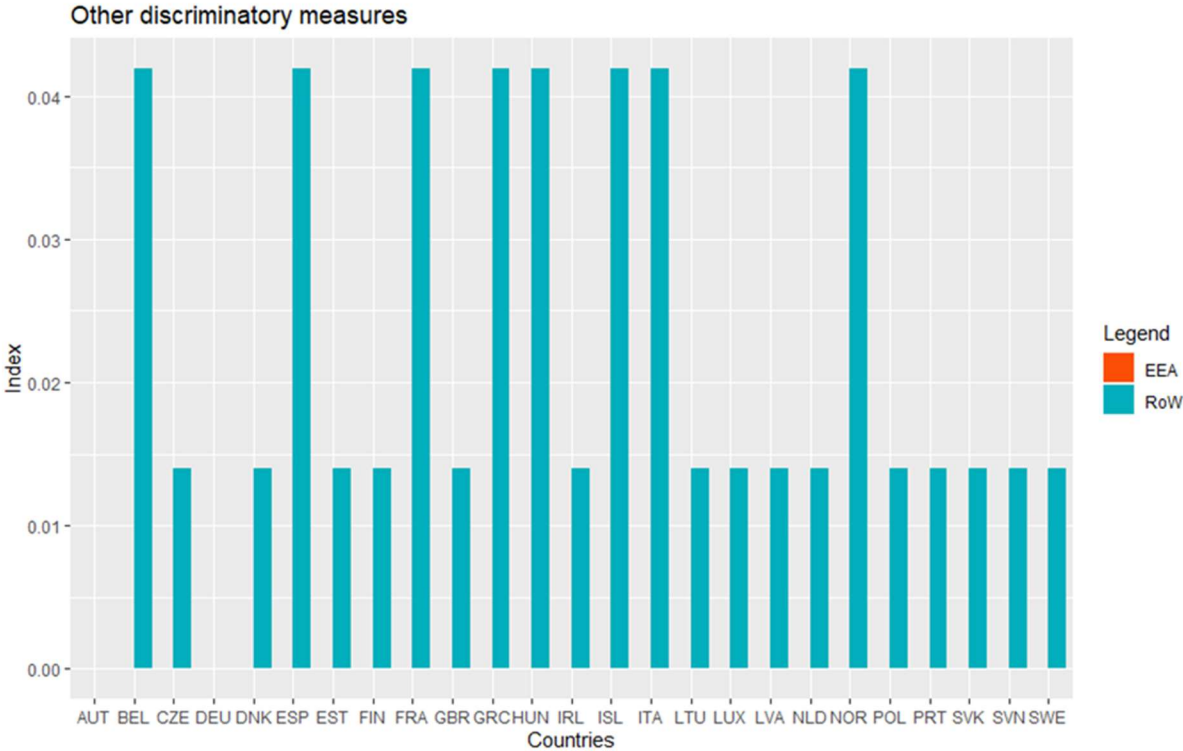
The other discriminatory measures against third countries are of negligible little importance (see Figure 3). The sub-indices have only three scores. For Austria and Germany, it is zero, the other extreme is the score 0.042, which is realised by Belgium, France, Greece, Hungary, Iceland, Italy, Norway and Spain. The other EEA countries have a score of 0.016. The overall very low sub-indices for barriers to competition also show only three scores, 0.032 for Greece, Iceland and Italy, zero for Germany and Ireland, and 0.016 for all other EEA countries (see Figure 4).

Although the regulations of the EEA countries, both vis-à-vis other EEA countries and the rest of the world, are far from being completely non-transparent, there are still some deficiencies in regulatory transparency (see Figure 5). Austria, Belgium, Luxembourg and Spain stand out negatively, while Denmark, France, Ireland, Latvia and Slovenia have complete transparency towards other EEA countries and the greatest possible transparency towards third countries.

Figure 4. *STRI barriers to competition for computer services within the EEA and with respect to the rest of the world (RoW) in 2018*
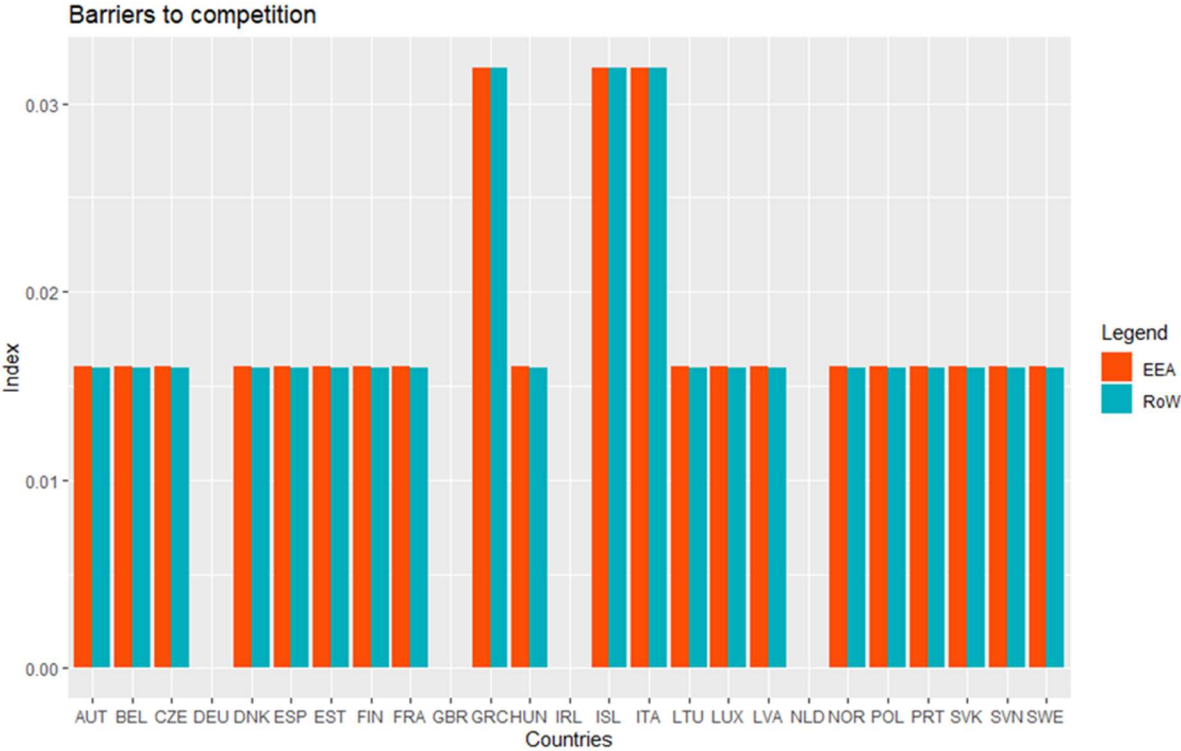

Figure 5. *STRI regulatory transparency for computer services within the EEA and with respect to the rest of the world (RoW) in 2018*
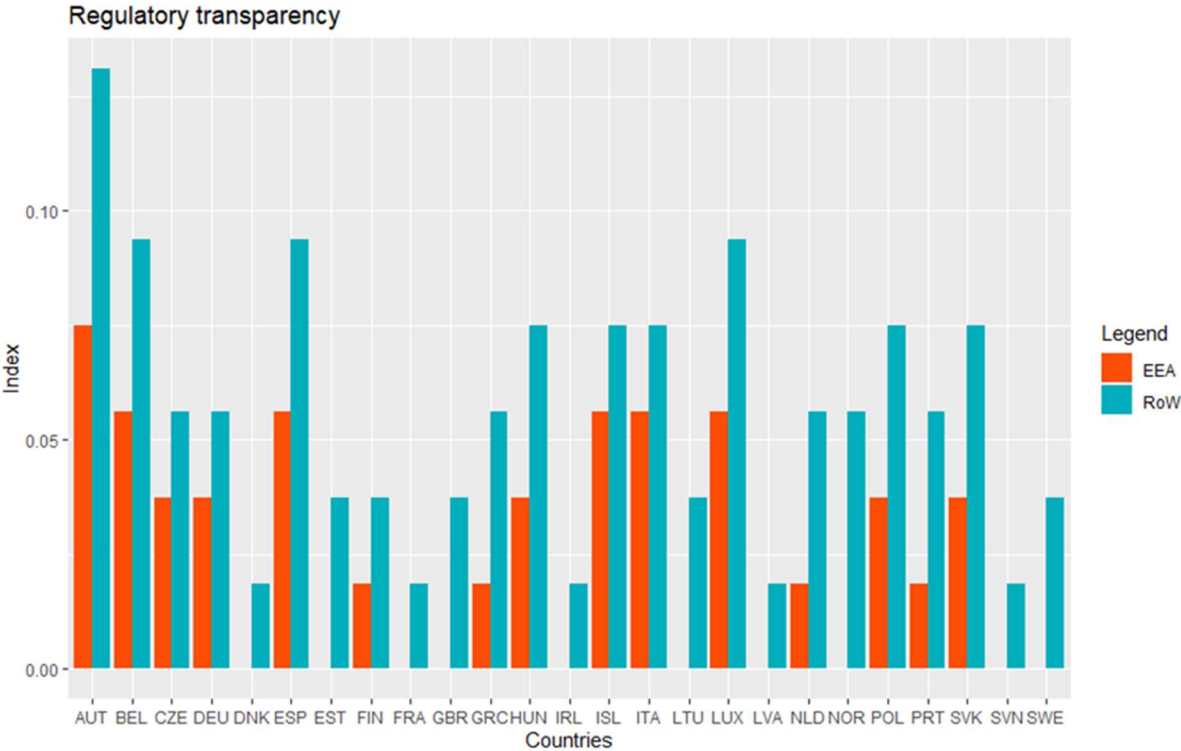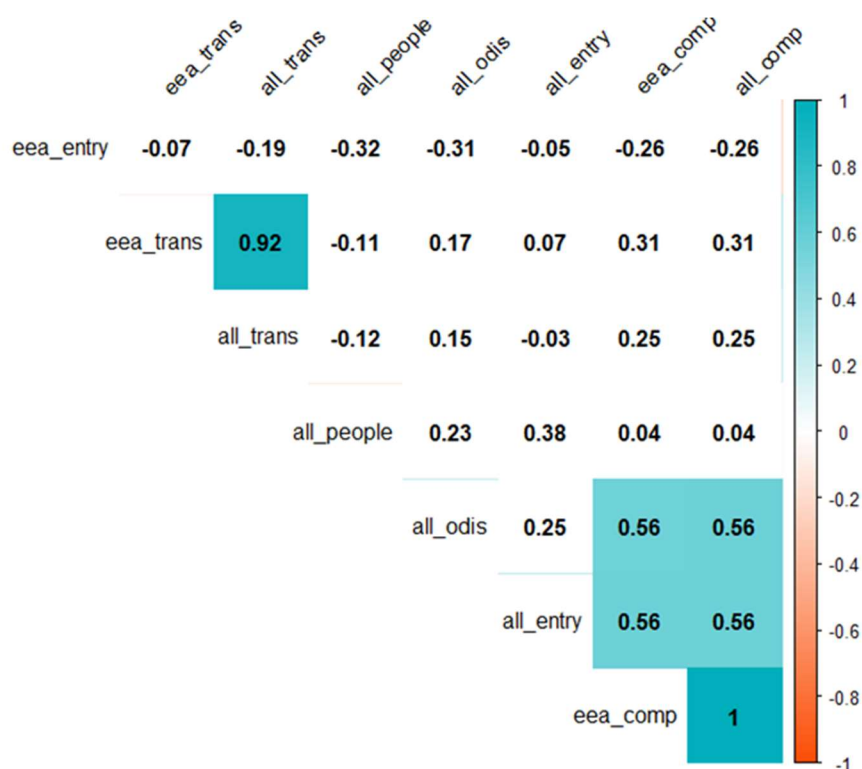
Figure 6. Correlation matrix for the computer services' STRI indicators (coloured cells highlights statistical significance of a correlation coefficient with α < 0.05)

The correlation matrix in Figure 6 shows two things. First, there is a remarkably high correlation between regulatory transparency within the EEA and the regulatory transparency of these countries vis-à-vis the rest of the world. Second, there are statistically significant correlations (with a level of significance α < 0.05) between foreign entry restrictions and barriers to competition, which are the same for other EEA countries and the rest of the world. Moreover, there is also a significant correlation between the other discriminatory measures and the barriers to competition. The correlation coefficient of one for the restrictions on competition vis-à-vis EEA countries and the rest of the world only confirms that both variables are equal.

Table 2. Results of the principal component analysis for the computer services' STRI indicators

| Principal component	1	2	3	4	5	6
Eigenvalue	2.347	1.767	0.868	0.716	0.226	0.076
Share of the variance explained	0.391	0.294	0.145	0.119	0.038	0.013
Cumulated share	0.391	0.686	0.830	0.950	0.987	1.000
	Eigenvectors (coefficients of the principal components)					
eea_trans	-0.493	0.439	-0.230	0.066	-0.088	0.706
all_entry	-0.332	-0.475	-0.101	0.618	-0.513	-0.092
all_people	-0.095	-0.466	-0.774	-0.266	0.319	0.036
all_odis	-0.405	-0.278	0.298	-0.714	-0.400	0.004
all_comp	-0.510	-0.241	0.428	0.179	0.683	0.001
all_trans	-0.462	0.479	-0.256	-0.032	-0.007	-0.701

Note: The eigenvalues are the variances of the principal components. The eigenvectors give the coefficients of the standardised variables (eea_trans etc.) used to calculate the principal components.

The correlations between the six different sub-indices of computer services trade restrictions suggest that they can be approximated by less than six principal components that capture a substantial part of the variation in the original variables. The results of the principal component analysis in Table 2 confirm this assumption. With an eigenvalue of 2.347, the first principal component covers the variance of 2.347 original variables, while the second principal component still captures that of 1.767 original variables. The first principal component thus explains 39.1% of the total variance and the second principal component 29.4%. Together, these two components capture 68.6% of the variance. The third principal component, however, with an eigenvalue of 0.868, grasps less than the variance of a standardised original variable. The screeplot in the left panel of Figure 7 also suggests that only the first two principal components should be included in the further analysis, since the strongest decrease in the explained variance occurs between the second and third principal component.

The lower panel in Table 2 and the biplot in the right panel in Figure 7 show how strongly the original variables load on the principal components. The upper horizontal scale and the right vertical scale of the biplot are the loadings of the first and second principal component and the arrows show how much the various original variables load on these two principal components. For example, the regulatory transparency within the EEA (eea_trans) loads with -0.493 on the first principal component and 0.439 on the second principal component. The coefficients in the lower panel of Table 2 show the same thing.[8]

By examining the coefficients of the principal components (component loadings) in Table 2, it can be concluded that the first principal component roughly corresponds to the overall computer services trade restrictiveness of the EEA countries, with restrictions on the movement of people playing only a minor role. This indicates that EEA countries with relatively high index scores for one kind of restrictions tend to have relatively high scores for the other kinds of restrictions (except for the restrictions on the movement of people). The second principal component mainly contrasts regulatory transparency within the EEA and towards third countries with all other restrictions. This is also obvious from the biplot in Figure 7, where the two indicators of regulatory transparency are located far apart from the other indicators.

Figure 7. Screeplot of the explained variance and biplot of the factor loadings for the computer services' STRI indicators

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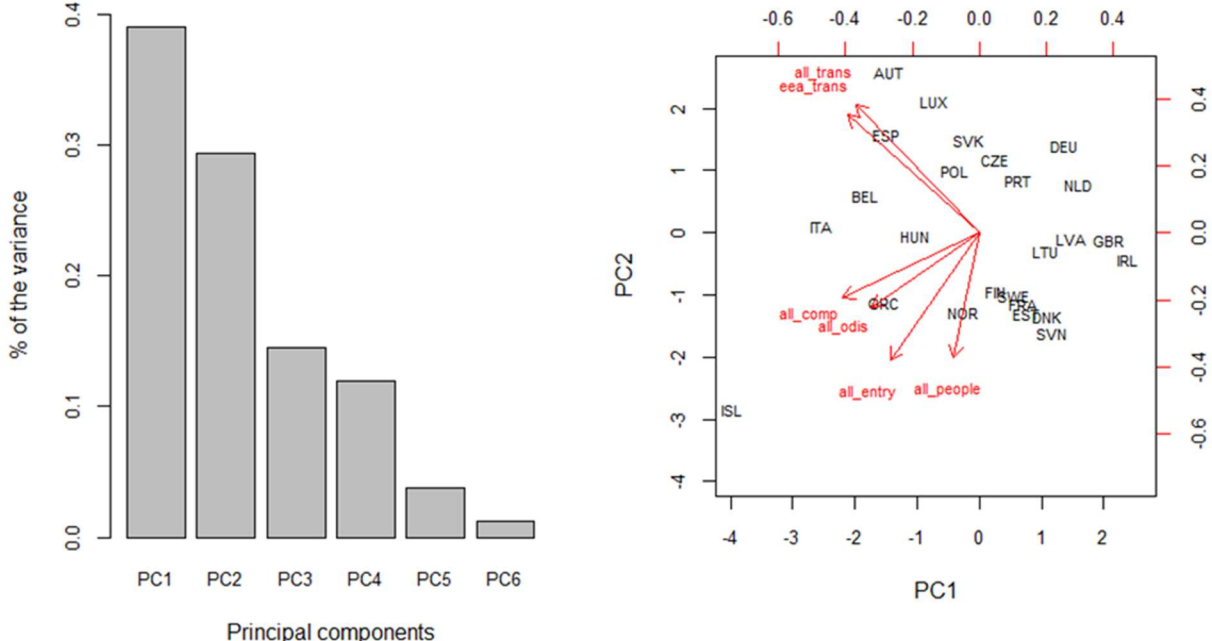
8   Depending on the software used, the signs of the eigenvectors (loadings) point in different directions. In the software R used here, they point by default in the negative direction.

The biplot in Figure 7 also shows the country-specific scores for the first two principal components, with those of the first principal component being plotted along the horizontal lower axis and those of the second principal component along the vertical left axis. This part of the graph can be better interpreted after the following cluster analysis for the original data.

Table 3. *Results of the k-means clustering for the computer services' STRI indicators with K = 2*

Cluster	1	2
Cluster members	CZE, DEU, DNK, EST, FIN, FRA, GBR, IRL, LTU, LVA, NLD, NOR, PRT, SVN, SWE	AUT, BEL, ESP, GRC, HUN, ISL, ITA, LUX, POL, SVK
Cluster means		
eea_trans	−0.649	0.974
all_entry	−0.128	0.193
all_people	0.057	−0.086
all_odis	−0.345	0.517
all_comp	−0.421	0.631
all_trans	−0.643	0.965
Within cluster sum of squares (SS)	56.71	44.11
Between SS/total SS	30.0 %	

Table 3 displays the results of the k-means clustering for the indicators of computer services trade restrictiveness with $K = 2$ clusters. The first cluster contains those 15 EEA countries with relatively low values of the standardised restrictiveness indices (i.e. these variables have an overall mean of zero and an overall standard deviation of one). The cluster means for almost all indices are below zero. The reverse applies to the second cluster. There, the countries with relatively high scores for almost all indices are gathered, the cluster means are greater than zero. The only exception in both clusters are the restrictions on the movement of people. Here, both cluster means are close to zero, so that the division into two clusters does not show a great discriminatory power with respect to this indicator. The biggest differences between the two clusters are in the regulatory transparency within the EEA and towards the rest of the world. There are also clear differences between the clusters in terms of other discriminatory measures and barriers to competition, which are however irrelevant in terms of absolute (non-standardised) index scores. Overall, however, the division of countries into two clusters still leaves a large amount of variation within the cluster, with only 30% of the variation being between the two clusters.

Figure 8 confirms this finding. It shows the two clusters, with countries plotted according to the first two principal components of the original data. The first principal component is plotted along the horizontal axis, the second along the vertical axis. It is obvious that the division into two clusters is mainly based on the first principal component. The first cluster with low cluster means for almost all indicators corresponds to positive scores for the first principal component, which can be interpreted as an overall restrictiveness for computer services trade, where, as mentioned, the signs of the scores are arbitrary depending on the software. The second cluster of more restrictive countries corresponds to negative scores for the first main component.

Thus, only two clusters appear to be insufficient to exploit the available information to classify EEA countries in terms of their computer services trade restrictions. This is also confirmed by the elbow and silhouette criteria, which both indicate that $K = 5$ is the optimal number of clusters (see Figure 9).

Figure 8. *Cluster plot of the EEA countries (k-means, K = 2) for the computer services' STRI indicators*
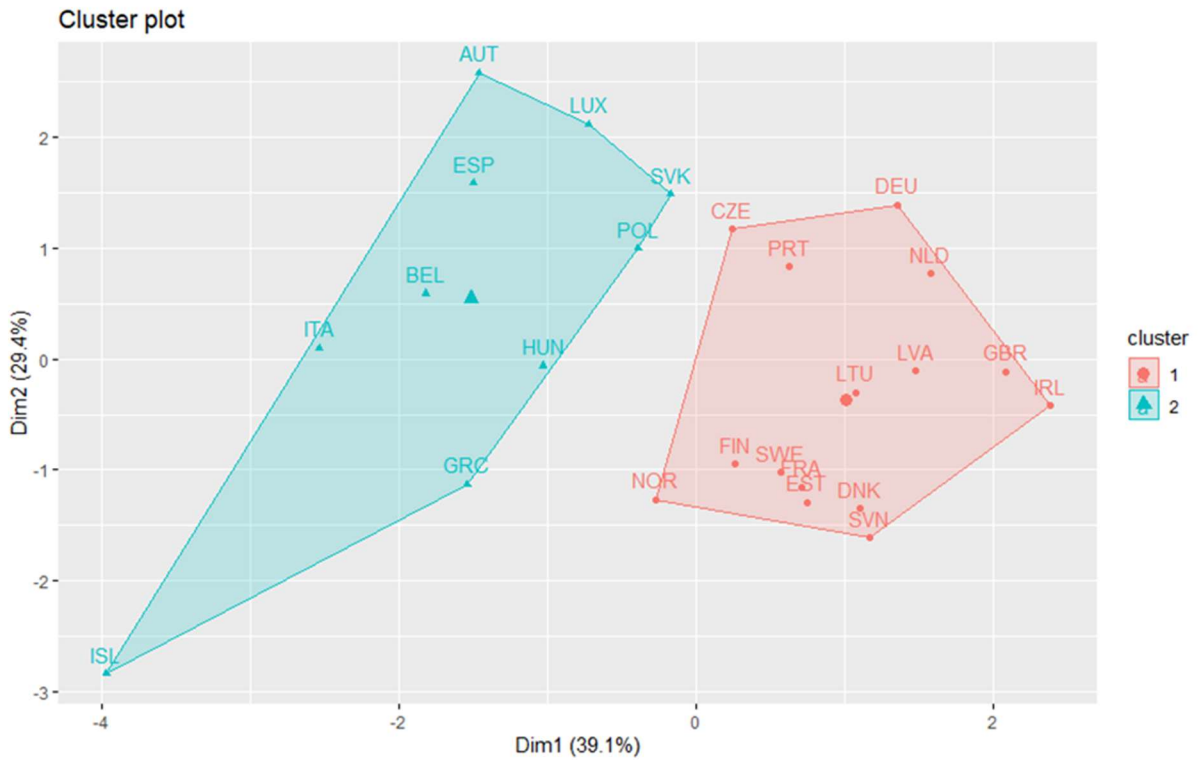

Figure 9. *Selection of the optimal number of clusters for the computer services' STRI indicators according to the elbow method (left panel) and average silhouette method (right panel)*
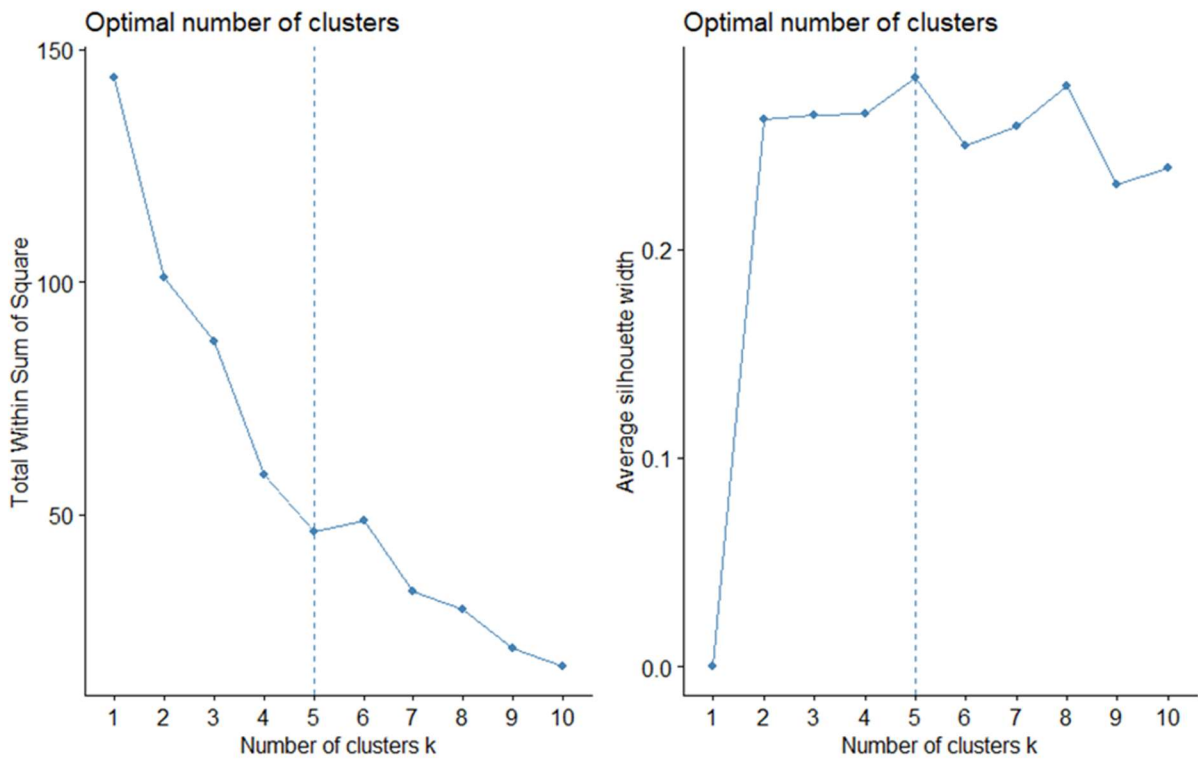
Table 4. *Results of the k-means clustering for the computer services' STRI indicators with K = 5*

Cluster	1	2	3	4	5
Cluster members	DEU, GBR, IRL, NLD	BEL, ESP, GRC, HUN, ITA	AUT, CZE, LUX, POL, PRT, SVK	DNK, EST, FIN, FRA, LTU, LVA, NOR, SVN, SWE	ISL
Cluster means					
eea_trans	−0.434	0.822	0.771	−0.920	1.278
all_entry	−0.669	−0.162	−0.416	0.232	3.892
all_people	0.290	0.022	−0.875	0.201	2.173
all_odis	−0.776	1.379	−0.696	−0.111	1.379
all_comp	−1.783	0.817	0.074	0.074	1.931
all_trans	−0.482	0.772	0.858	−0.858	0.643
Within cluster sum of squares (SS)	4.80	11.07	12.14	18.37	0.00
Between SS/total SS	67.8 %				

The results of this clustering with *K* = 5 clusters are shown in Table 4. The first cluster comprises Germany, Ireland, the Netherlands and the United Kingdom. Almost all cluster means are negative, i.e. below the mean for all EEA countries. The only exception are restrictions on the movement of people, but the cluster mean is still near to the overall mean of zero. This is the cluster with the least restrictive countries regarding trade in computer services, with particular emphasis on the low level of restrictions on the entry of third countries and barriers to competition vis-à-vis third countries.

Figure 10. *Optimal clustering of the EEA countries (k-means, K = 5) for the computer services' STRI indicators*
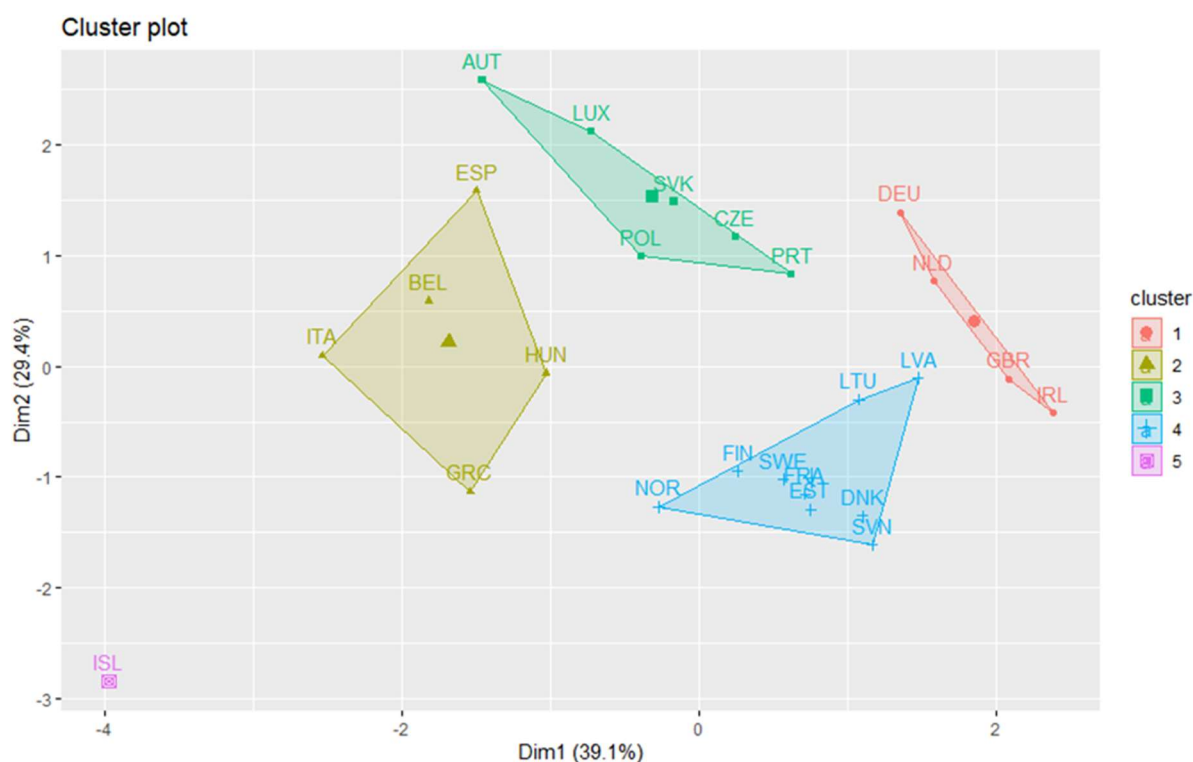
Belgium, Greece, Hungary, Italy and Spain are gathered in the second cluster, which is characterised by relatively strong restrictions in almost all areas. Close to the overall mean are only the cluster means for the restrictions on foreign entry and movement of people towards the rest of the world. The third cluster, comprising Austria, the Czech Republic, Luxembourg, Poland, Portugal and Slovakia, is characterised by a low level of regulatory transparency, while the other restrictions are largely below the overall mean. The reverse is true for the fourth cluster, which is the largest with nine countries. This cluster has a high degree of regulatory transparency, while the cluster means for the other restrictions are close to their overall means. Finally, Iceland alone forms the fifth cluster, which is characterised by relatively extremely high index scores for almost all restrictions. Slightly lower, but still above the overall mean, is only the index score for regulatory transparency vis-à-vis third countries.

Compared to the two-cluster solution, the five clusters are much more homogeneous, with the within cluster sum of squares being lowest for the first cluster (the fifth cluster does not count because it contains only one country). At the same time, the share of the between sum of squares in the total sum of squares has risen to 67.8%. The good discriminatory power of the $K = 5$ clustering is also visible in Figure 10, where the five clusters are shown within the coordinate system of the first two principal components of the standardised original data.

Overall, these results suggest two conclusions. Despite the overall low level of restrictions on computer services trade, there are still two starting points for policy measures. First, the overall restrictiveness should be reduced in the countries of the second cluster and Iceland. Secondly, the countries of the third cluster should make efforts to increase their regulatory transparency. The countries in the fourth cluster could serve as good examples in this respect.

4   Empirical results for accounting services

Accounting, auditing and book-keeping services (ISIC 692) are part of the other business services that are often referred to as professional services. According to OECD (2018a), the international market for accounting services is dominated by a handful of corporations with a high degree of concentration, organised as a network, and generally owned and managed independently with presence in a large number of countries. With respect to the four modes of service trade, information is only available for the broader aggregate of other business services. In 2017, the total imports of other business services of the EEA countries (28 EU countries plus Iceland and Norway) by all four modes of trade in services amounted to 1009 billion euro.[9] 55% of these imports is trade by mode 3 (commercial presence in the foreign country), 34% is trade by mode 1 (cross border provision) and 11% is trade by mode 4 (temporary movement of people), while the trade by mode 2 (consumption abroad) is far less than 1%. Although imports of business services by mode 3 dominate in almost all EEA countries, the shares vary from 11% for Ireland to 75% for the UK. Conversely, the shares for mode 1 imports range from 18% for the UK to 67% for Ireland. Import shares for Mode 4 differ between 4% for Spain and 22% for Ireland.

Table 5. Descriptive statistics of STRI restrictions and FDI regulatory restrictiveness index for accounting services in 2018

Variable	Mean	Median	Std. Dev.	Min	Max
Foreign entry restrictions EEA (eea_entry)	0.040	0.033	0.010	0.033	0.066
Movement of people EEA (eea_people)	0.023	0.020	0.005	0.010	0.030
Barriers to competition EEA (eea_comp)	0.008	0.008	0.004	0.000	0.015
Regulatory transparency EEA (eea_trans)	0.012	0.009	0.012	0.000	0.035
Foreign entry restrictions RoW (all_entry)	0.099	0.100	0.034	0.044	0.177
Movement of people RoW (all_people)	0.120	0.118	0.057	0.030	0.286
Other discriminatory meas. RoW (all_odis)	0.011	0.007	0.007	0.000	0.021
Barriers to competition RoW (all_comp)	0.011	0.008	0.006	0.000	0.023
Regulatory transparency RoW (all_trans)	0.028	0.027	0.015	0.009	0.062
FDI regulatory restrictions (fdi_restr)	0.092	0.000	0.175	0.000	0.613

The descriptive statistics in Table 5 show that the STRI restrictions on trade in accounting services within the EEA are also very low, with foreign entry restrictions on average slightly higher than for computer services. The means do not exceed the index score 0.04 and the maximum values are below 0.07. The STRI restrictions vis-à-vis the rest of the world are larger for all indicators. This is particularly true for the restrictions on foreign entry and on the movement of people. In terms of the means, the restrictions on the movement of people are the strongest, followed by the restrictions on foreign entry and the lack of regulatory transparency. The same applies to the maximum values. The means and maximum values for these restrictions on trade in accounting services are well above those for the corresponding restrictions on trade in computer services.[10] On the contrary, the other discriminatory measures and the barriers to competition vis-à-vis third countries are also very low for accounting services. Finally, although the OECD FDI regulatory restrictiveness index has a relatively low mean and a median of zero, the range of this index is very wide with a maximum value of 0.613. This already indicates that there are a few EEA countries that are rated as very restrictive by this index.

In the next step let us look at the bar plots for each indicator. Figure 11 shows the STRI restrictions on foreign entry in 2018. In terms of these restrictions within the EEA, France, followed by Austria, Belgium and Portugal, stand out with relatively high index scores. These countries and several others (notably Estonia, Greece, Iceland, Italy and Sweden) also have the highest index scores for these restrictions vis-à-vis the rest of the world. At the other end of the scale are the Czech Republic and the Netherlands with low index scores vis-à-vis both other EEA countries and third countries.

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[9]   These and the following own calculations for the broader aggregate of "other business services" are based on the TISMOS (Trade in services by GATS modes of supply) database of the WTO.

[10] OECD (2018a) points out that the restrictions on foreign market entry in accounting and auditing services are hardly on foreign equity limits, but that many countries restrict the ownership of these companies to locally qualified professionals. This is particularly true for auditing services. For example, ownership restrictions are often linked to the requirement that the majority of the board and managers of these companies must be locally qualified.

Figure 11. *STRI restrictions on foreign entry for accounting services within the EEA and with respect to the rest of the world (RoW) in 2018*
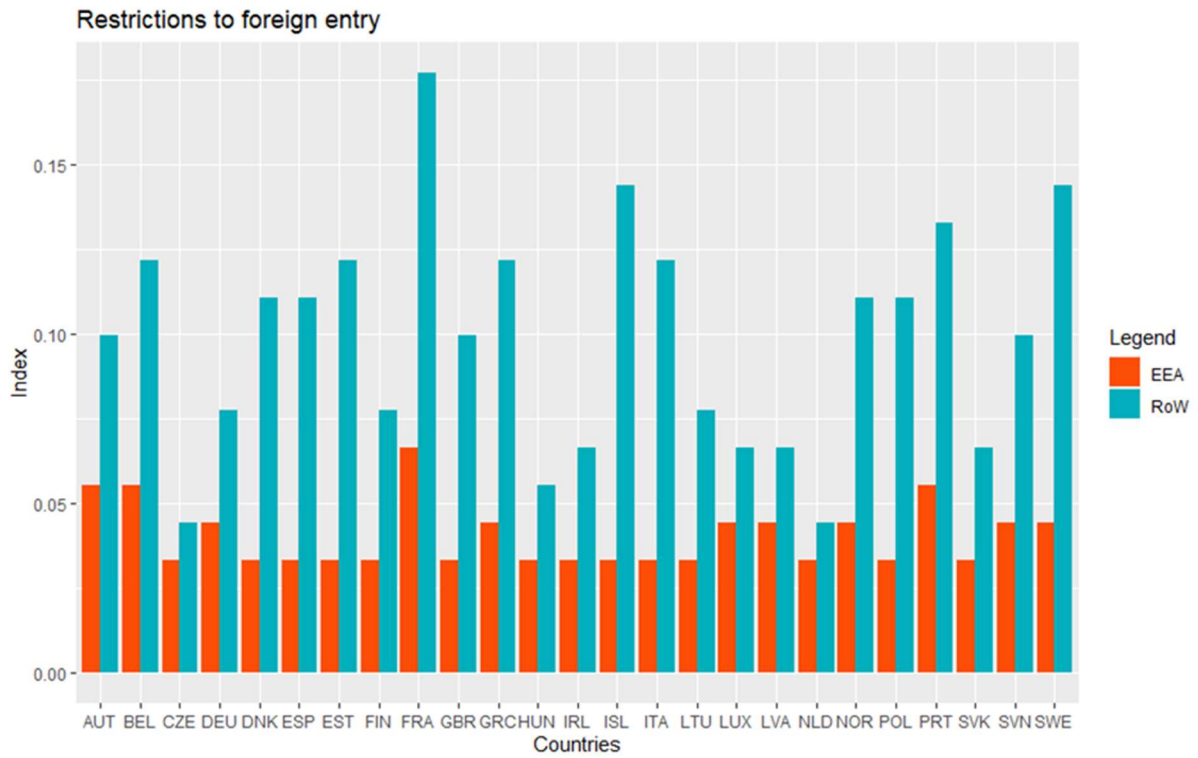

Figure 12. *STRI restrictions on the movement of people for accounting services within the EEA and with respect to the rest of the world (RoW) in 2018*
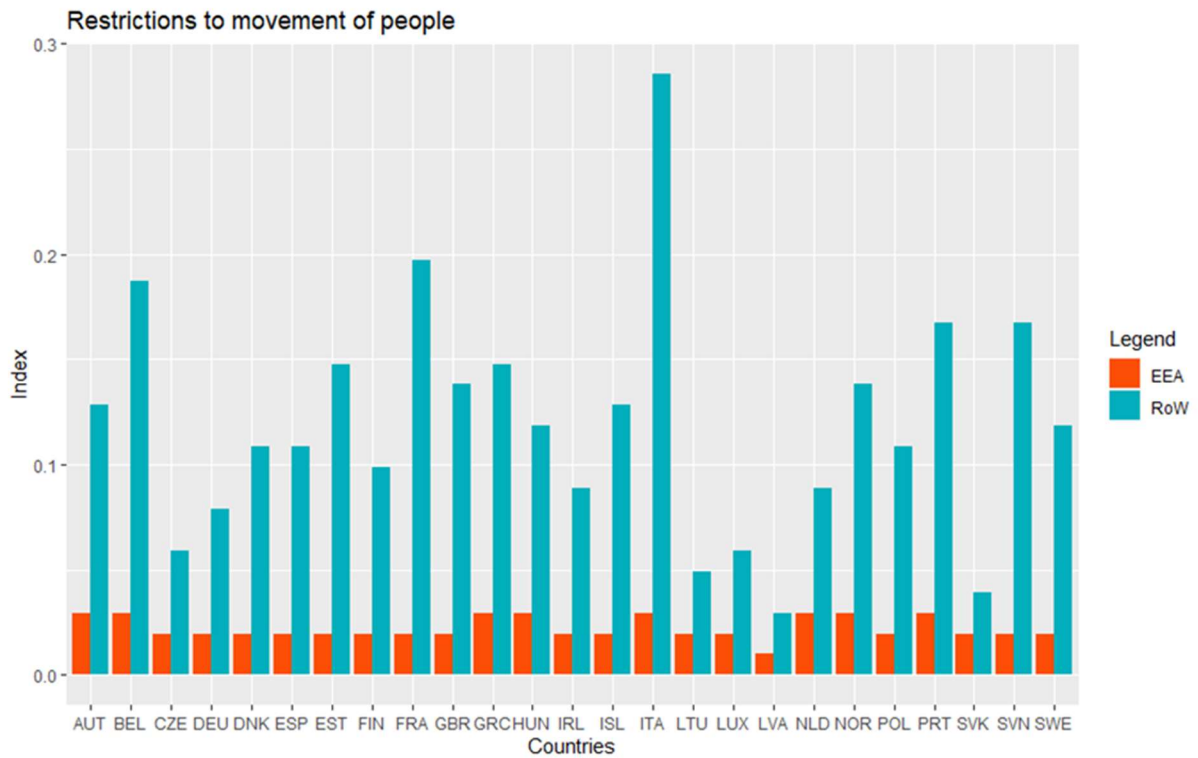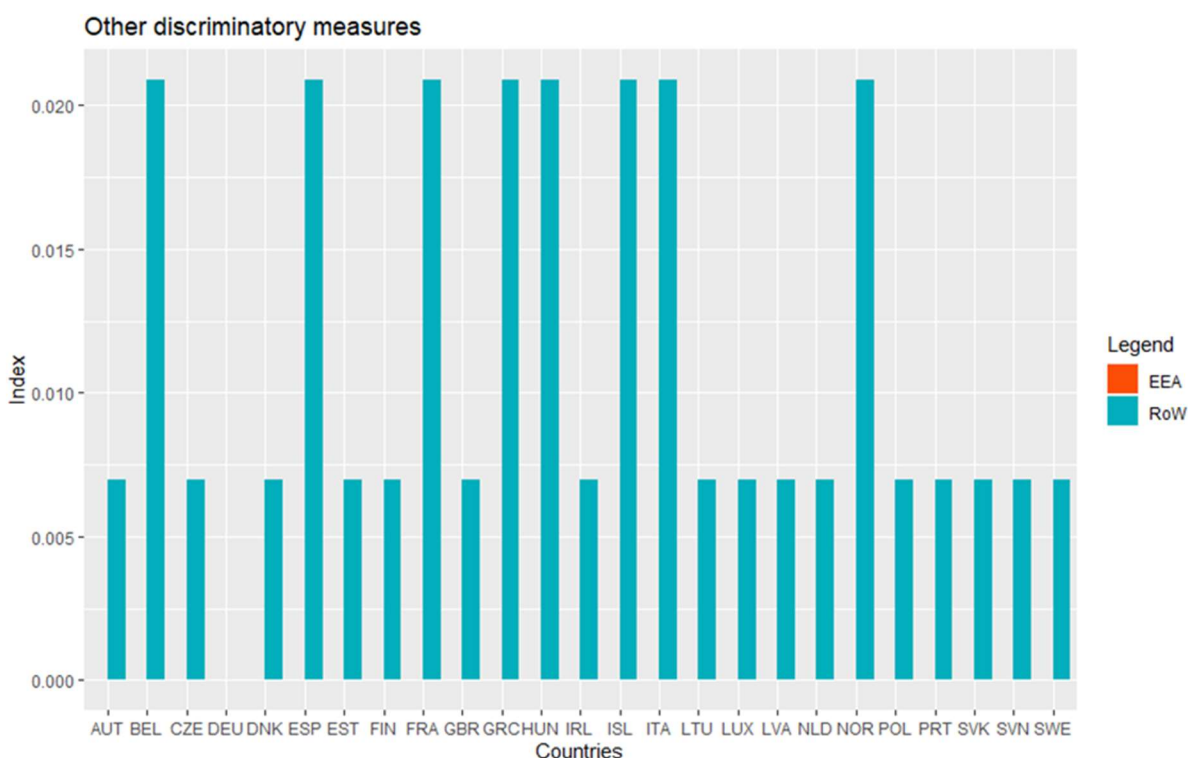
Figure 13. STRI other discriminatory measures for accounting services within the EEA and with respect to the rest of the world (RoW) in 2018

There are no substantial differences between countries in the low restrictions on the movement of people within the EEA (see Figure 12). The situation is different for these restrictions vis-à-vis the rest of the world. Italy is the most restrictive, but Belgium, France, Portugal and Slovenia also have quite high index scores. Only Latvia and Slovakia can be considered as having really low restrictions. Overall, the range of these restrictions vis-à-vis third countries is wide for the EEA countries.

Overall, other discriminatory measures are extremely limited and exist only in relation to third countries (see Figure 13). The EEA countries are divided into two groups plus Germany. At the top end, with an index score of 0.021, are Belgium, France, Greece, Hungary, Iceland, Italy, Norway and Spain, while almost all other countries have an index score of 0.007. Only Germany shines here with a zero.

The barriers to competition are also extremely low (see Figure 14). Germany, Ireland and the Netherlands have no such restrictions at all. The UK has only low barriers vis-à-vis the rest of the world, while Austria, Denmark, Finland, Latvia, Lithuania, Luxembourg, Norway and Slovakia have the same low barriers vis-à-vis both third countries and EEA countries. Another group has the same index scores against EEA countries but twice as high scores against non-EEA countries. Finally, there are Belgium, Iceland, Portugal and Slovenia, which also have twice the index scores towards other EEA countries. Belgium and Slovenia also have even higher barriers to non-EEA countries. However, as mentioned before, this is only a relative comparison; all countries have low barriers in absolute terms.

Although overall regulatory transparency is quite high, Austria, Belgium, Iceland, Italy, Luxembourg and Spain have a somewhat less positive rating of their transparency vis-à-vis other EEA countries (see Figure 15). Together with Hungary, Poland and Slovakia, the lack of regulatory transparency towards third countries is also above average for these countries.

As expected, few countries stand out in the OECD FDI regulatory restrictiveness index with extremely high scores (see Figure 16). These are Austria, Belgium, Denmark and to a much lesser extent Greece and Norway. Otherwise, only Finland, Iceland and Sweden have index scores worth mentioning. For all other EEA countries, the scores are not worth mentioning or zero.

Figure 14. *STRI barriers to competition for accounting services within the EEA and with respect to the rest of the world (RoW) in 2018*
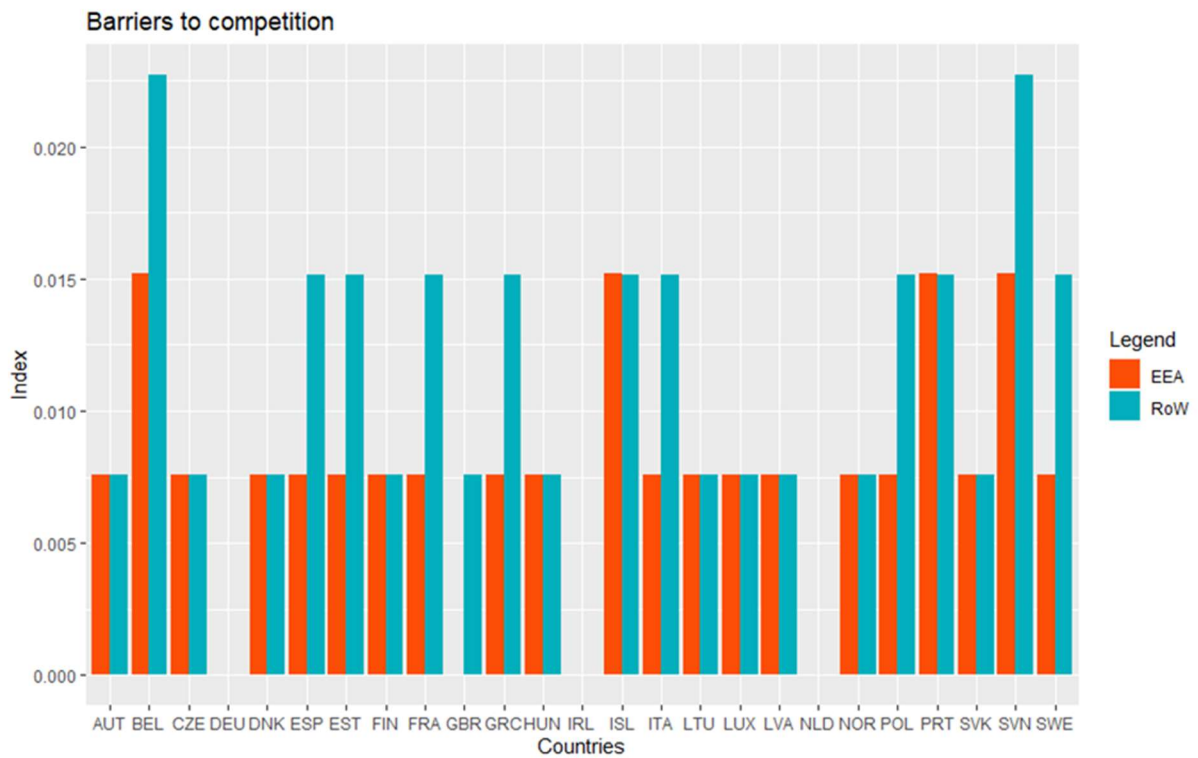
Figure 15. *STRI regulatory transparency for accounting services within the EEA and with respect to the rest of the world (RoW) in 2018*
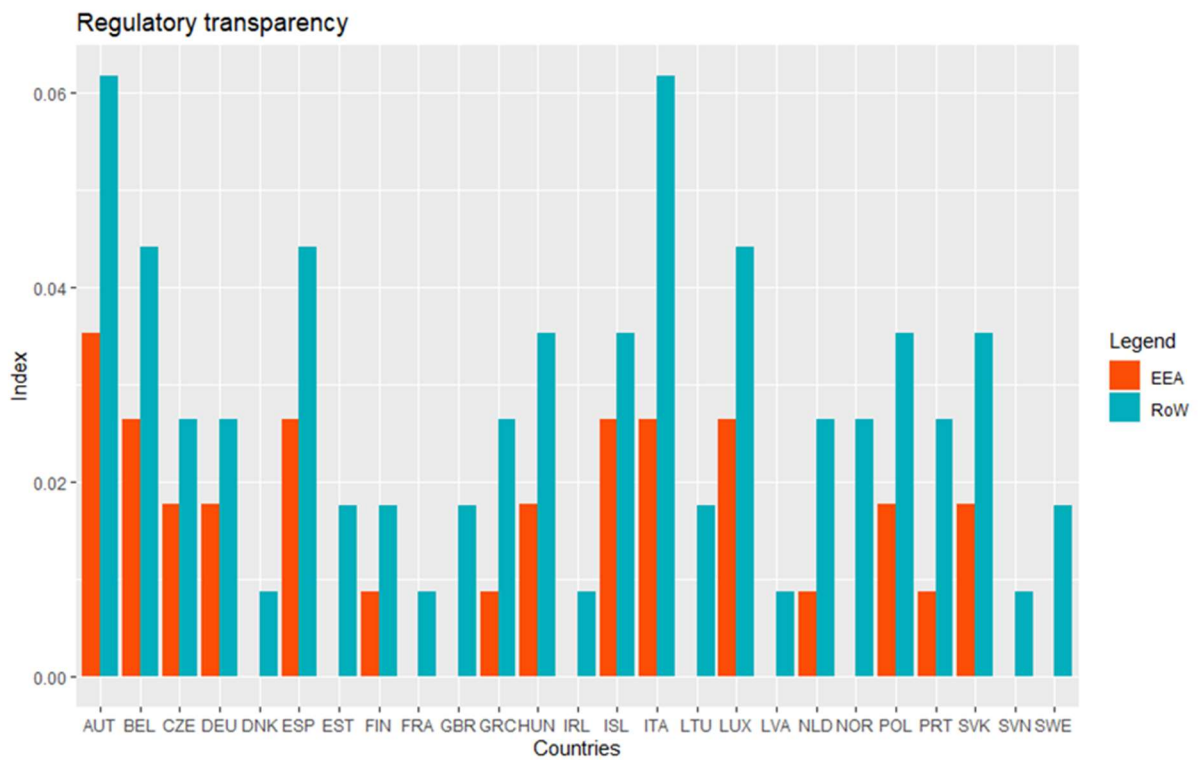
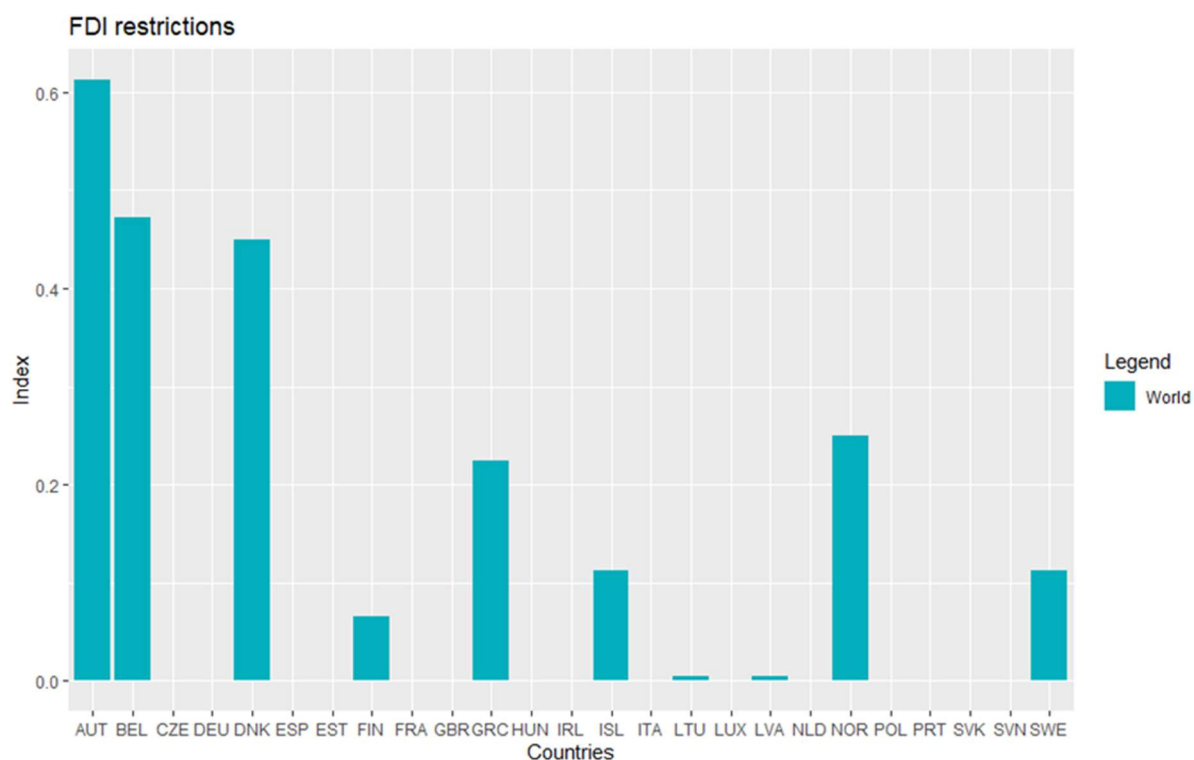***Figure 16.*** *FDI regulatory restrictiveness index for accounting services in 2018*

Figure 17. *Correlation matrix for the accounting services' STRI indicators and FDI regulatory restrictiveness index (coloured cells highlights statistical significance of a correlation coefficient with a < 0.05)*

The correlation matrix in Figure 17 shows that the FDI regulatory restrictiveness index exists in relative isolation. It is only statistically significantly correlated with the restrictions on the movement of people vis-à-vis EEA countries. The correlation matrix also provides several other interesting results. The strongest

correlations are found between the two indicators regarding the lack of regulatory transparency (vis-à-vis other EEA countries and third countries) on the one hand, and between barriers to competition vis-à-vis other EEA countries and third countries on the other hand. For the other two STRI restrictions on foreign entry and movement of people there is also a significant correlation between the scores for other EEA countries and those for third countries. This means that EEA countries that are in a certain restrictive towards third countries are also in this way relatively restrictive towards other EEA countries. It is also striking that the indicators towards other EEA countries are not correlated, while the indicators towards third countries are all significantly correlated, except for regulatory transparency. Thus, for the first four indicators, regulatory strength vis-à-vis the rest of the world tends to point in the same direction, while regulatory transparency is detached from the other indicators. Finally, there are significant correlations between restrictions on the movement of people to other EEA countries and regulatory transparency as well as other discriminatory measures against the rest of the world, and between barriers to competition within the EEA and restrictions on foreign entry vis-à-vis third countries.

The correlations between the different STRI sub-indices of accounting services trade restrictions and the FDI regulatory restrictiveness index suggest that the ten indicators can be approximated by less than ten principal components that capture a substantial part of the variation in the original variables. The results of the principal component analysis in Table 6 confirm this expectation. With an eigenvalue of 3.942, the first principal component covers the variance of almost four original variables, while the second principal component still captures that of 2.104 original variables. The eigenvalues of the third and fourth principal components are just above one, so that they each capture slightly more than the variance of an original variable. After that, the explanatory power of the principal components drops significantly.[11] The screeplot in the left panel of Figure 18 also does not prevent us from considering four principal components in the further analysis. In total, these four principle components capture 81.8% of the total variance of the ten original variables.

Table 6: *Results of the principal component analysis for the accounting services' STRI indicators and FDI regulatory restrictiveness index (first six principal components)*

Principal Component	1	2	3	4	5	6
Eigenvalue	3,942	2,104	1,109	1,028	0,593	0,477
Share of the variance explained	0,394	0,210	0,111	0,103	0,059	0,048
Cumulated share	0,394	0,604	0,715	0,818	0,877	0,925

| Eigenvectors (coefficients of the principal components)						
eea_entry	-0,263	-0,191	-0,499	-0,283	0,569	-0,207
eea_people	-0,296	0,312	-0,319	0,376	-0,173	-0,555
eea_comp	-0,339	-0,180	0,303	-0,452	-0,295	-0,410
eea_trans	-0,215	0,532	0,241	-0,276	0,267	0,167
all_entry	-0,356	-0,366	-0,056	0,072	0,196	0,485
all_people	-0,396	-0,112	-0,025	0,448	0,165	-0,039
all_odis	-0,354	0,029	0,177	0,378	-0,274	0,274
all_comp	-0,384	-0,290	0,340	-0,162	-0,073	-0,103
all_trans	-0,264	0,543	0,162	-0,063	0,234	0,094
fdi_restr	-0,237	0,155	-0,568	-0,345	-0,536	0,350

Note: see Table 2

The examination of the coefficients of the principal components (component loadings) in Table 6 shows that the first principal component roughly corresponds to the overall accounting services trade restrictiveness of

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[11] To save space, only the first six principal components are shown in Table 6. However, as can be seen from the table, the remaining four principal components together explain only 7.5% of the total variance.

the EEA countries, because all coefficients point in the same direction. This indicates that EEA countries with relatively high index scores for one kind of restrictions tend to have relatively high scores for the other kinds of restrictions. The second principal component mainly contrasts regulatory transparency within the EEA and towards third countries as well as restriction to the movement of people from other EEA countries with restrictions on foreign entry and barriers to competition. This is also obvious from the biplot in Figure 18, where the two indicators of regulatory transparency and the indicator for the movement of people within the EEA are located far apart from the indicators for entry and movement of people regulations. The third principal component contrasts, on the one hand, foreign entry and movement of people restrictions as well as the FDI regulatory restrictiveness index, with, on the other hand, barriers to competition, regulatory transparency, with respect to both EEA and third countries, and other discriminatory measures towards third countries. The fourth principal component contrasts intra-EEA foreign entry restrictions and lack of regulatory transparency, all barriers to competition and the FDI regulatory restrictiveness index with all restrictions on the movement of people and discriminatory measures against third countries.

Figure 18. Screeplot of the explained variance and biplot of the factor loadings for the accounting services' STRI indicators and FDI regulatory restrictiveness index
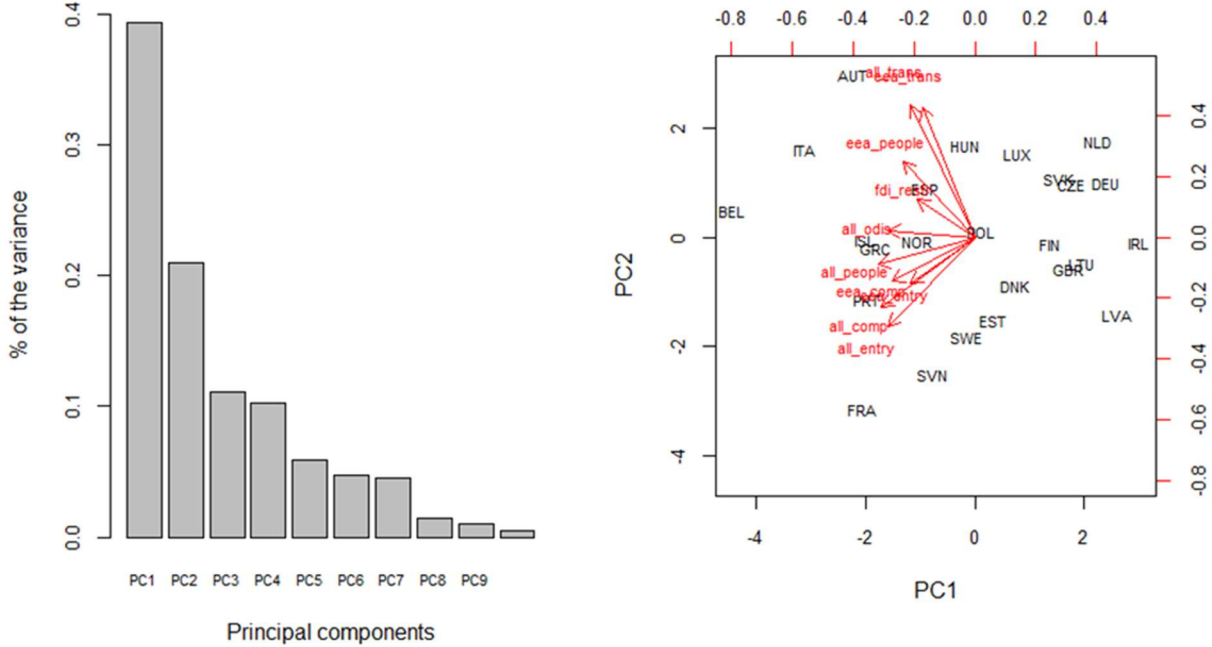
After having just used the principal component analysis to find a low-dimensional representation of the observations for the different indexes that explain a good fraction of the total variance, the next step is to use again the cluster analysis to find homogeneous subgroups of countries among the observations. Table 7 displays the results of the k-means clustering for the indicators of accounting services trade restrictiveness with $K = 2$ clusters. The first cluster contains those 14 EEA countries with relatively low values of the standardised restrictiveness indices (i.e. these variables have an overall mean of zero and an overall standard deviation of one). The cluster means for all indices are below zero. The reverse applies to the second cluster. There, the 11 countries with relatively high values for almost all indices are gathered, the cluster means are greater than zero.

The biggest differences between the two clusters are in the restrictions on foreign entry and the movement of people as well as other discriminatory measures and barriers to competition vis-à-vis third countries. With respect to the absolute (non-standardised) values, however, only the former two are of importance, while the original values of the latter two are very small. The differences between the two clusters are smallest in terms of regulatory transparency, both towards other EEA countries and towards the rest of the world.

Overall, however, the division of countries into two clusters still leaves a large amount of variation within the cluster, with only 29.1% of the variation being between the two clusters.

Table 7. *Results of the k-means cluster analysis for the accounting services' STRI indicators and FDI regulatory restrictiveness index with K = 2*

Cluster	1	2
Cluster members	CZE, DEU, DNK, EST, FIN, GBR, HUN, IRL, LTU, LUX, LVA, NLD, POL, SVK	AUT, BEL, ESP, FRA, GRC, ISL, ITA, NOR, PRT, SVN, SWE
Cluster means		
eea_entry	-0.495	0.630
eea_people	-0.385	0.490
eea_comp	-0.495	0.630
eea_trans	-0.189	0.240
all_entry	-0.629	0.800
all_people	-0.582	0.741
all_odis	-0.529	0.673
all_comp	-0.577	0.735
all_trans	-0.274	0.349
Fdi_restr	-0.315	0.401
Within cluster sum of squares (SS)	67.99	102.16
Between SS/total SS	29.1 %	

Figure 19. *Cluster plot of the EEA countries (k-means, K = 2) for the accounting services' STRI indicators and FDI regulatory restrictiveness index*
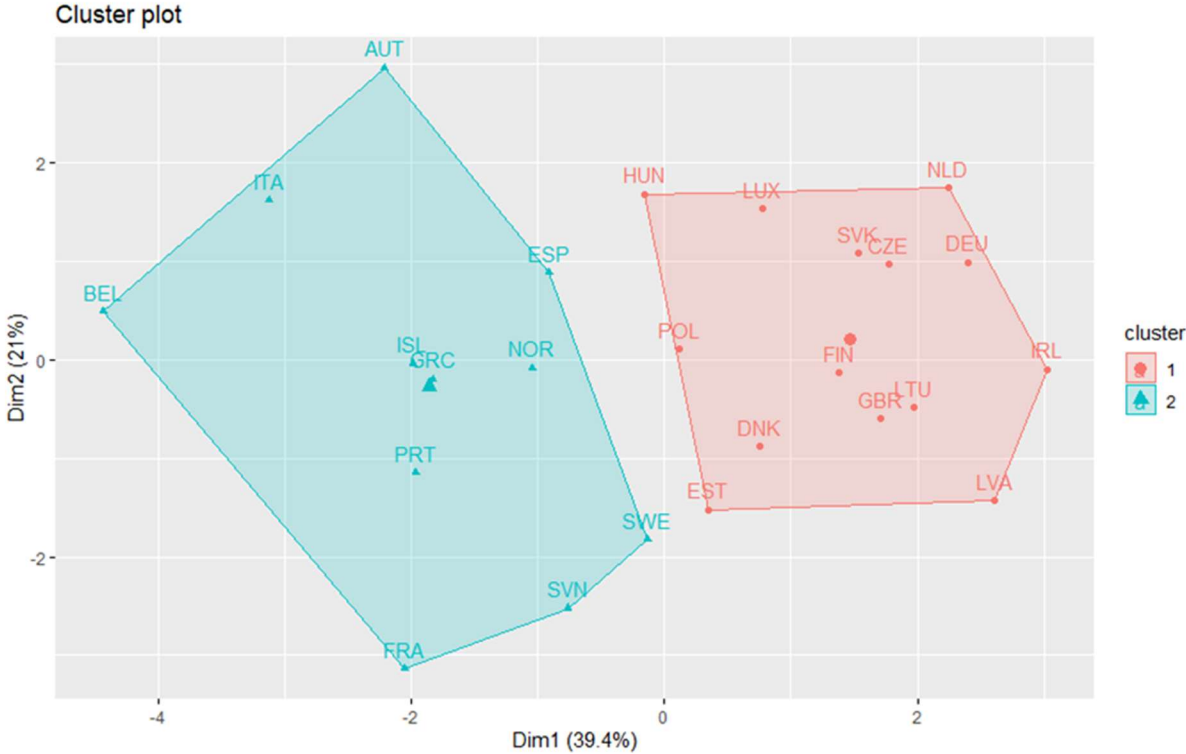
Figure 19 confirms this finding. It shows the two clusters, with countries plotted according to the first two principal components of the original data. The first principal component is plotted along the horizontal axis, the second along the vertical axis. It is obvious that the division into two clusters is mainly based on the first principal component. The first cluster with low cluster means for all indicators corresponds to positive scores for the first principal component, which can be interpreted as an overall restrictiveness for accounting services trade, where, as mentioned, the signs of the scores are arbitrary depending on the software. The second cluster of more restrictive countries corresponds to negative scores for the first main component.

Figure 20. *Selection of the optimal number of clusters for the accounting services' STRI indicators and FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)*
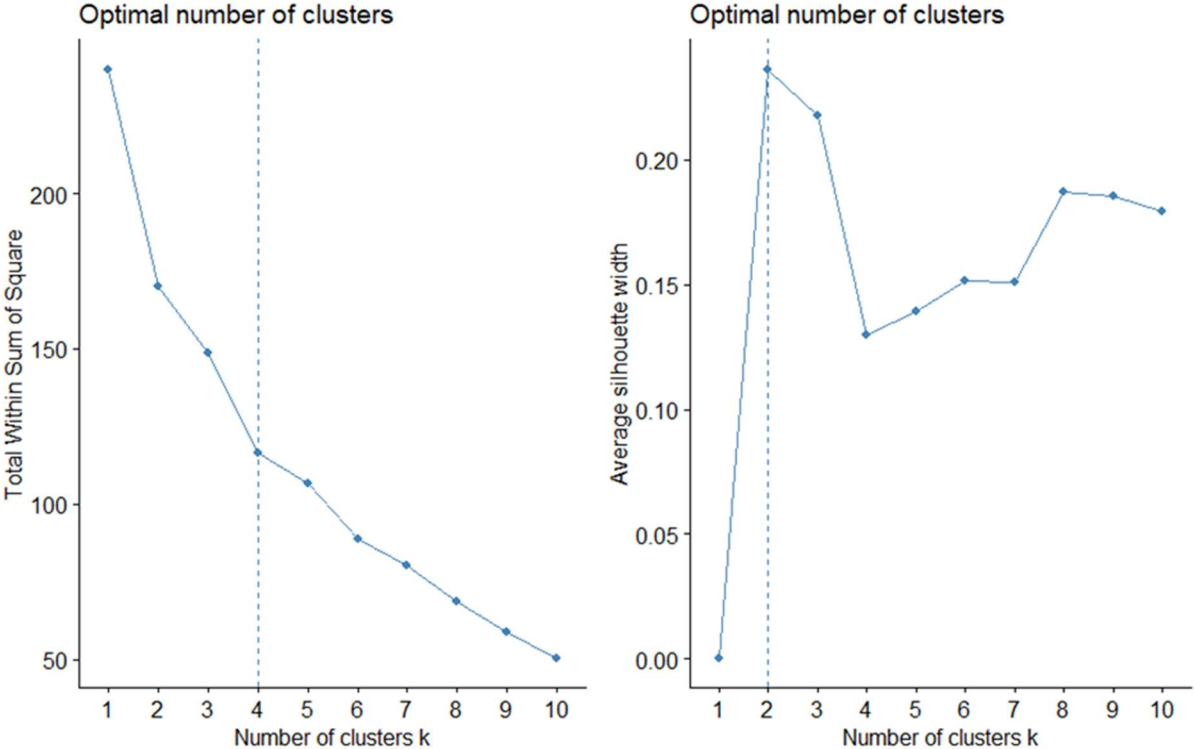
Thus, only two clusters might be insufficient to exploit the available information to classify EEA countries in terms of their accounting services trade restrictions. However, the elbow and silhouette criteria provide two different results for the optimal number of clusters (see Figure 20). The elbow criterion, which looks at the trade-off between the number of clusters and the total within clusters sum of squares, suggests that four clusters are appropriate. In contrast, according to the average-silhouette criterion, which considers the quality of the clusters, two clusters would be appropriate.

The results of this clustering with $K = 4$ clusters are shown in Table 8. The first cluster comprises twelve EEA countries and all cluster means are negative, i.e. below the mean for all EEA countries. Obviously, this is the cluster with the least restrictive countries regarding trade in accounting services, with particular emphasis on the low level of restrictions towards third countries. In contrast, the cluster means for the lack of regulatory transparency, both towards EEA countries and third countries, are negative but not particularly low. This is different in the second cluster. Here five countries (Estonia, France, Portugal, Slovenia and Sweden) are grouped together, which on average have a much lower lack of regulatory transparency. Otherwise, however, this second cluster is characterised by relatively high restrictions in almost all areas. The only exceptions are, on the one hand, the restrictions on the movement of persons from other EEA countries and the discriminatory measures taken against the rest of the world, which are both insignificant in terms of magnitude, and, on the other hand, the FDI regulatory restrictiveness indicator.

Table 8. *Results of the k-means cluster analysis for the accounting services' STRI indicators and FDI regulatory restrictiveness index with K = 4*

Cluster	1	2	3	4
Cluster members	CZE, DEU, DNK, FIN, GBR, IRL, LTU, LUX, LVA, NLD, POL, SVK	EST, FRA, PRT, SVN, SWE	ESP, GRC, HUN, ISL, ITA, NOR	AUT, BEL
Cluster means				
eea_entry	-0.453	0.884	-0.357	1.582
eea_people	-0.517	-0.149	0.714	1.331
eea_comp	-0.577	0.693	0.289	0.866
eea_trans	-0.180	-0.853	0.517	1.657
all_entry	-0.683	1.074	0.354	0.354
all_people	-0.720	0.713	0.619	0.678
all_odis	-0.683	-0.200	1.400	0.400
all_comp	-0.694	0.980	0.327	0.735
all_trans	-0.308	-0.759	0.697	1.655
fdi_restr	-0.279	-0.400	0.031	2.582
Within cluster sum of squares (SS)	52.27	23.45	32.14	8.53
Between SS/total SS		51.5 %		

Figure 21. *Optimal Clustering of the EEA countries (k-means, K = 4) for the accounting services' STRI indicators and FDI regulatory restrictiveness index*

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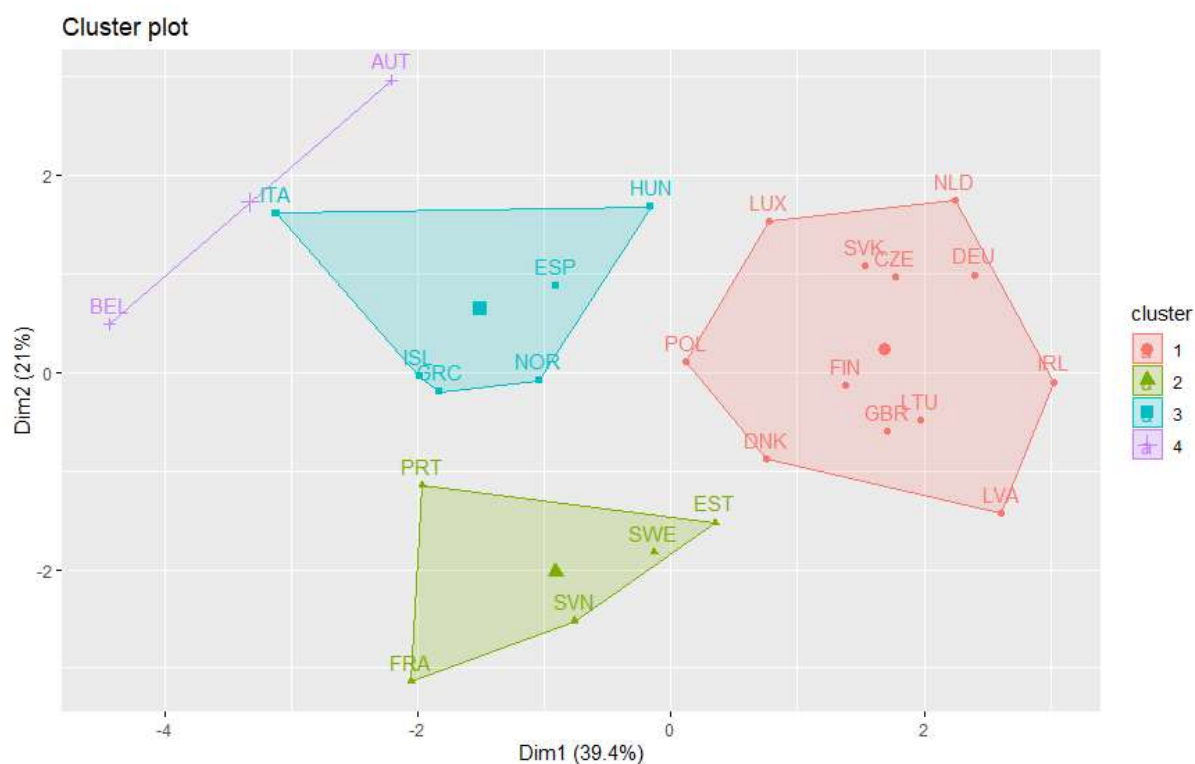
The third cluster (Greece, Hungary, Iceland, Italy, Norway and Spain) also shows clearly above mean regulation in almost all areas. Only the restrictions on foreign entry by other EEA countries are below the overall average in this cluster and the FDI regulatory restrictiveness index is close to its overall mean. Unlike the second cluster, the third cluster is also characterised by a relatively large lack of regulatory transparency. The fourth cluster comprises only Austria and Belgium and occupies a negative leading position in almost all areas. As expected from Figure 16, the mean value for the FDI regulatory restrictiveness index is also extremely high in this cluster. However, this is not the only reason for the isolated clustering of Austria and Belgium. Denmark, which has the same FDI regulatory restrictiveness index score as Belgium, has nevertheless been assigned to the first cluster.

Compared to the two-cluster solution, the four clusters are much more homogeneous, with the within cluster sum of squares being lowest for the second cluster (the fourth cluster does not count because it contains only two countries). At the same time, the share of the between sum of squares in the total sum of squares has risen to 51.8%, however that is not an overwhelming result, compared to 67.8% for the computer services trade restrictions. However, it must be taken into account that the inclusion of the FDI regulatory restrictiveness index introduces much variation into the data, because is hardly correlated with the other indicators. The relatively good discriminatory power of the $K =4$ clustering is also visible in Figure 21, where the four clusters are shown within the coordinate system of the first two principal components of the standardised original data. It can clearly be seen that the first cluster has the lowest overall restrictivenss, as high scores for the first principal component mean a low overall restrictiveness. The second and third clusters are roughly equal in terms of overall restrictiveness, but differ in terms of the second principal component, which contrasts regulatory transparency towards both EEA countries and third countries and restrictions on movement of people from other EEA countries with the remaining restrictions. For the former, the second cluster is less restrictive than the third cluster.

Overall, these results suggest several conclusions and starting points for policy measures. The twelve countries in the first cluster are already doing quite well overall in terms of their restrictions on accounting services trade but could still do some work on their regulatory transparency. In contrast, the second and third clusters still have potential for reducing typical service trade restrictions. The third cluster should additionally increase its regulatory transparency. Austria and Belgium should make efforts to reduce the whole range of restrictions. Somewhat problematic with this last conclusion is that Austria in particular has quite a high FDI regulatory restrictiveness index score and it is difficult to assess the actual policy relevance of this indicator, as it does not include the implementation of restrictive measures and is hardly correlated with the STRI indicators.

5 Empirical results for legal services

Legal services (ISIC 692) are also part of the other business services and comprise advisory and representation services in domestic and international law. OECD (2018e) explains that international law includes advisory services in home country law, third country law, international law, as well as a right to appear in international commercial arbitration, while domestic law extends to advising and representing clients before a court or judicial body in the law of the host country.

Table 9. *Descriptive statistics of STRI restrictions and FDI regulatory restrictiveness index for legal services in 2018*

Variable	Mean	Median	Std. Dev.	Min	Max
Foreign entry restrictions EEA (eea_entry)	0.045	0.050	0.028	0.000	0.101
Movement of people EEA (eea_people)	0.012	0.013	0.004	0.000	0.013
Barriers to competition EEA (eea_comp)	0.012	0.013	0.006	0.000	0.020
Regulatory transparency EEA (eea_trans)	0.011	0.008	0.011	0.000	0.032
Foreign entry restrictions RoW (all_entry)	0.165	0.121	0.134	0.030	0.503
Movement of people RoW (all_people)	0.158	0.148	0.081	0.027	0.336
Other discriminatory meas. RoW (all_odis)	0.018	0.022	0.009	0.000	0.036
Barriers to competition RoW (all_comp)	0.014	0.013	0.011	0.000	0.046
Regulatory transparency RoW (all_trans)	0.029	0.024	0.020	0.008	0.080
FDI regulatory restrictions (fdi_restr)	0.139	0.000	0.291	0.000	1.000

The descriptive statistics in Table 9 show that, on average, EEA countries have low STRI barriers to trade in legal services with other EEA countries. The restrictions on foreign entry are comparatively the most pronounced. The picture changes when the restrictions vis-à-vis third countries are considered. Here the restrictions on foreign entry and movement of people are considerable, while the other restrictions are still less important. This can be seen from the mean and median values as well as from the maximum values. OECD (2018e) argues that the dominance of the restrictions on foreign entry and the movement of people reflect the characteristics of this sector and the relevant policy environment. Legal services are skilled labour intensive and subject to licensing in several countries. The FDI regulatory restrictiveness index also signals relatively strict restrictions, whereby the large standard deviation and the wide range between the minimum and maximum value is noticeable.

A more detailed look at the individual indicators confirms the impression from the descriptive statistics but also provides some further insights. With respect to the restrictions of foreign entry of other EEA countries, Figure 22 shows that although there is some variation, the overall restrictiveness is low. It tends to be somewhat stronger in the Central and Eastern European countries than in the Western European countries. Except for Greece and Luxembourg, this finding also applies to these restrictions to third countries. Luxembourg, Poland and to a similar extent Hungary have extremely high index scores, followed by Estonia, Greece, Lithuania and Slovenia. However, the scores for France, Iceland and Portugal are also still quite high.

As far as restrictions on the movement of people are concerned, the common internal market seems to work very well (see Figure 23). Finland, Latvia and Sweden have no such restrictions at all, all other countries have an extremely low index score of 0.013. The situation is different with this type of restrictions towards third countries. Here France, Luxembourg and Poland have extremely high scores, but several other EEA countries also have relatively high scores.

Other discriminatory measures of EEA countries exist only towards third countries, but the scores are exceedingly small and take only four different values (see Figure 24). Here again, Luxembourg and Poland have the highest scores.

Figure 25 shows that the barriers to competition towards other EEA countries and third countries are the same in most EEA countries and are also extremely low. Larger differences between the two groups of countries are only found in Luxembourg, Poland and, to a minor extent, Hungary. The United Kingdom and the Netherlands stand out here because they have no barriers to competition at all.

The index values for the lack of regulatory transparency are generally somewhat higher than the values for the last two indicators (see Figure 26). Again, Luxembourg and Poland are in the lead, but are now followed

by Austria and Hungary. For the lack of regulatory transparency vis-à-vis other EEA countries, Austria is ahead, followed by Belgium, Iceland, Italy, Luxembourg and Spain, which are all on a par.

Figure 22. STRI restrictions on foreign entry for legal services within the EEA and with respect to the rest of the world (RoW) in 2018
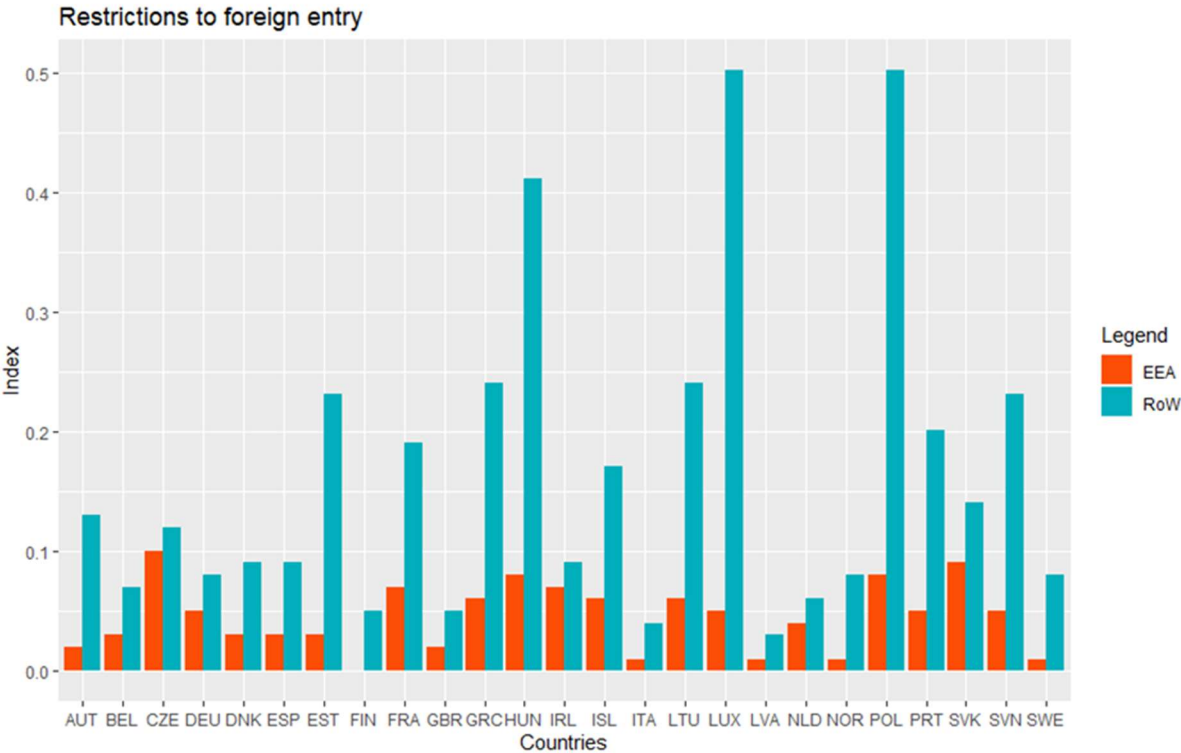
Figure 23. STRI restrictions on the movement of people for legal services within the EEA and with respect to the rest of the world (RoW) in 2018
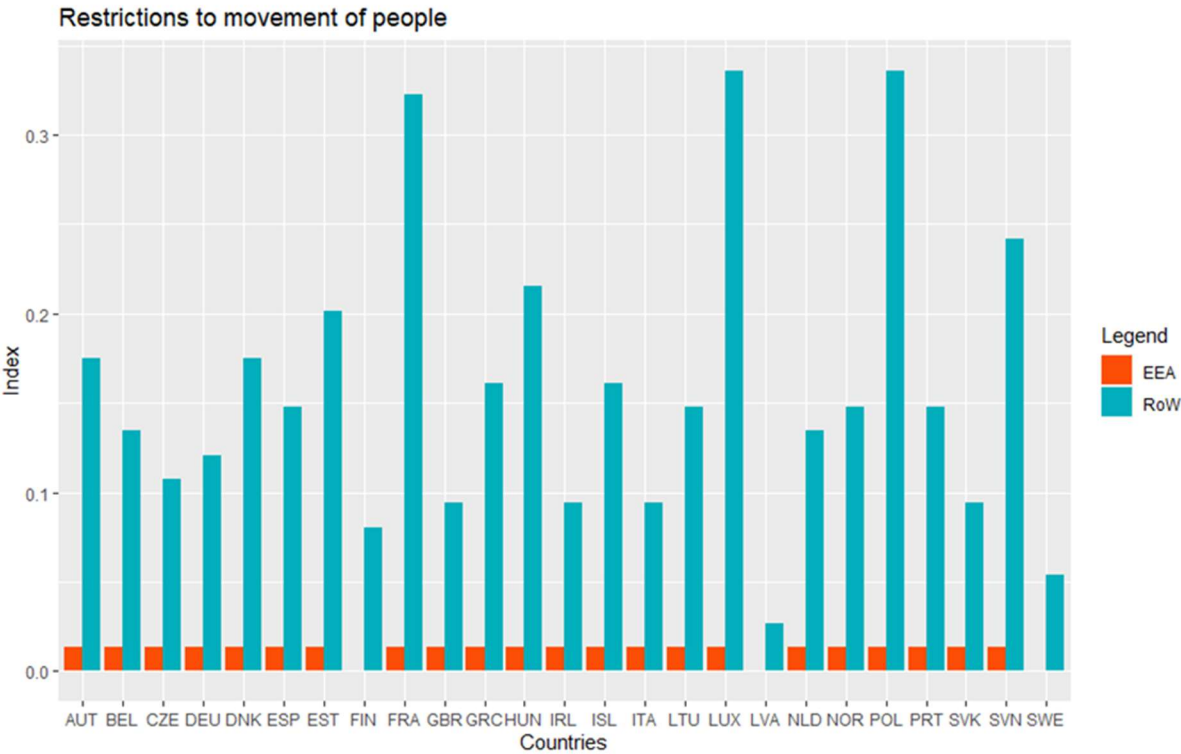
Figure 24. *STRI other discriminatory measures for legal services within the EEA and with respect to the rest of the world (RoW) in 2018*
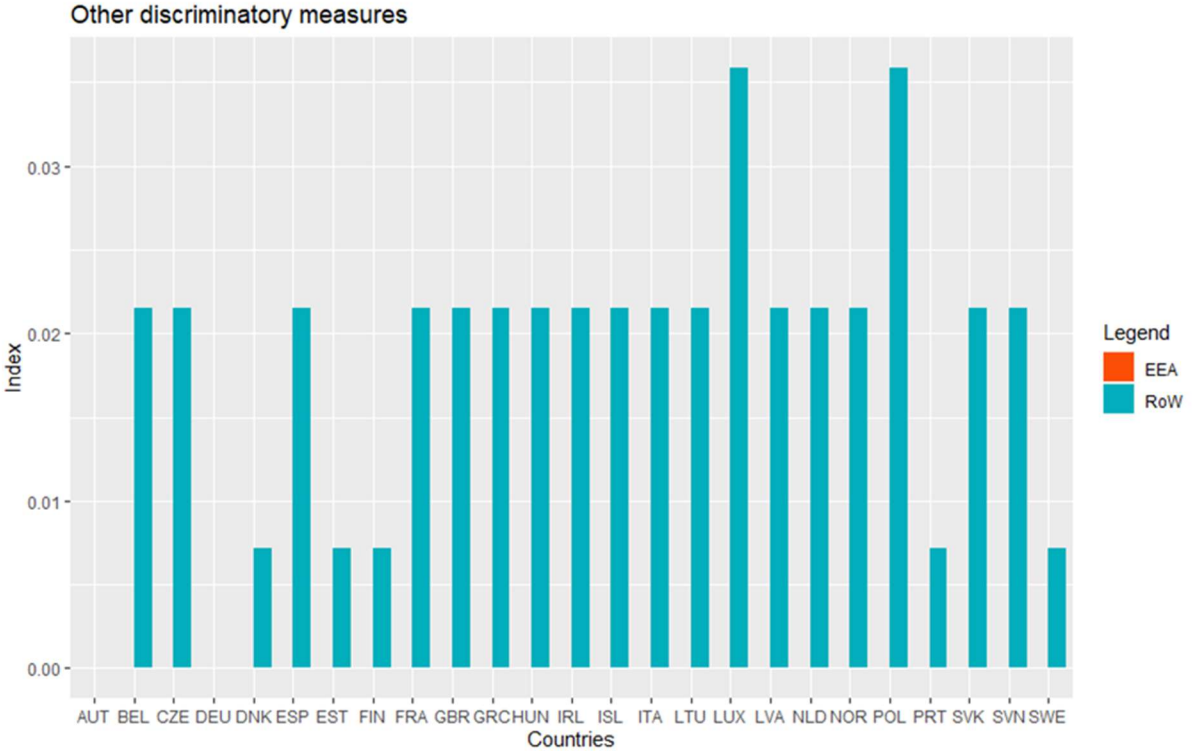
Figure 25. *STRI barriers to competition for legal services within the EEA and with respect to the rest of the world (RoW) in 2018*
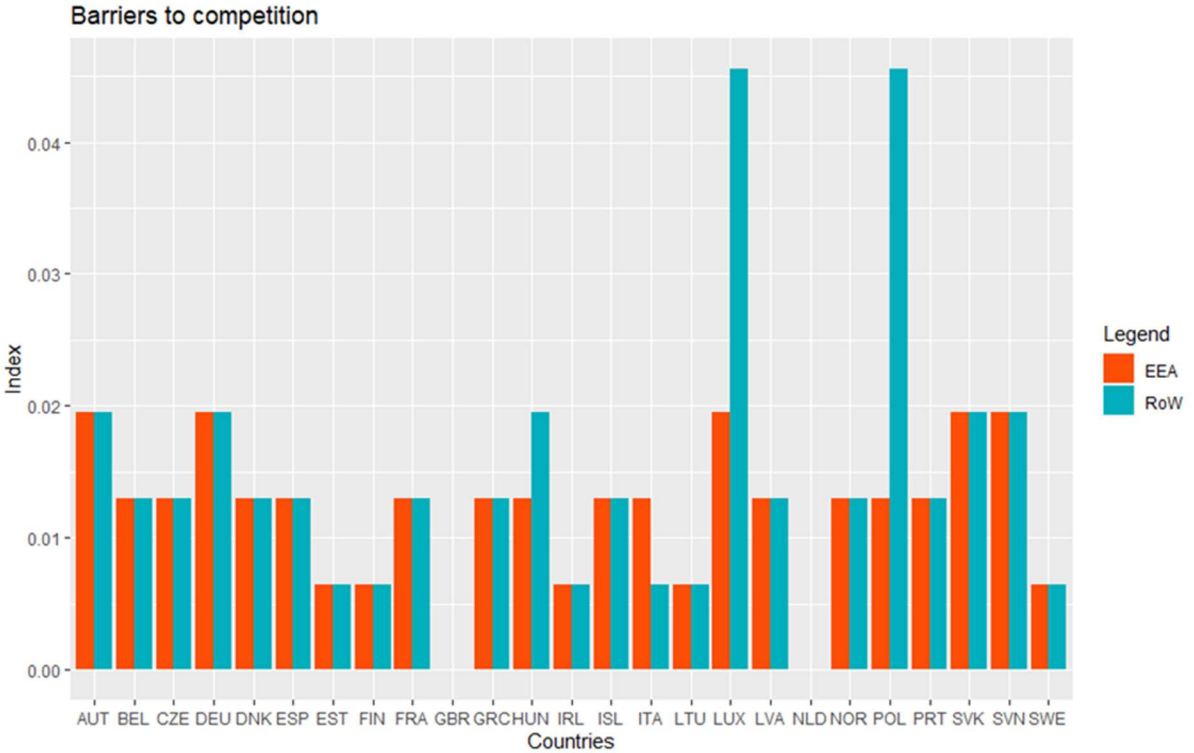
Figure 26. *STRI regulatory transparency for legal services within the EEA and with respect to the rest of the world (RoW) in 2018*
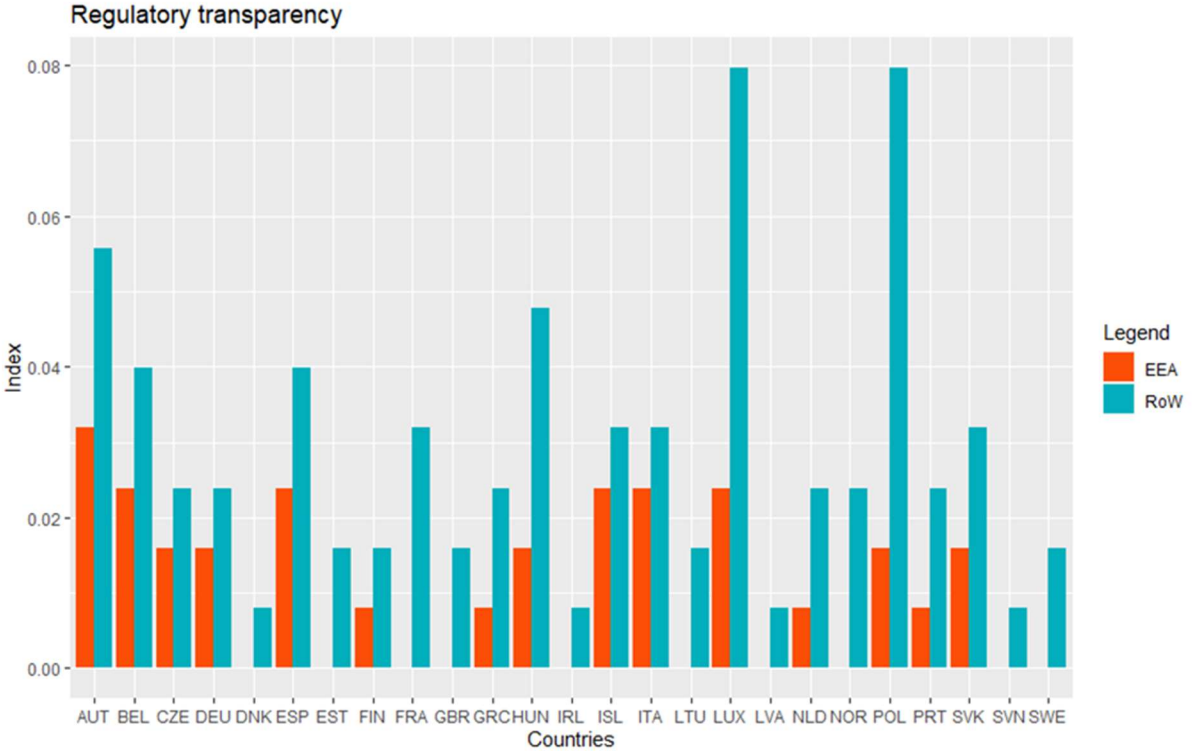
Figure 27. *FDI regulatory restrictiveness index for legal services in 2018*
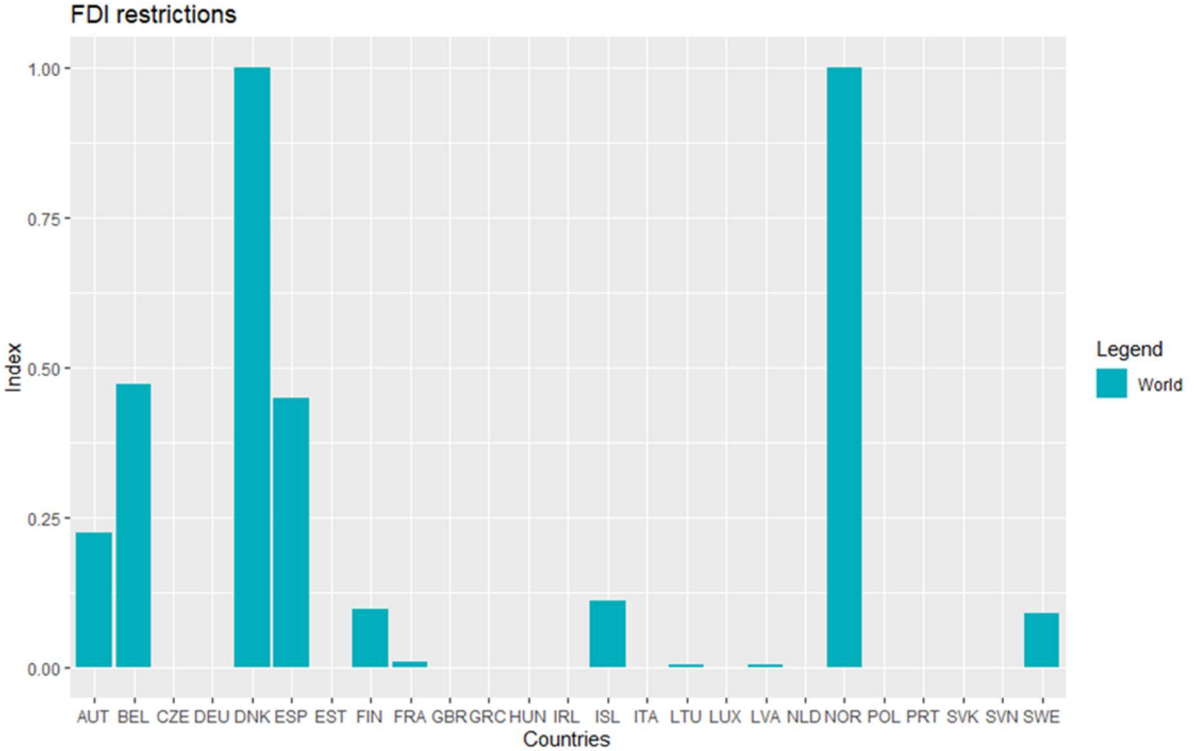
The five OECD STRI sub-indices (vis-à-vis third countries) for Luxembourg and Poland add up to a total STRI of one, so that the legal services of these countries are considered by this indicator to be completely closed to third countries. Looking at the OECD FDI regulatory restrictiveness index in Figure 27, the situation is completely different. According to this index, legal services in these two countries are completely open to foreigners. In contrast, Denmark and Norway are completely closed and Belgium and Spain have relatively high index scores. Lower values are recorded for Austria, Finland, Iceland and Sweden, while all other EEA countries are considered to be completely or almost completely open.

The correlation matrix in Figure 28 confirms this inconsistency. The FDI Index is not statistically significantly correlated with any other indicator. In contrast, there are numerous correlations between the STRI sub-indices. The sub-indices towards third countries are all significantly correlated, with the strongest correlation between restrictions on foreign entry and movement of people. For restrictions towards other EEA countries, these two types of restrictions are also correlated. In addition, there is a significant correlation between barriers to competition and regulatory transparency. Furthermore, all restrictions vis-à-vis other EEA countries are significantly correlated with their counterparts vis-à-vis third countries. This means that the legal services sectors of the EEA countries that are highly protected against third countries are also relatively highly protected against other EEA countries. Finally, there are significant correlations between restrictions on market entry by other EEA countries and other discriminatory measures vis-à-vis third countries, and between barriers to competition and regulatory transparency vis-à-vis both groups of countries.

Figure 28. *Correlation matrix for the legal services' STRI indicators and FDI regulatory restrictiveness index (coloured cells highlights statistical significance of a correlation coefficient with a < 0.05)*

The quite pronounced correlations between the various sub-indices again promise that these can be approximated by a principal component analysis through a smaller number of principal components. However, the lack of correlation between the FDI regulatory restrictiveness index and the other indicators could also make this exercise more difficult. Table 10 shows the results of the principal component analysis including the FDI regulatory restrictiveness index. With an eigenvalue of 4.496, the first principal component covers the variance of 4.5 original variables, while the second principal component still captures that of 1.5 original variables. The eigenvalues of the third and fourth principal components are just above one, so that they each capture slightly more than the variance of an original variable. After that, the explanatory power of the

principal components drops significantly.[12] The screeplot in the left panel of Figure 29 also does not prevent us from considering four principal components in the further analysis. In total, these four principle components capture 81.5% of the total variance of the ten original variables.

The examination of the coefficients of the principal components (component loadings) in Table 10 shows that the first principal component roughly corresponds to the overall legal services trade restrictiveness of the EEA countries, because all coefficients with the exception of the FDI regulatory restrictiveness index point in the same direction. Actually, the contribution of the FDI index is negligible in terms of the magnitude of the coefficient. The first principal component indicates that EEA countries with relatively high index scores for one kind of restrictions tend to have relatively high scores for the other kinds of restrictions. The barriers to competition and regulatory transparency vis-à-vis other EEA countries and the FDI regulatory restrictiveness index load relatively strongly in one direction on the second principal component, while the restrictions on foreign entry by other EEA countries and the other discriminatory measures against third countries load in the other direction. The third principal component is strongly influenced by the restrictions on foreign entry from other EEA countries and the FDI index, while the other indicators play only a minor role. The fourth principal component contrasts all restrictions towards other EEA countries with those towards third countries and the FDI regulatory restrictiveness index. Thus, this principal component captures in addition to the general restrictiveness covered by the first principal component, which is of much greater importance, the rivalry between restrictions vis-à-vis other EEA countries and those vis-à-vis third countries.

Table 10. *Results of the principal component analysis for the legal services' STRI indicators and FDI regulatory restrictiveness index (first six principal components)*

Principal Component	1	2	3	4	5	6
Eigenvalue	4.496	1.549	1.094	1.009	0.797	0.565
Share of the variance explained	0.450	0.155	0.109	0.101	0.080	0.057
Cumulated share	0.450	0.604	0.714	0.815	0.894	0.951
	Eigenvectors (coefficients of the principal components)					
eea_entry	0.282	-0.381	0.155	-0.460	0.222	-0.286
eea_people	0.242	-0.058	0.665	-0.387	-0.179	0.228
eea_comp	0.268	0.444	-0.009	-0.191	0.509	-0.381
eea_trans	0.245	0.463	-0.217	-0.414	-0.436	0.077
all_entry	0.407	-0.218	-0.085	0.233	0.165	0.226
all_people	0.386	-0.102	0.212	0.303	0.153	0.389
all_odis	0.264	-0.338	0.014	0.233	-0.508	-0.628
all_comp	0.418	0.154	-0.164	0.233	0.208	-0.165
all_trans	0.405	0.199	-0.196	0.099	-0.333	0.203
fdi_restr	-0.086	0.452	0.607	0.407	-0.080	-0.223

Note: see Table 2

The biplot in Figure 29 also confirms the special role of the FDI regulatory restrictiveness index, as its arrow points with respect to the first principal component points in a different direction than the arrows of all other indicators. Therefore, the principal component analysis was also carried out without this index.[13] In this case three principal components have an eigenvalue greater than zero. The first two principal components are very similar to the first two components from the analysis with the FDI index, while the third principal component

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[12] To save space, only the first six principal components are shown in Table 6. However, as can be seen from the table, the remaining four principal components together explain only 4.9% of the total variance.
[13] The detailed results are available from the author upon request.

is very close to the fourth principal component from the first analysis. All in all, if the FDI index is omitted, the influences of the STRI indicators on the principal components are somewhat more pronounced, but very close to the first analysis.

Figure 29. *Screeplot of the explained variance and biplot of the factor loadings for the legal services' STRI indicators and FDI regulatory restrictiveness index*
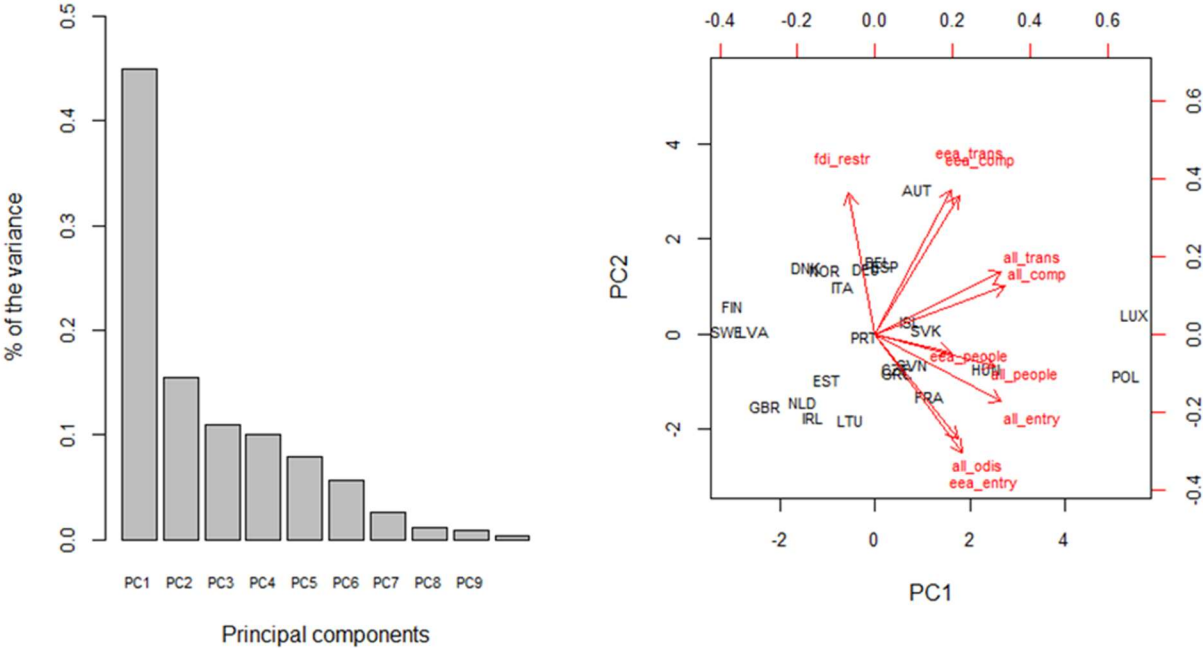
Table 11. *Results of the k-means cluster analysis for the legal services' STRI indicators and FDI regulatory restrictiveness index with K = 2*

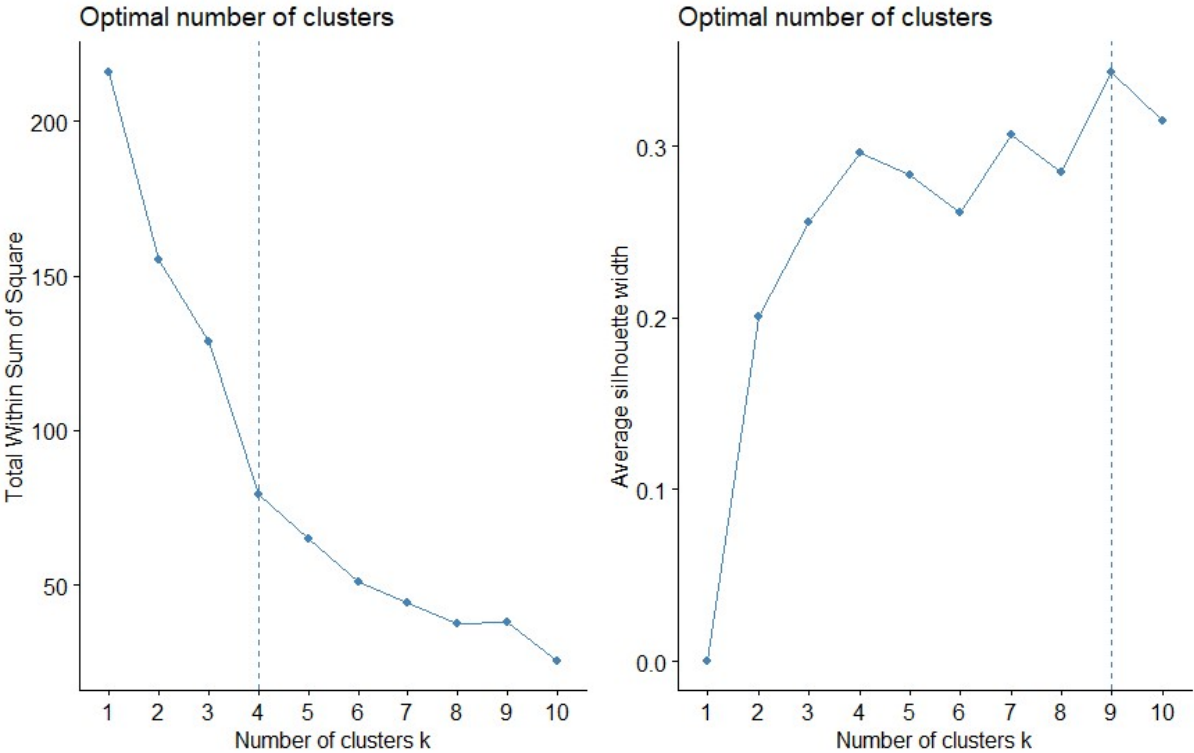| Cluster	1	2
Cluster members	HUN, LUX, POL	AUT, BEL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, IRL, ISL, ITA, LTU, LVA, NLD, NOR, PRT, SVK, SVN, SWE
Cluster means		
eea_entry	0.920	−0.125
eea_people	0.362	−0.049
eea_comp	0.580	−0.079
eea_trans	2.286	−0.105
all_entry	0.769	−0.312
all_people	1.691	−0.231
all_odis	1.400	−0.191
all_comp	2.060	−0.281
all_trans	2.040	−0.278
fdi_restr	−0.478	0.065
Within cluster sum of squares (SS)	10.97	158.86
Between SS/total SS	29.2 %	

Figure 30. *Cluster plot of the EEA countries (k-means, K = 2) for the legal services' STRI indicators and FDI regulatory restrictiveness index*
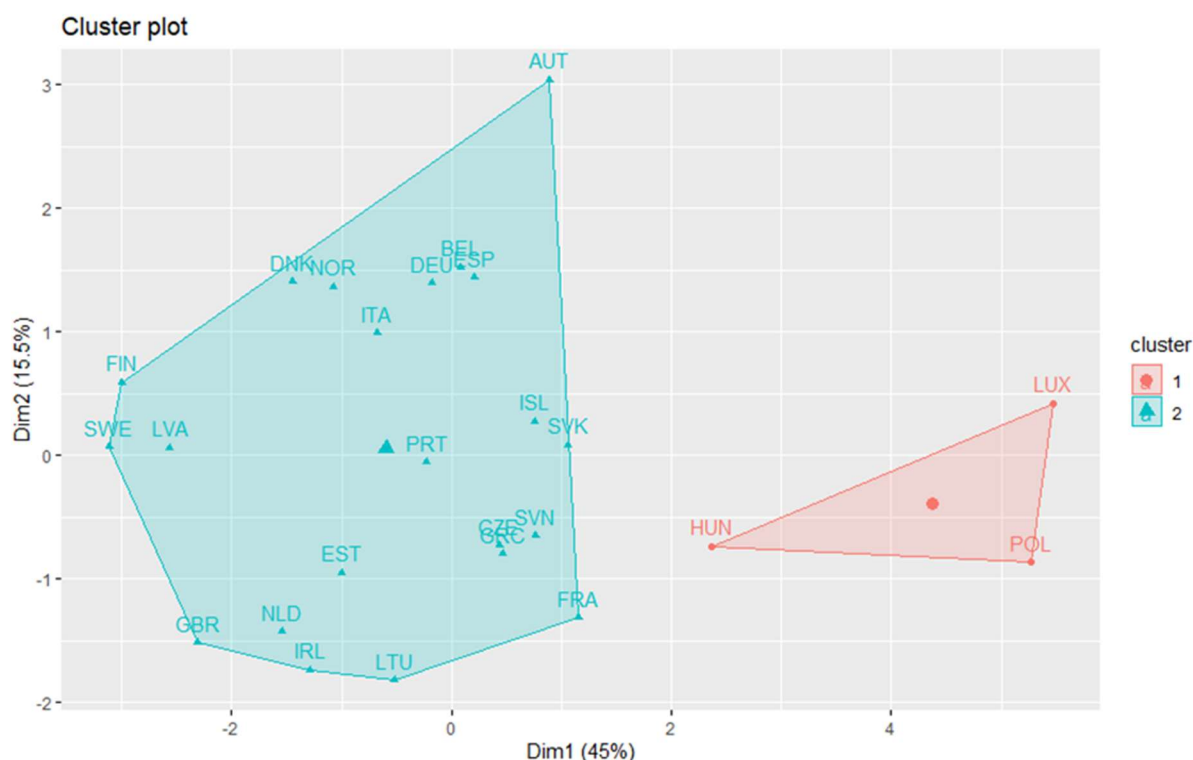
Let us next look at the cluster analysis for the restrictiveness indicators. Table 11 displays the results of the k-means clustering for the indicators of computer services trade restrictiveness with $K = 2$ clusters. The first cluster contains those three EEA countries (Hungary, Luxembourg and Poland) with high values of the standardised restrictiveness indices (i.e. these variables have an overall mean of zero and an overall standard deviation of one). The cluster means for the all Intra-EEA STRI indicators are clearly about zero and the STRI with respect to the rest of the world are extremely high. In contrast to this clear finding, the cluster mean for the FDI regulatory restrictiveness index is below the overall mean. The second cluster is a less meaningful agglomeration of 22 EEA countries where the cluster means for all STRI indicators are just below the overall mean. Only the cluster mean for the FDI index is very slightly above the overall mean. The low informative power of this clustering is also reflected in the low between sum of squares to total sum of squares ratio of 29.2% and can also be seen in Figure 30. Here the second cluster takes up the entire left half of the scatterplot of the first and second principal component.

Thus, only two clusters are obviously insufficient to exploit the available information to classify EEA countries in terms of their legal services trade restrictions. However, the elbow and silhouette criteria do not provide truly clear results regarding the optimal number of clusters (see Figure 31). The elbow criterion, which looks at the trade-off between the number of clusters and the total within clusters sum of squares, yields only weak evidence that six clusters are appropriate. According to the average-silhouette criterion, which considers the quality of the clusters, nine clusters would be appropriate. Since nine clusters appear to be too many, the results of the analysis with $K = 6$ clusters are presented below.

Figure 31. Selection of the optimal number of clusters for the legal services' STRI indicators and FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)
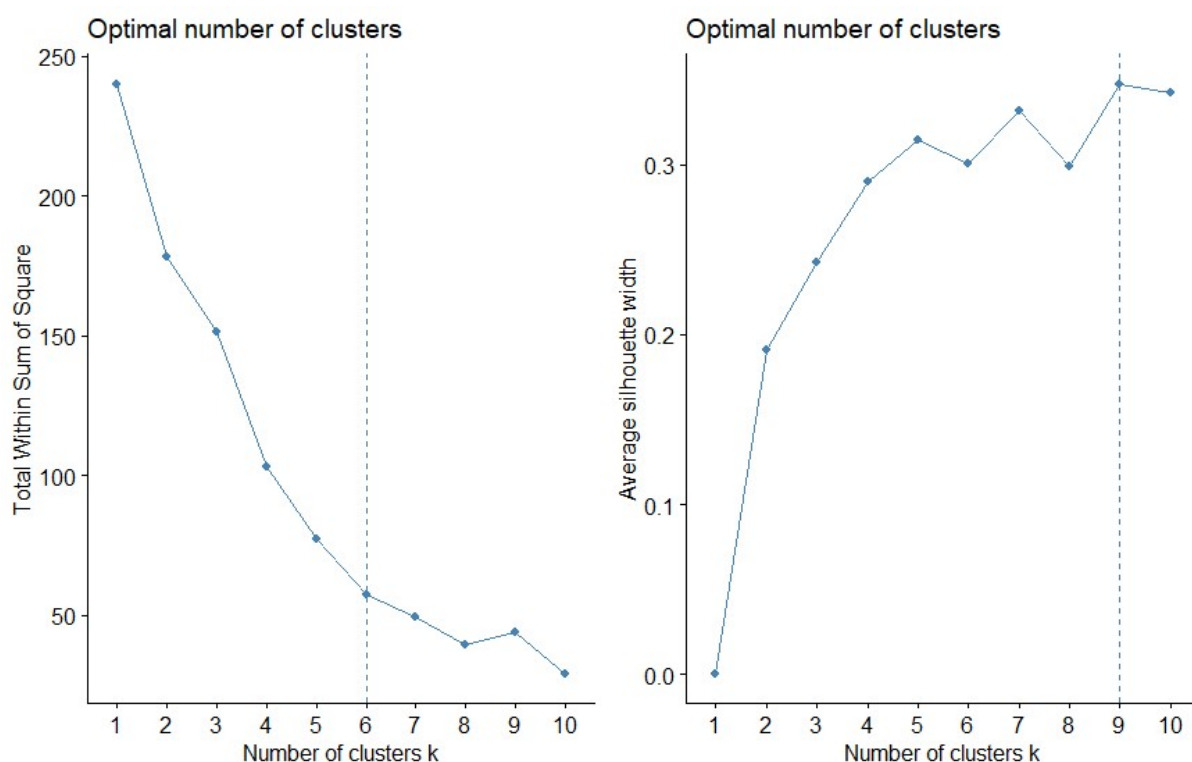

The first cluster comprises Estonia, Ireland, Lithuania, the Netherlands and the United Kingdom. Only its cluster mean for restrictions on the movement of people from other EEA countries is above its overall mean, while all other indicators have cluster means below their overall means or cluster means very close to their overall means (restrictions on foreign entry towards other EEA countries and other discriminatory measures towards third countries). The second cluster (Austria, Belgium, Germany, Italy and Spain) is characterised by low restrictions on foreign entry both towards other EEA and third countries. The cluster means of the restrictions on the movement of people and other discriminatory measures towards the rest of the world are also negative, while all other restrictions are stronger than the respective overall averages. Eight countries are grouped in the third cluster, which has above-average cluster means for almost all indicators. Only the lack of regulatory transparency towards both EEA and third countries is close to the overall average and the cluster mean of the FDI regulatory restrictiveness index is significantly lower than its overall mean. Denmark and Norway form a separate fourth cluster only because their legal services sectors are rated as completely closed by the FDI index. For almost all other indicators the cluster means are negative or close to the corresponding overall means. Only the restrictions on the movement of people from other EEA countries are moderately above the overall mean. Finland, Latvia and Sweden constitute the fifth cluster with the lowest overall restrictiveness. In particular, the restrictions on foreign entry and movement of people are extremely low. The counterpart is the sixth cluster with Luxembourg and Poland as the only members. Here the cluster averages of all STRI indicators are very clearly above the respective overall averages. This is extremely pronounced in the case of restrictions vis-à-vis third countries. Only the FDI regulatory restrictiveness index is below average.

Table 12. *Results of the k-means cluster analysis for the legal services' STRI indicators and FDI regulatory restrictiveness index with K = 6*

Cluster	1	2	3	4	5	6
Cluster members	EST, GBR, IRL, LTU, NLD	AUT, BEL, DEU, ESP, ITA	CZE, FRA, GRC, HUN, ISL, PRT, SVK, SVN	DNK, NOR	FIN, LVA, SWE	LUX, POL
Cluster means						
eea_entry	−0.015	−0.589	0.919	−0.875	−1.355	0.740
eea_people	0.362	0.362	0.362	0.362	−2.653	0.362
eea_comp	−1.458	0.658	0.482	0.188	−0.596	0.776
eea_trans	−0.852	1.279	0.041	−1.005	−0.750	0.897
all_entry	−0.227	−0.616	0.360	−0.594	−0.831	2.511
all_people	−0.291	−0.291	0.287	0.040	−1.281	2.186
all_odis	0.062	−0.556	0.178	−0.402	−0.659	1.915
all_comp	−0.951	0.000	0.104	−0.119	−0.515	2.852
all_trans	−0.665	0.471	−0.057	−0.665	−0.801	2.581
fdi_restr	−0.474	0.313	−0.425	2.964	−0.255	−0.478
Within cluster sum of squares (SS)	10.16	16.15	24.05	1.84	3.69	1.56
Between SS / total SS			76.1 %			

Figure 32. *Optimal clustering of the EEA countries (k-means, K = 6) for the legal services' STRI indicators and FDI regulatory restrictiveness index*
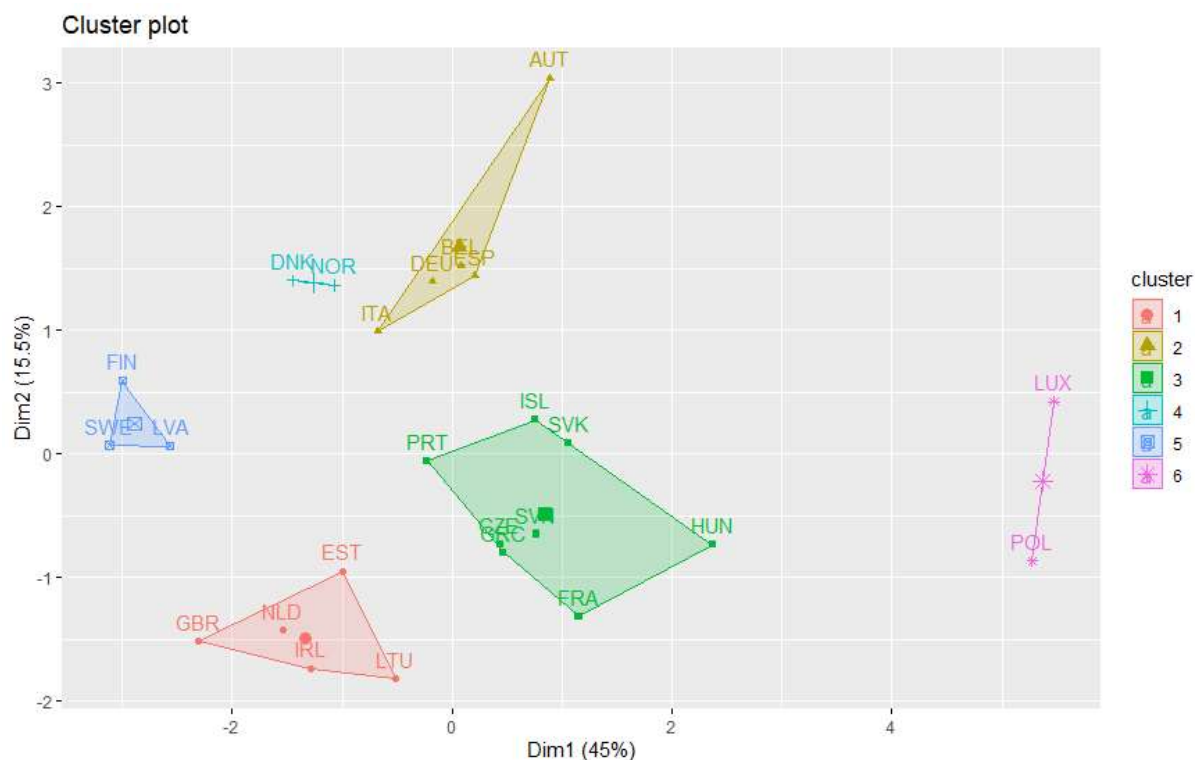
Although the formation of six clusters has led to a significant increase in the ratio of the between sum of squares to the total sum of squares to 76.1%, the formation of some clusters is not completely convincing. This is particularly true of the fourth cluster with Denmark and Norway, which only resulted from the high FDI index values. The cluster plot in Figure 32 confirms this concern. It shows the six clusters within the coordinate system of the first two principal components of the standardised original data. The unfortunate positioning of Denmark and Norway is also clearly visible in this graph.

Therefore, the search for the optimal number of clusters was carried out once again without the FDI regulatory restrictiveness index. The elbow criterion now suggests only four clusters, while the average silhouette criterion still insists on nine clusters (see Figure 33). Hence, the cluster analysis without the FDI index was carried out again with $K = 4$ clusters.

Figure 33. Selection of the optimal number of clusters for the legal services' STRI indicators and without FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)

The renewed clustering maintains the two opposite small clusters with, on the one side, Finland, Latvia and Sweden, and, on the other side, Luxembourg and Poland (see Table 13). The other two clusters are larger. The second cluster now comprises nine countries, thus extending the old second cluster to include the Czech Republic, Hungary, Iceland and Slovakia. It has below-average cluster means for the restrictions on foreign entry, movement of people and other discriminatory measures against third countries, while the cluster means for all other restrictions are above average. The relatively large lack of regulatory transparency vis-à-vis other EEA countries is particularly striking. The remaining eleven countries – including Denmark and Norway – are gathered in the fourth cluster. It is characterised by above-average restrictions on the movement of people mainly from other EEA countries and to a lesser extent from third countries. The restrictions on foreign entry and other discriminatory measures are around the overall mean, while the cluster means of all other restrictions are below the overall mean. Overall, 63.4% of the total sum of squares in this new clustering can be attributed to the sum of squares between clusters.

Table 13. Results of the k-means cluster analysis for the legal services' STRI indicators and without FDI regulatory restrictiveness index with K = 4

Cluster	1	2	3	4
Cluster members	FIN, LVA, SWE	AUT, BEL CZE, DEU, ESP, HUN, ISL, ITA, SVK	LUX, POL	DNK, EST, FRA, GBR, GRC, IRL, LTU, NLD, NOR, PRT, SVN
Cluster means				
eea_entry	-1.355	0.281	0.740	0.005
eea_people	-2.653	0.362	0.362	0.362
eea_comp	-0.596	0.580	0.776	-0.453
eea_trans	-0.750	1.024	0.897	-0.796
all_entry	-0.831	-0.191	2.511	-0.074
all_people	-1.281	-0.236	2.186	0.145
all_odis	-0.659	-0.144	1.915	-0.051
all_comp	-0.515	0.079	2.852	-0.443
all_trans	-0.801	0.372	2.581	-0.555
Within cluster sum of squares (SS)	3.62	35.28	1.56	38.69
Between SS / total SS		63.4 %		

Figure 34. Optimal clustering of the EEA countries (k-means, K = 4) for the legal services' STRI indicators and without FDI regulatory restrictiveness index
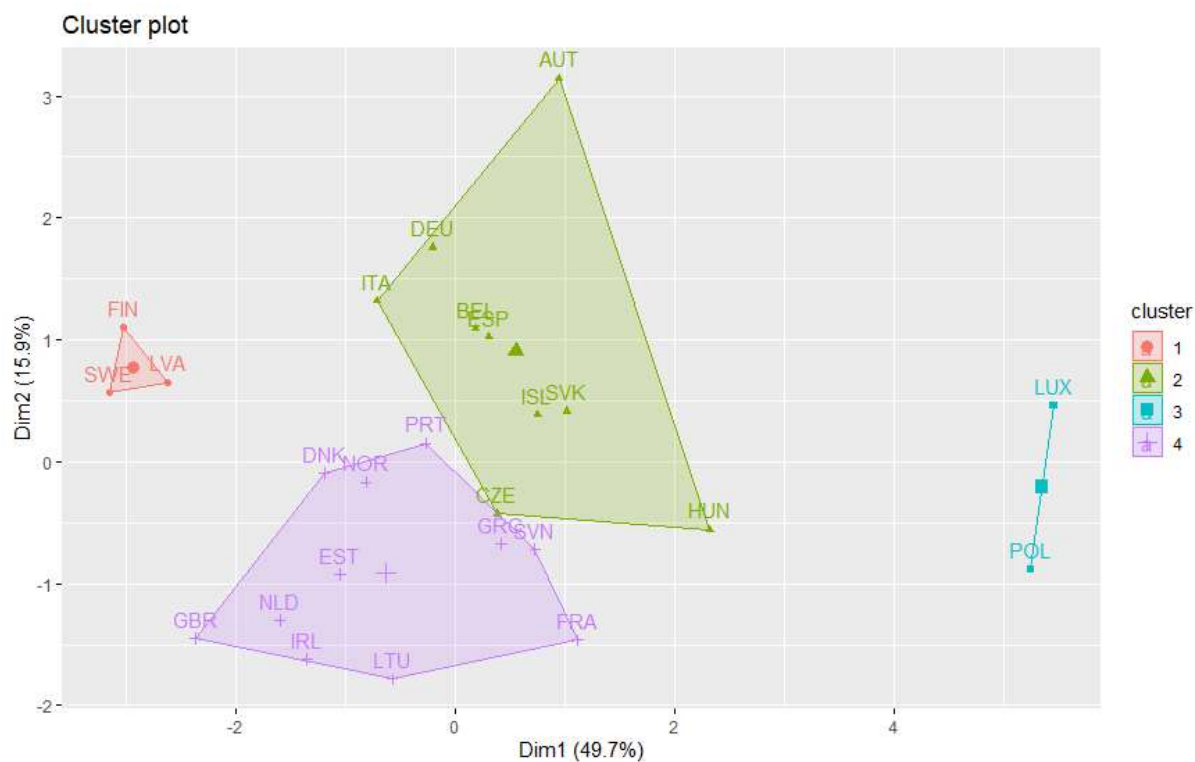
The cluster plot in Figure 34 shows that the overall restrictiveness – the first principal component on the horizontal axis – is somewhat less pronounced within the fourth cluster than in the second cluster. Overall, the clustering shows a good discriminatory power with respect to the first principal component, while a clear interpretation with respect to the second principal component, whose values are mapped on the vertical axis, is more difficult in this case.

In terms of policy implications, the first to stand out are Luxembourg and Poland, whose legal services are each considered to be completely closed to third countries with an overall STRI of one. In particular, measures to reduce restrictions on foreign entry and movement of people would be needed, as these two types of restrictions dominate the overall index. There is also potential for reducing the overall restrictiveness of the countries in the second cluster and France, Greece and Slovenia in the fourth cluster. It could be examined by these countries to what extent the regulation of this sector in Finland, Latvia and Sweden can serve as good example.

6   Empirical results for architecture services

Architecture services and related technical consultancy (ISIC 711) are also part of the other business services. They form the backbone of the construction industry and play a key role in building design and urban planning. According to OECD (2018b), an important feature is the regulatory complementarity between architecture, engineering and construction services. Often, architectural and engineering activities are combined into projects offered by one firm.

Table 14. *Descriptive statistics of STRI restrictions and FDI regulatory restrictiveness index for architecture services in 2018*

Variable	Mean	Median	Std. Dev.	Min	Max
Foreign entry restrictions EEA (eea_entry)	0.020	0.011	0.013	0.011	0.045
Movement of people EEA (eea_people)	0.011	0.015	0.007	0.000	0.015
Barriers to competition EEA (eea_comp)	0.011	0.010	0.006	0.000	0.020
Regulatory transparency EEA (eea_trans)	0.018	0.013	0.018	0.000	0.053
Foreign entry restrictions RoW (all_entry)	0.043	0.034	0.040	0.000	0.179
Movement of people RoW (all_people)	0.154	0.123	0.093	0.046	0.307
Other discriminatory meas. RoW (all_odis)	0.016	0.010	0.011	0.000	0.031
Barriers to competition RoW (all_comp)	0.011	0.010	0.006	0.000	0.020
Regulatory transparency RoW (all_trans)	0.039	0.040	0.021	0.013	0.093
FDI regulatory restrictions (fdi_restr)	0.015	0.000	0.049	0.000	0.225

Table 14 shows that the Intra-EEA STRI indicators for architecture services trade consistently have extremely low means, medians and maximum scores. In relation to third countries, restrictions on foreign entry are on average lower for architectural services than for accounting and legal services. In contrast, restrictions on the movement of people have about the same strength. These types of restrictions also determine the overall STRI significantly. Among the other STRI indicators vis-à-vis the rest of the world, the lack of regulatory transparency still plays a certain role. The FDI regulatory restrictiveness index, which likes to dance out of the line of the other indicators, has a low average value, but with a minimum value of zero and a maximum value of 0.225 it has a rather wide range.

In the following, we will again look at the differences between countries for the individual indicators. Most EEA countries have low or moderate levels of restrictions on foreign entry (see Figure 35). Regarding these restrictions towards other EEA countries, Austria, Belgium, France and Slovakia stand out with relatively high scores. Towards third countries, this is the case for France, Iceland, Italy and Slovakia.

The freedom of movement of people within the European single market seems to be largely realised for architects (see Figure 36). The scores for this type of restrictions are zero for eight EEA countries and 0.015 for the other 17 EEA countries. The situation is quite different for restrictions on the movement of people from third countries outside the EEA. Here, Estonia, Italy, Poland, Portugal, Slovakia and Slovenia are particularly striking with scores of 0.307. Several other EEA countries also have relatively high scores in this area.

Other discriminatory measures exist only against third countries and their extent is extremely limited (see Figure 37). The scores for Austria and Germany are zero, for another 15 EEA countries 0.01 and for the remaining 8 EEA countries 0.02. The scores for the barriers to competition are also negligible and always show the same values towards other EEA countries and third countries (see Figure 38). They are zero for Ireland, the Netherlands and the United Kingdom, 0.01 for another 17 EEA countries and 0.02 for the remaining five EEA countries.

The situation regarding regulatory transparency is much more mixed (see Figure 39). Austria has the lowest level of transparency towards other EEA countries, followed by Belgium, Iceland, Italy, Luxembourg and Spain. Furthermore, several EEA countries still have room for more regulatory transparency vis-à-vis third countries, most notably Austria, followed by Belgium, Luxembourg and Spain.

Figure 35. *STRI restrictions on foreign entry for architecture services within the EEA and with respect to the rest of the world (RoW) in 2018*
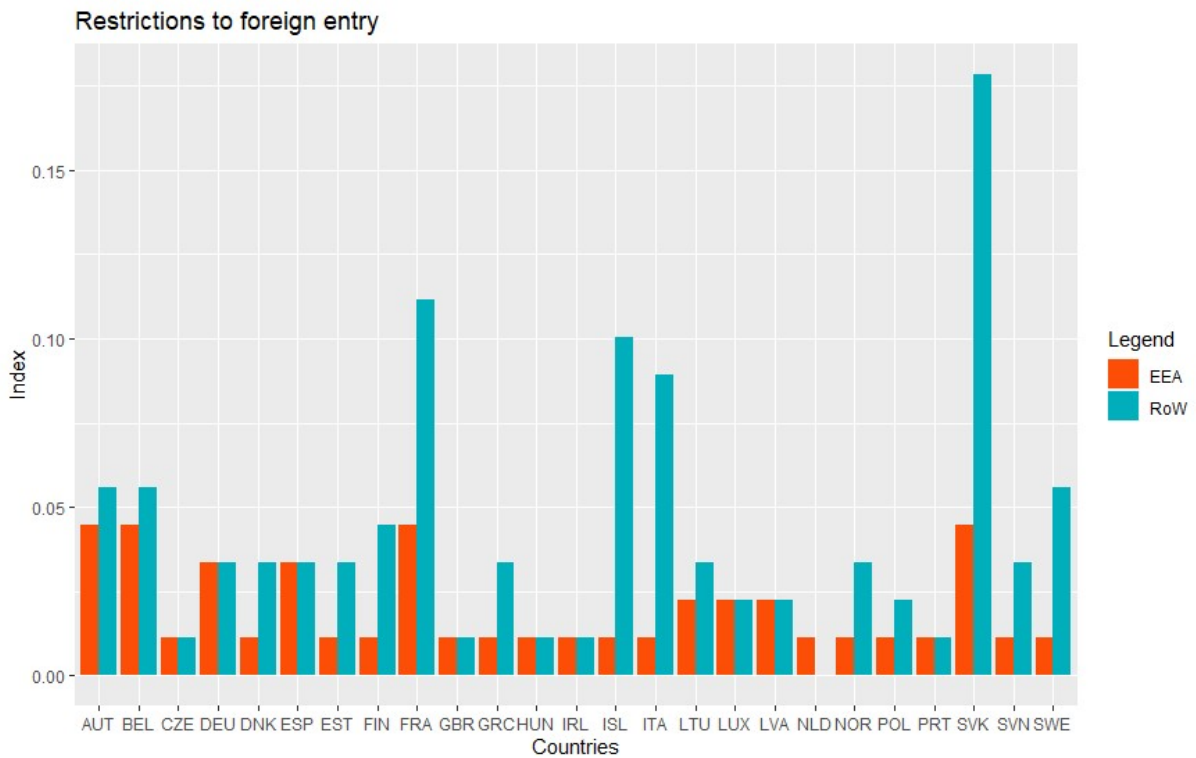
Figure 36. *STRI restrictions on the movement of people for architecture services within the EEA and with respect to the rest of the world (RoW) in 2018*
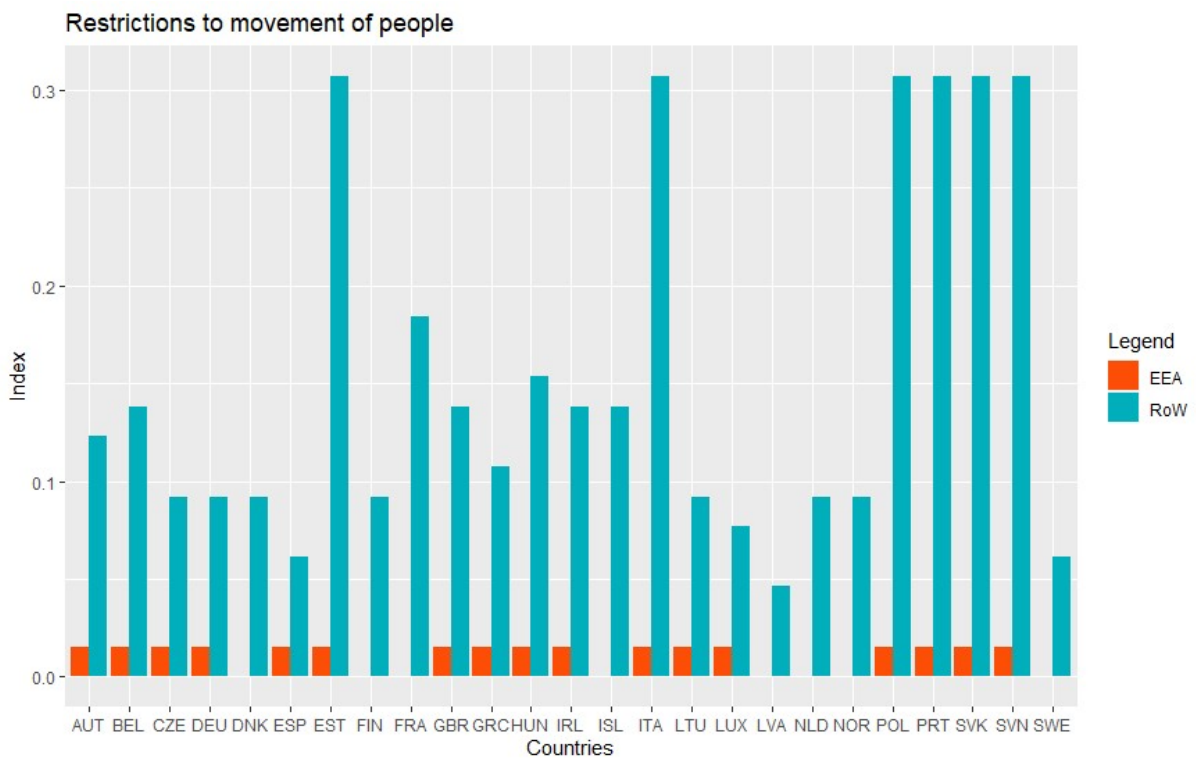
Figure 37. *STRI other discriminatory measures for architecture services within the EEA and with respect to the rest of the world (RoW) in 2018*
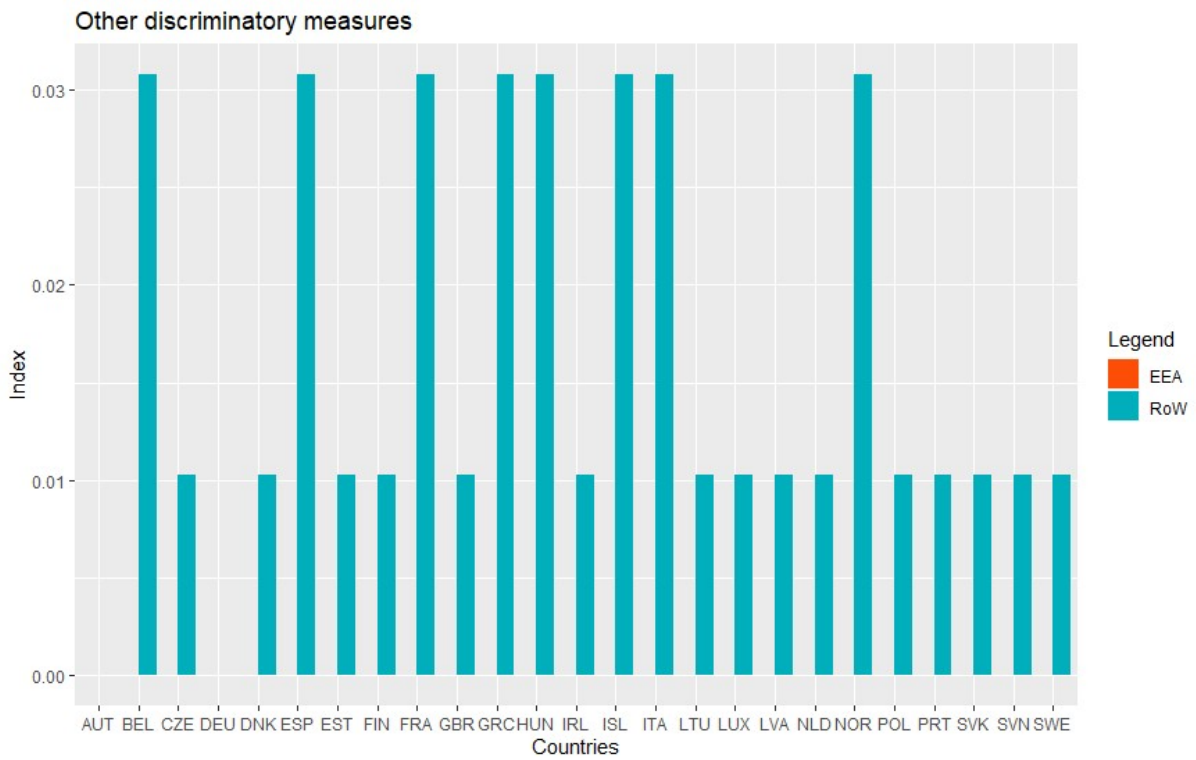
Figure 38. *STRI barriers to competition for architecture services within the EEA and with respect to the rest of the world (RoW) in 2018*
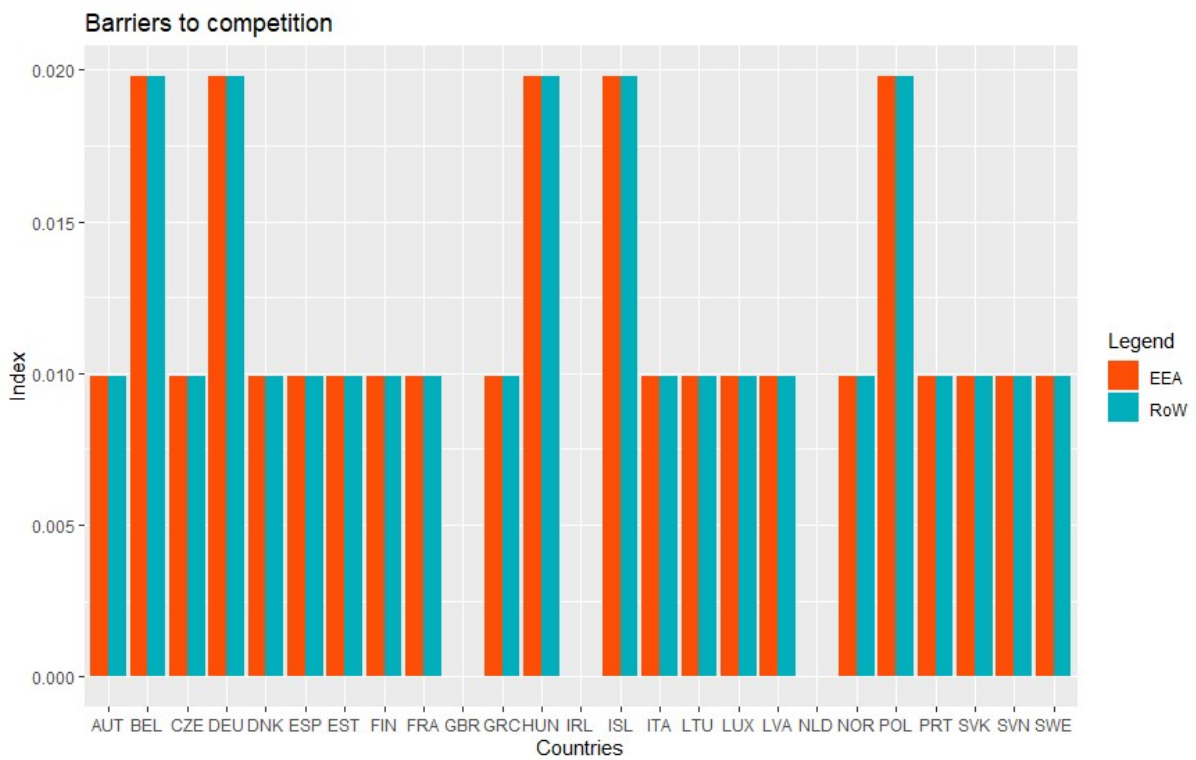
Figure 39. *STRI regulatory transparency for architecture services within the EEA and with respect to the rest of the world (RoW) in 2018*
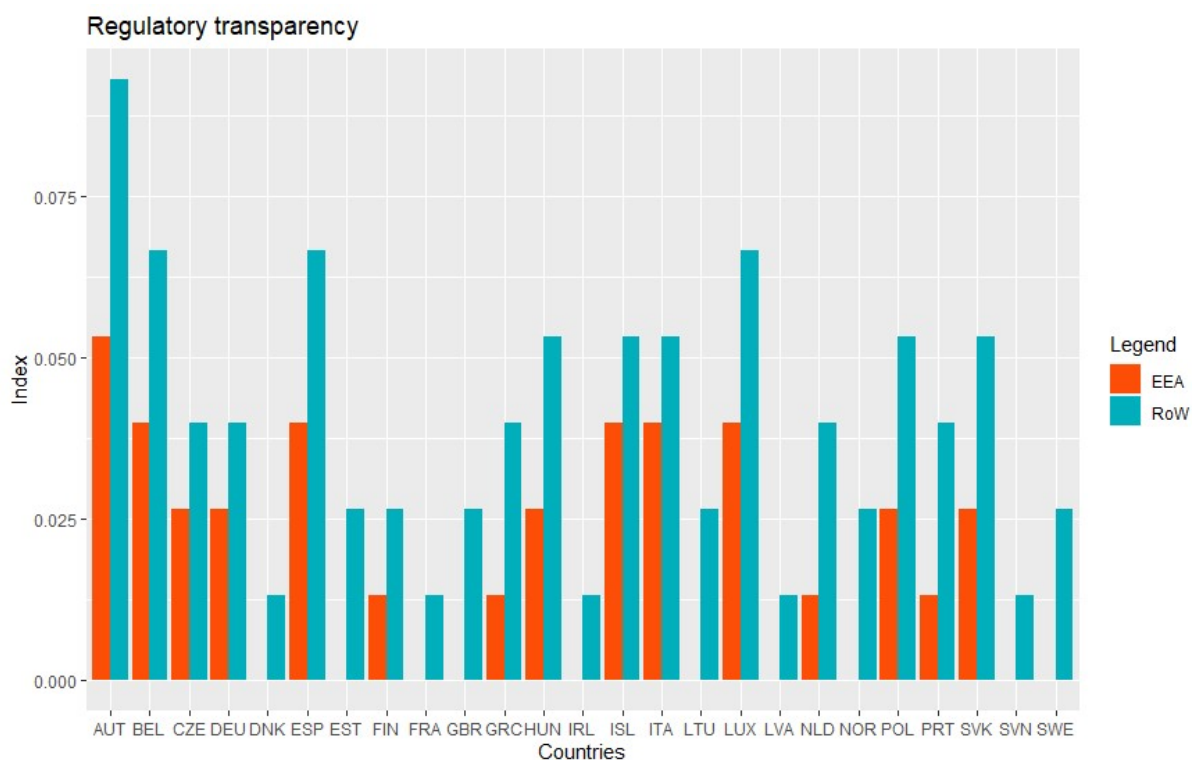
Figure 40. *FDI regulatory restrictiveness index for legal services in 2018*
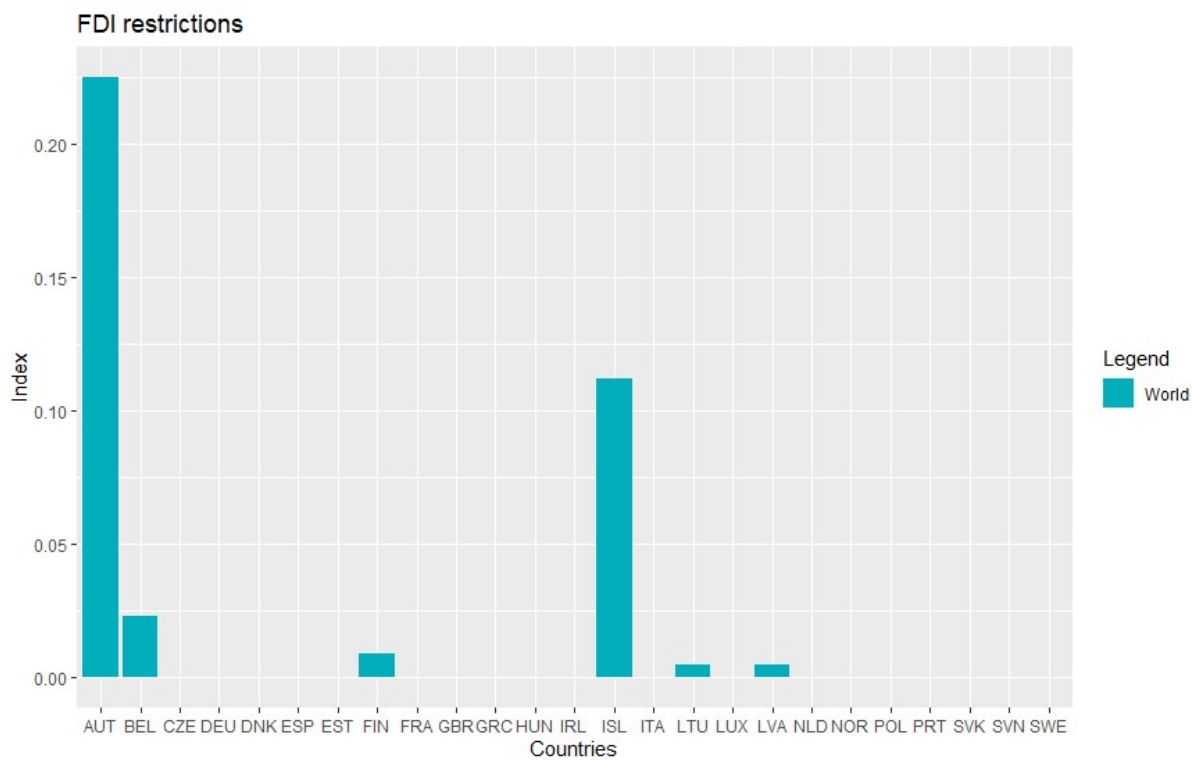
Finally, the FDI regulatory restrictiveness index rates only two EEA countries as relatively restrictive: Austria and, to a much lesser extent, Iceland, the rest being almost open (see Figure 40). But this time the index does not lead a completely isolated existence. The correlation matrix in Figure 41 shows that it is significantly correlated with the lack of regulatory transparency both towards other EEA countries and third countries. But that was it.

Figure 41. *Correlation matrix for the architecture services' STRI indicators and FDI regulatory restrictiveness index (coloured cells highlights statistical significance of a correlation coefficient with α < 0.05)*

The correlation matrix in Figure 41 provides several further insights. Firstly, all STRI sub-indices vis-à-vis other EEA countries are positively and significantly correlated with the corresponding sub-indices vis-à-vis third countries. Second, regulatory transparency vis-à-vis other EEA countries is correlated with both the barriers to competition and the restrictions on foreign entry vis-à-vis other EEA countries. Since the barriers to competition vis-à-vis other EEA countries and third countries are identical, the same correlation with regulatory transparency vis-à-vis other EEA countries is of course also found here. Thirdly, regulatory transparency vis-à-vis third countries is positively and significantly correlated with both foreign entry restrictions and restrictions on the movement of people from other EEA countries. Fourthly, there are no significant correlations between the five STRI sub-indices towards third countries.

The numerous correlations between the various restriction indicators again suggest that they can be well approximated by a smaller number of principal components. In this principal component analysis, the intra-EEA sub-index for the barriers to competition is omitted because it is perfectly collinear with the corresponding sub-index vis-à-vis the rest of the world. The upper part of Table 15 shows that the first four principal components have eigenvalues greater than one, so they should be considered in the further analysis. The screeplot in the left panel of Figure 42 also does not prevent us from considering four principal components in the further analysis. The first principal component explains the variance of 3.17 variables or, in other words, 35% of the total variance. The second and third principal components each account for 16% of the total variance and the fourth principal component for 13%. Together, the first four principal components capture almost 80% of the total variance of the nine restrictiveness indicators included.
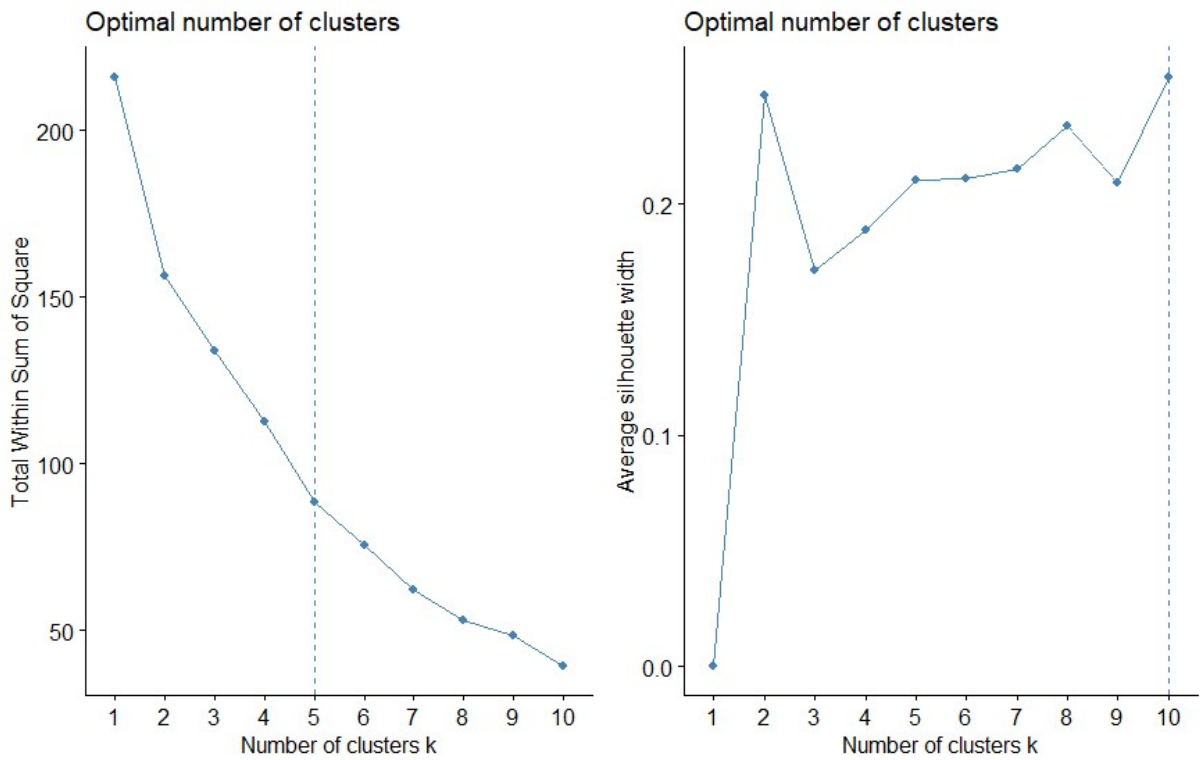
Table 15. Results of the principal component analysis for the architecture services' STRI indicators and FDI regulatory restrictiveness index (first six principal components)

Principal Component	1	2	3	4	5	6
Eigenvalue	3.170	1.440	1.410	1.136	0.701	0.633
Share of the variance explained	0.352	0.160	0.157	0.126	0.078	0.070
Cumulated share	0.352	0.512	0.669	0.795	0.873	0.943
	Eigenvectors (coefficients of the principal components)					
eea_entry	-0.360	-0.218	0.044	-0.420	0.539	-0.318
eea_people	-0.222	0.634	-0.268	0.034	0.369	-0.020
eea_trans	-0.512	0.099	0.112	0.198	-0.004	0.131
all_entry	-0.259	-0.465	-0.352	-0.440	-0.035	0.105
all_people	-0.085	0.251	-0.690	-0.226	-0.382	0.166
all_odis	-0.102	-0.455	-0.288	0.550	0.241	0.450
all_comp	-0.311	-0.155	-0.185	0.398	-0.354	-0.730
all_trans	-0.507	0.173	0.154	0.151	0.047	0.196
fdi_restr	-0.347	-0.020	0.416	-0.233	-0.491	0.263

Note: see Table 2

Figure 42. Screeplot of the explained variance and biplot of the factor loadings for the architecture services' STRI indicators and FDI regulatory restrictiveness index
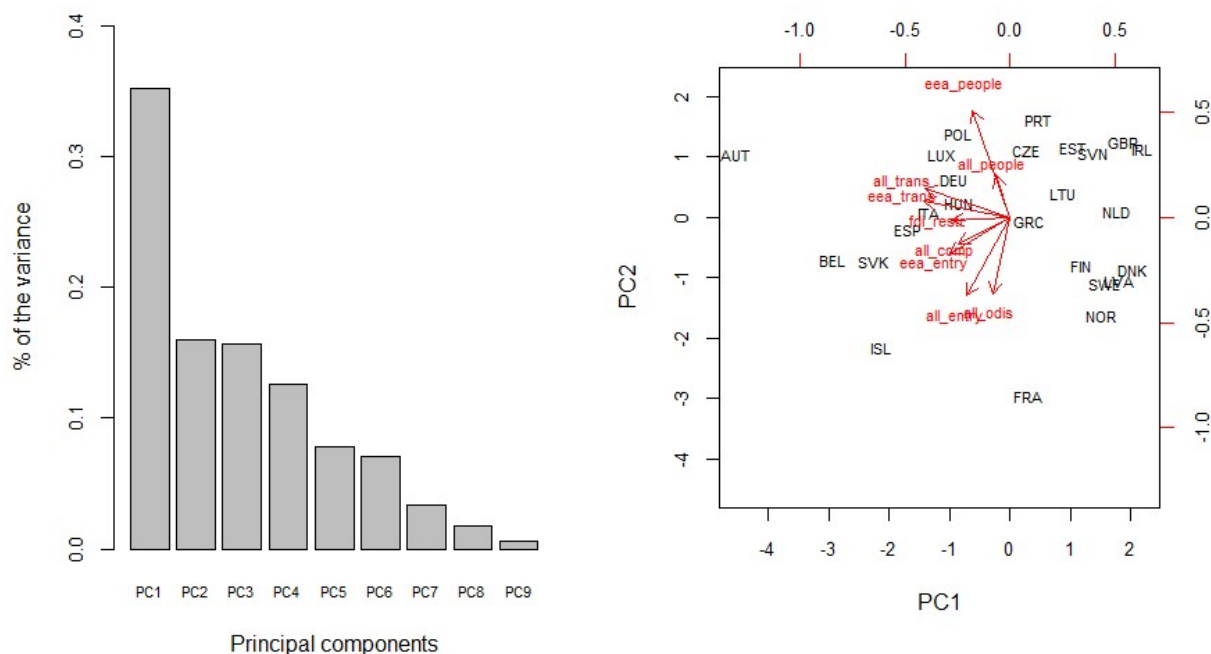
In the case of architecture services, the first principal component also reflects the overall restrictiveness, with the two sub-indices for the lack of regulatory transparency loading particularly strongly on this principal component (see the lower part of Table 15). This interpretation is also supported by the biplot in the right

panel of Figure 42 since the arrows of all sub-indices point in the same direction with respect to the first principal component. The second principal component contrasts the two sub-indices of restrictions on the movement of people and lack of regulatory transparency with all other sub-indices. The biplot in the right-hand panel of Figure 42 also shows this very clearly, and it is obvious that in the second principal component the contrast between, on the one hand, restrictions on the movement of people from other EEA countries, and, on the other hand, other discriminatory measures and restrictions on foreign entry from third countries is the strongest. The third principal component captures the opposite loadings of, on the one hand, restrictions on foreign entry from third countries, restrictions on the movement of people mainly from third countries, but to a lesser extent also from other EEA countries, and other discriminatory measures against third countries, and, on the other hand, the FDI Index. Finally, the fourth principal component contrasts the restrictions on foreign entry, both from other EEA countries and from third countries, with the other discriminatory measures and barriers to competition, two indicators that are small in absolute terms.

Let us next look at the cluster analysis for the restrictiveness indicators. The results of the k-means clustering with $K = 2$ clusters are shown in the Table 16. The first cluster comprises 15 EEA countries. The cluster means for all nine restriction indicators are below the respective overall means. The opposite is true for the second cluster, which includes ten countries. Here all cluster means are above the respective overall means. The differences between the two clusters are particularly large with respect to regulatory transparency both towards other EEA countries and towards third countries. By contrast, they are much smaller for the absolutely most important restriction on the movement of people from third countries.

Table 16. *Results of the k-means cluster analysis for the architecture services' STRI indicators and FDI regulatory restrictiveness index with K = 2*

Cluster	1	2
Cluster members	CZE, DNK, EST, FIN, FRA, GBR, GRC, IRL, LTU, LVA, NLD, NOR, PRT, SVN, SWE	AUT, BEL, DEU, ESP, HUN, ISL, ITA, LUX, POL, SVK
Cluster means		
eea_entry	-0.366	0.550
eea_people	-0.308	0.462
eea_trans	-0.700	1.050
all_entry	-0.284	0.427
all_people	-0.117	0.175
all_odis	-0.153	0.230
all_comp	-0.490	0.735
all_trans	-0.655	0.983
fdi_restr	-0.282	0.424
Within cluster sum of squares (SS)	66.06	90.45
Between SS/total SS	27.5 %	

The cluster plot in Figure 43 shows very clearly that the division into two clusters leads to a very good discrimination with respect to the first principal component as a measure of the overall restrictiveness (plotted on the horizontal axis). All countries of the first cluster have positive principal component scores and all countries of the second cluster have negative principal component scores. However, the information of the second principal component cannot be used at all if the countries are divided into only $K = 2$ clusters. So, the between sum of squares to total sum of squares ratio amounts to only 27.5%.

In the search for the optimal number of clusters, the elbow criterion and the average silhouette criterion do not provide in this case very concise assistance in decision-making (see Figure 44). It is necessary to look very closely in order to decide between two and five clusters using the elbow criterion. According to the average silhouette criterion, the values for two and ten clusters are almost identical. Since it is not very useful to divide 25 countries into ten clusters, in the following a clustering with K = 5 clusters will be considered, whose results are shown in Table 17.

Figure 43. *Cluster plot of the EEA countries (k-means, K = 2) for the architecture services' STRI indicators and FDI regulatory restrictiveness index*
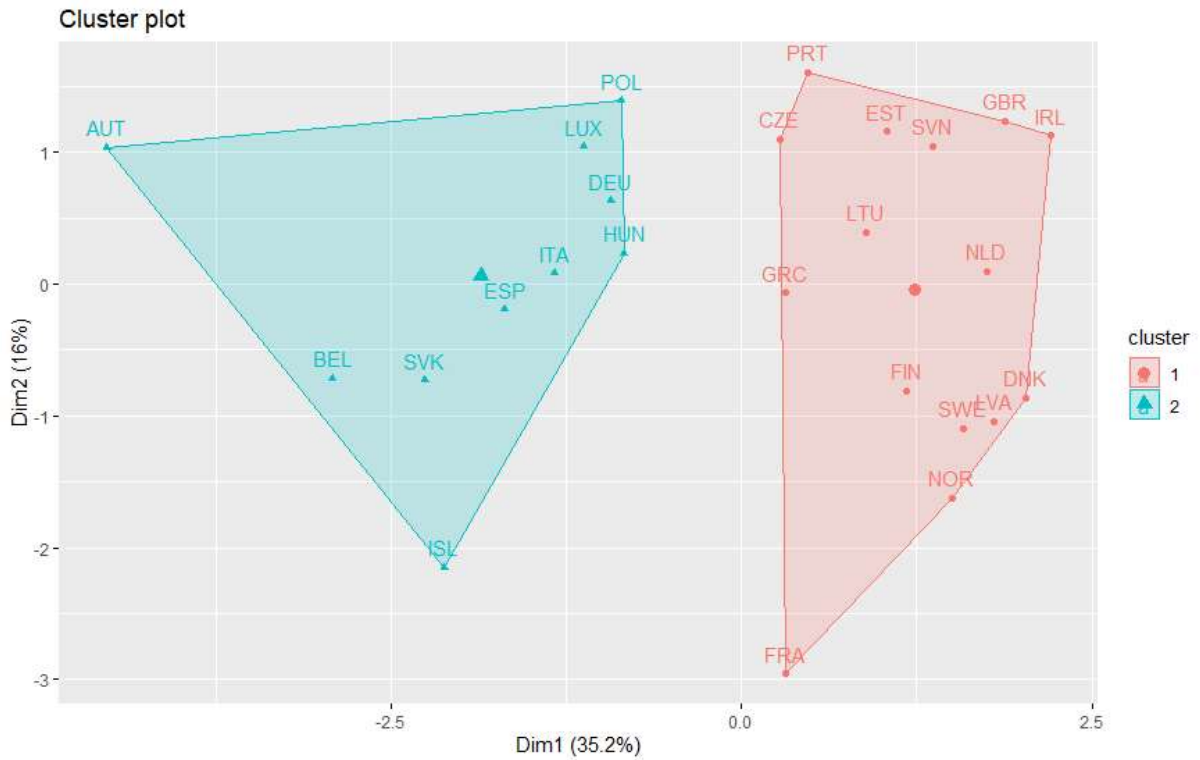
Figure 44. *Selection of the optimal number of clusters for the architecture services' STRI indicators and FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)*

Table 17. Results of the k-means cluster analysis for the architecture services' STRI indicators and FDI regulatory restrictiveness index with K = 5

Cluster	1	2	3	4	5
Cluster members	FRA, SVK	CZE, EST, GBR, IRL, LTU, PRT, SVN	AUT	BEL, DEU, ESP, GRC, HUN, ISL, ITA, LUX, POL	DNK, FIN, LVA, NLD, NOR, SWE
Cluster means					
eea_entry	1.923	-0.530	1.923	0.111	-0.510
eea_people	-0.378	0.672	0.672	0.439	-1.428
eea_trans	-0.244	-0.678	2.040	0.856	-0.751
all_entry	2.560	-0.568	0.314	0.034	-0.294
all_people	0.985	0.466	-0.337	-0.007	-0.805
all_odis	0.421	-0.536	-1.494	0.634	-0.217
all_comp	-0.140	-0.640	-0.140	0.832	-0.432
all_trans	-0.293	-0.612	2.578	0.734	-0.719
fdi_restr	-0.308	-0.294	4.265	-0.003	-0.261
Within cluster sum of squares (SS)	9.32	16.89	0.00	51.11	9.59
Between SS / total SS			59.8 %		

Figure 45. Cluster plot of the EEA countries (k-means, K = 5) for the architecture services' STRI indicators and FDI regulatory restrictiveness index
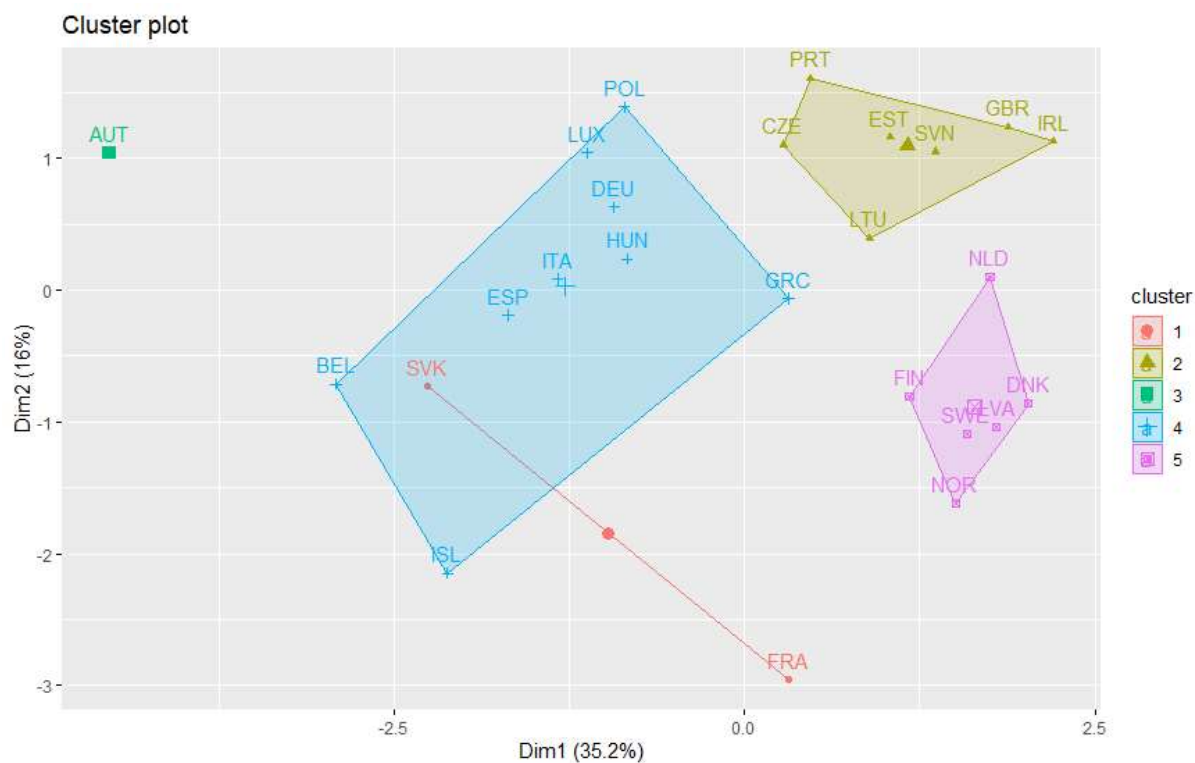
The first cluster includes only France and Slovakia. It is characterised by extremely high cluster means for restrictions on foreign entry both from other EEA countries and from third countries. The cluster means for

restrictions on movement of people from third countries and other discriminatory measures are also quite high. All other cluster means are below the respective overall means. The second cluster comprises seven countries, which, according to the cluster means, have quite high restrictions on the movement of people both from other EEA countries and from third countries. All other cluster means are below the respective overall means. The third cluster is formed only by Austria. Although Austria has very high scores for restrictions on foreign entry from other EEA countries and a lack of regulatory transparency both vis-à-vis other EEA countries and third countries, Austria's unique position is probably due to its extremely high FDI regulatory restrictiveness index score. The fourth cluster gathers nine countries and seems to be quite heterogeneous, at least with respect to some restriction indicators. Although the cluster means for restrictions on the movement of people and the lack of regulatory transparency vis-à-vis other EEA countries and other discriminatory measures, barriers to competition and the lack of regulatory transparency vis-à-vis third countries are above the respective overall means, all other cluster means are very close to the respective overall means. The fifth cluster comprises the six countries that are least restrictive regarding the trade in architectural services. All cluster means are below the respective overall means. The two cluster means for the movement of persons and the two cluster means for the lack of regulatory transparency are particularly low.

In the cluster plot in Figure 45, the extreme isolation of Austria in the upper left corner of the coordinate system of the two principal components is striking. On the other hand, the large area for the fourth cluster shows its heterogeneity. This can also be seen in Table 17 from the fact that the inner-half sum of the squares for this cluster is 51.11, while it is only 16.89 and 9.59 for the only slightly smaller clusters 3 and 5. Furthermore, the less restrictive architectural services trade policy in the countries of the fifth cluster, with regard to both the first and the second principal component, results in a position of this cluster in the lower right-hand corner of the coordinate system.

Figure 46. Selection of the optimal number of clusters for the architecture services' STRI indicators and without FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)
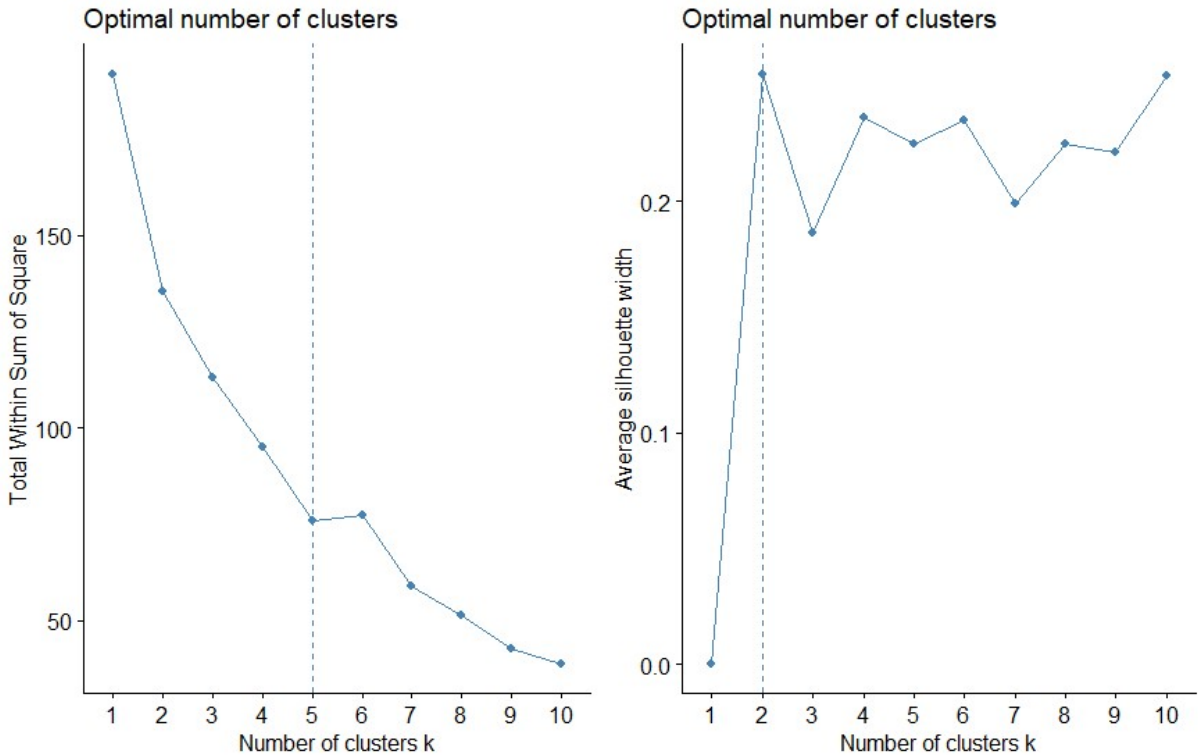
Since Austria's isolated position is only due to its high FDI regulatory restrictive index score, the search for the optimal number of clusters was carried out once again without the FDI regulatory restrictiveness index. The elbow criterion now suggests clearly five clusters, while the average silhouette criterion clearly indicates two clusters (see Figure 46). Hence, the cluster analysis without the FDI index was carried out again with $K = 5$ clusters.

Table 18. *Results of the k-means cluster analysis for the architecture services' STRI indicators and without FDI regulatory restrictiveness index with K = 5*

Cluster	1	2	3	4	5
Cluster members	FRA, SVK	CZE, EST, GBR, IRL, LTU, PRT, SVN	AUT, BEL, DEU, ESP, LUX	DNK, FIN, LVA, NLD, NOR, SWE	GRC, HUN, ISL, ITA, POL
Cluster means					
eea_entry	1.923	-0.530	1.237	-0.510	-0.652
eea_people	-0.378	0.672	0.672	-1.428	0.252
eea_trans	-0.244	-0.678	1.279	-0.751	0.670
all_entry	2.560	-0.568	-0.079	-0.294	0.202
all_people	0.985	0.466	-0.601	-0.805	0.522
all_odis	0.421	-0.536	-0.153	-0.217	0.996
all_comp	-0.140	-0.640	0.560	-0.432	0.910
all_trans	-0.293	-0.612	1.302	-0.719	0.536
Within cluster sum of squares (SS)	9.32	16.88	19.63	9.55	20.61
Between SS / total SS			60.4 %		

Figure 47. *Optimal clustering of the EEA countries (k-means, K = 5) for the architecture services' STRI indicators and without FDI regulatory restrictiveness index*
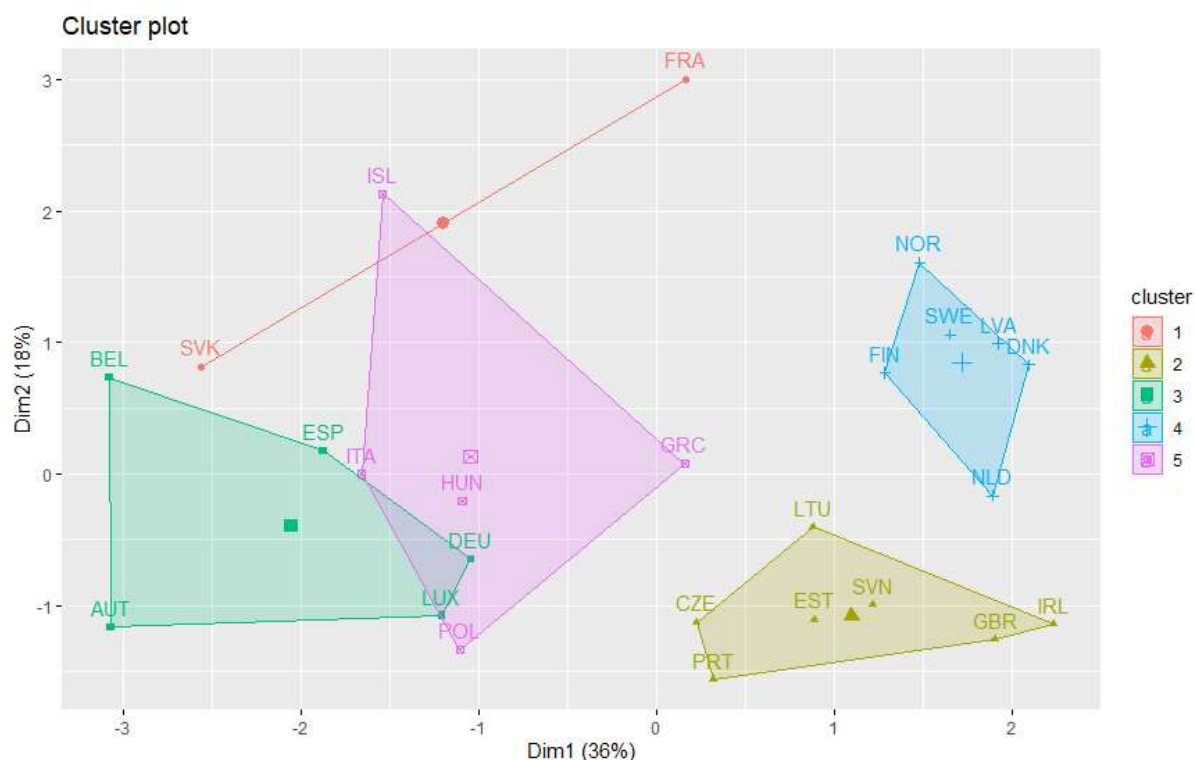
The renewed clustering maintains the first two clusters of the analysis with the FDI index (see Table 18). In the third cluster, Austria is now joined by Belgium, Germany, Luxembourg and Spain. In this cluster, the cluster means for the restrictions on foreign entry from other EEA countries and for the lack of regulatory transparency are remarkably high. The cluster means for restrictions on the movement of people from other

EEA countries and barriers to competition both towards other EEA countries and third countries remain well above the respective overall means. Only the cluster mean for restrictions on the movement of people from third countries is significantly below the corresponding overall mean. The new fourth cluster corresponds to the previous fifth cluster of least restrictive countries on trade in architectural services. The four countries moved to the third cluster are all from the previous fourth cluster of nine countries, which is now the fifth cluster. This cluster is now much more homogeneous and shows a below-average cluster mean only in the case of restrictions on foreign entry from other EEA countries. The cluster means of all other restriction sub-indices are mostly significantly higher than the corresponding overall means. Only the cluster means for restrictions on movement of people from other EEA countries and restrictions on foreign entry from third countries are relatively close to the corresponding overall means.

The cluster plot in Figure 47 shows that Austria has moved from the upper left corner to the lower left corner. The omission of the FDI index has therefore led to a completely different assessment of this country with respect to the second principal components. At the same time, its negative score for the first principal component (the overall restrictiveness) has also been significantly reduced. However, Austria, now together with Belgium, remains the country with the most negative rating in terms of an overall restrictiveness of the architectural services trade. The tightness of the cluster change between Germany and Luxembourg is reflected in the fact that the third and fifth clusters now overlap in the general restrictiveness covered by the first principal component.

In terms of policy implementations for more free trade in architectural services, the key issue is to reduce restrictions on the movement of people, both towards third countries and to a much lesser extent towards other EEA countries. With respect to third countries, efforts must be made in particular by the countries in the first, second and fifth cluster. In contrast, the countries in the third cluster are more called upon to reduce these and other restrictions vis-à-vis other EEA countries. Moreover, the countries in the third and fifth clusters should definitely increase their regulatory transparency.

7 Empirical results for engineering services

Engineering services and related technical consultancy (ISIC 711) are also part of the other business services and comprise several related activities, such as engineering and integrated engineering services, and engineering related scientific and technical consulting services. They form the backbone of the construction industry and provide important inputs for the economy. According to OECD (2018d), an important feature is the regulatory complementarity between architecture, engineering and construction services. Often, architectural and engineering activities are combined into projects offered by one firm.

Table 19 shows that the Intra-EEA STRI indicators for engineering services trade consistently have extremely low means, medians and maximum scores. In relation to third countries, restrictions on foreign entry are on average lower for engineering services than for accounting and legal services. In contrast, restrictions on the movement of people have about the same strength. These types of restrictions also determine the overall STRI significantly. Among the other STRI indicators vis-à-vis the rest of the world, the lack of regulatory transparency still plays a certain role. The FDI regulatory restrictiveness index for engineering services is identical to the one for architecture services. It has a low average value, but with a minimum value of zero and a maximum value of 0.225 it has a rather wide range.

Table 19. *Descriptive statistics of STRI restrictions and FDI regulatory restrictiveness index for engineering services in 2018*

Variable	Mean	Median	Std. Dev.	Min	Max
Foreign entry restrictions EEA (eea_entry)	0.005	0.000	0.011	0.000	0.034
Movement of people EEA (eea_people)	0.007	0.000	0.008	0.000	0.016
Barriers to competition EEA (eea_comp)	0.009	0.009	0.005	0.000	0.018
Regulatory transparency EEA (eea_trans)	0.018	0.013	0.018	0.000	0.053
Foreign entry restrictions RoW (all_entry)	0.051	0.046	0.040	0.011	0.193
Movement of people RoW (all_people)	0.138	0.093	0.091	0.047	0.310
Other discriminatory meas. RoW (all_odis)	0.014	0.009	0.009	0.000	0.027
Barriers to competition RoW (all_comp)	0.009	0.009	0.005	0.000	0.018
Regulatory transparency RoW (all_trans)	0.039	0.040	0.021	0.013	0.093
FDI regulatory restrictions (fdi_restr)	0.015	0.000	0.049	0.000	0.225

In the following, we will again look at the differences between countries for the individual indicators. Most EEA countries have no or only low restrictions on foreign entry (see Figure 48). Regarding these restrictions towards other EEA countries, Austria, Germany, Latvia, Luxemburg and Spain stand out with some residual entry regulations. Towards third countries, this is the case for Iceland, Italy and Slovakia.

The freedom of movement of people within the European single market seems to be largely realised for engineers (see Figure 49). The scores for this type of restrictions are zero for 13 EEA countries and 0.016 for the other 12 EEA countries. The situation is quite different for restrictions on the movement of people from third countries outside the EEA. Here, Italy, Poland, Portugal, Slovakia and Slovenia are particularly striking with scores of 0.310. Several other EEA countries also have relatively high scores in this area.

Other discriminatory measures exist only against third countries and their extent is extremely limited (see Figure 50). The scores for Austria and Germany are zero, for another 15 EEA countries 0.009 and for the remaining 8 EEA countries 0.027. The scores for the barriers to competition are also negligible and always show the same values towards other EEA countries and third countries (see Figure 51). They are zero for Ireland, the Netherlands and the United Kingdom, 0.009 for another 19 EEA countries and 0.018 for the remaining three EEA countries (Germany, Hungary and Iceland).

Figure 48. *STRI restrictions on foreign entry for engineering services within the EEA and with respect to the rest of the world (RoW) in 2018*

Restrictions to foreign entry
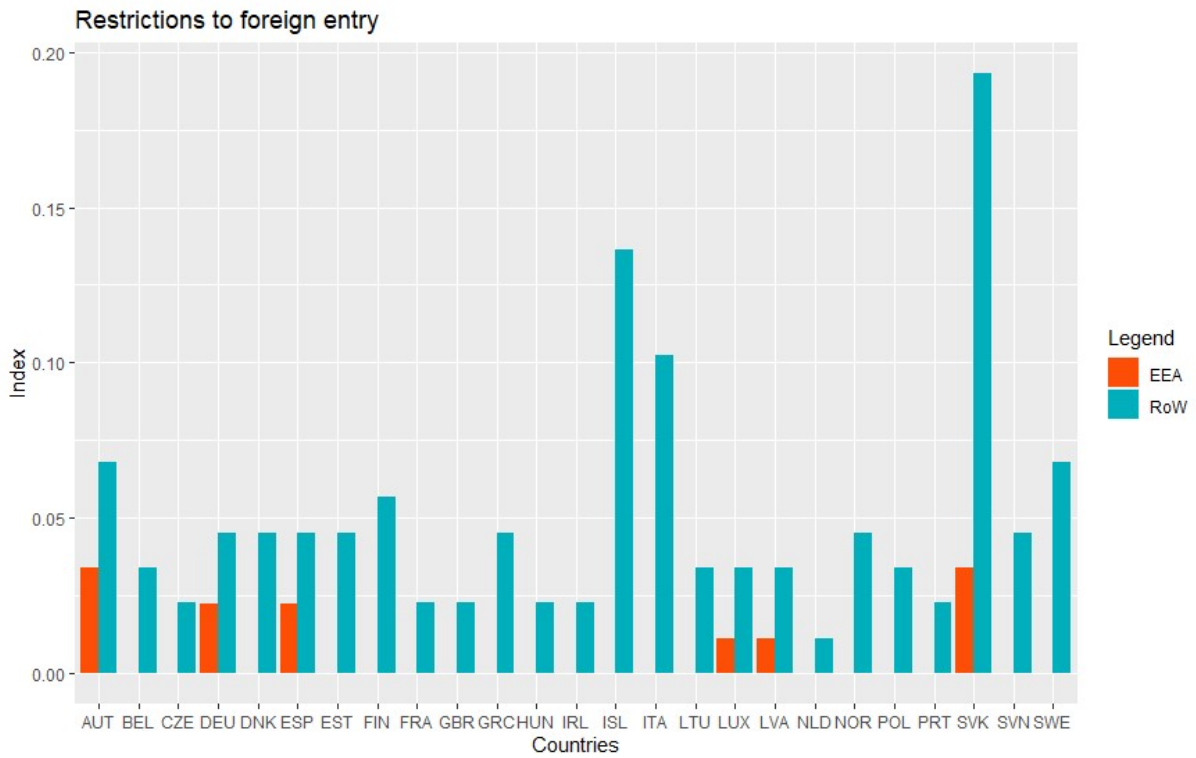
Figure 49. *STRI restrictions on the movement of people for engineering services within the EEA and with respect to the rest of the world (RoW) in 2018*

Restrictions to movement of people
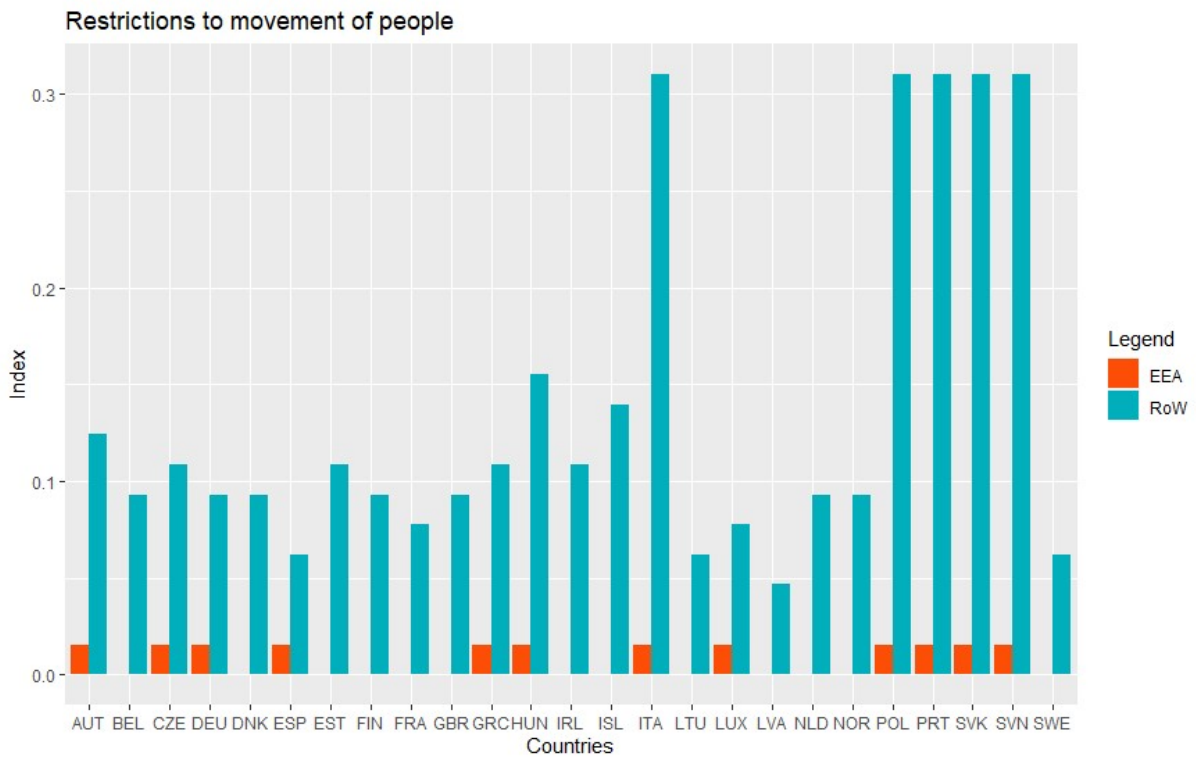
Figure 50. *STRI other discriminatory measures for engineering services within the EEA and with respect to the rest of the world (RoW) in 2018*
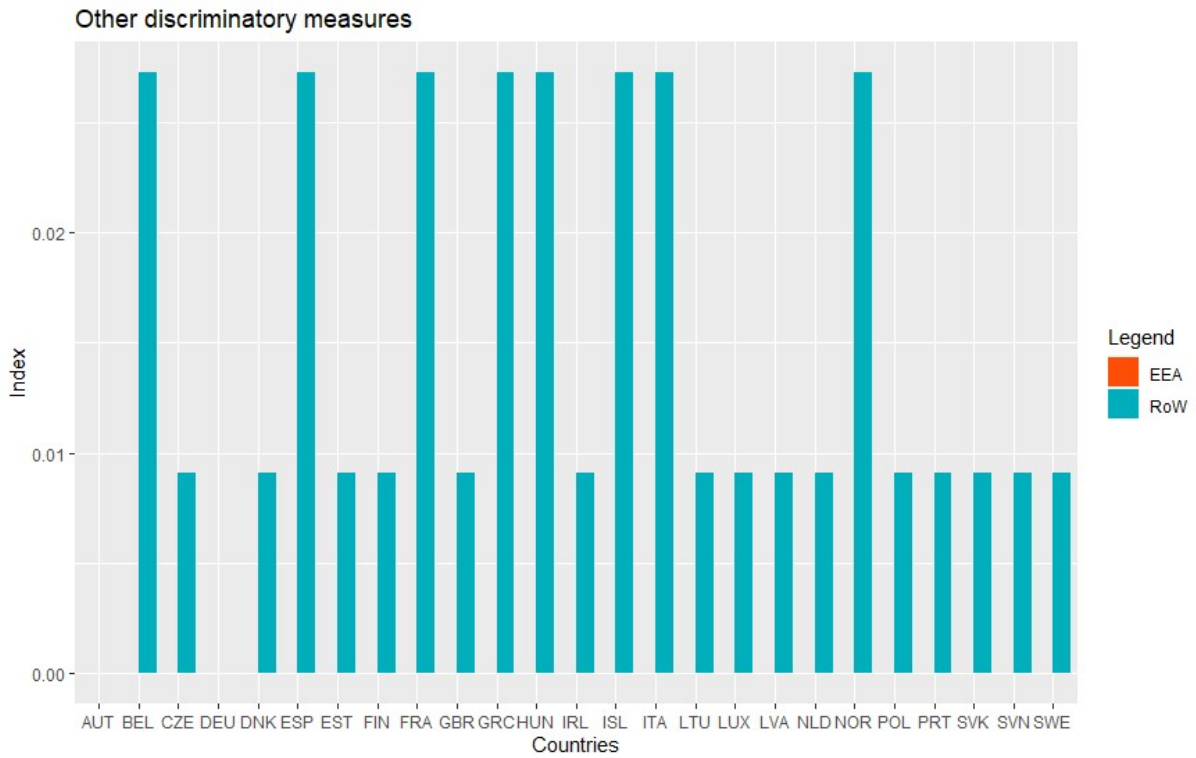
Figure 51. *STRI barriers to competition for engineering services within the EEA and with respect to the rest of the world (RoW) in 2018*
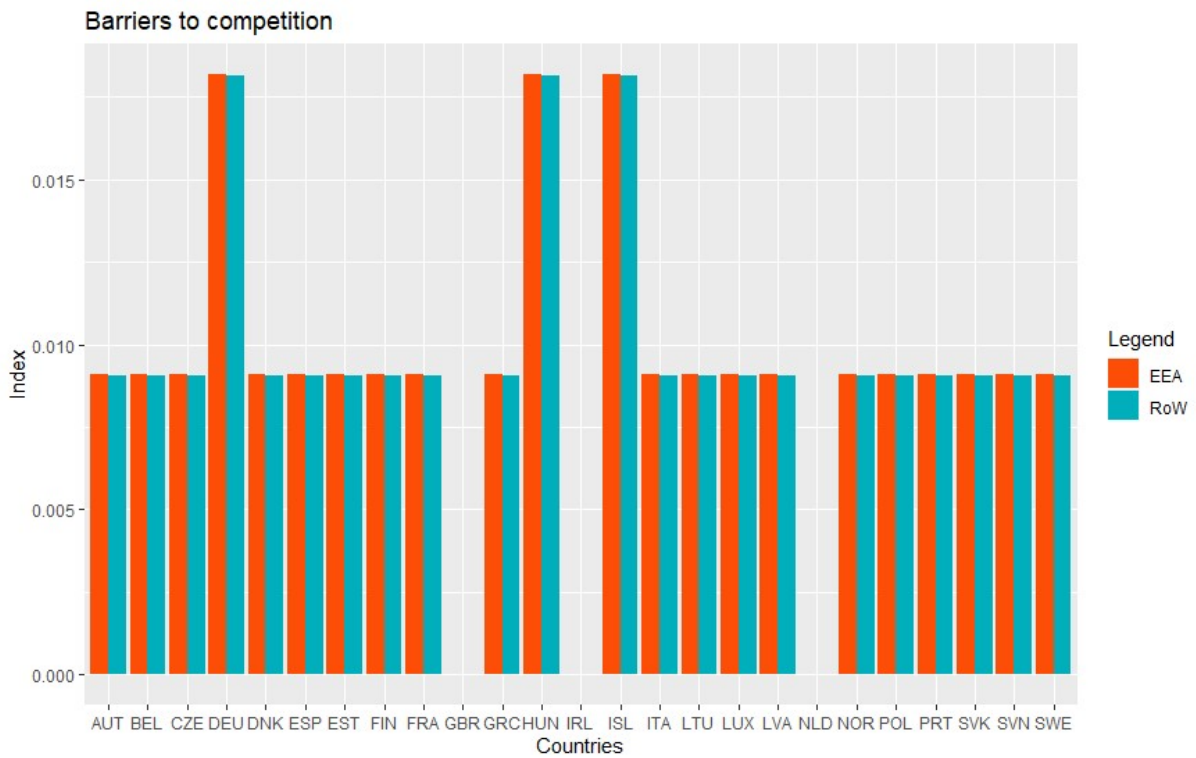
Figure 52. *STRI regulatory transparency for engineering services within the EEA and with respect to the rest of the world (RoW) in 2018*

Regulatory transparency
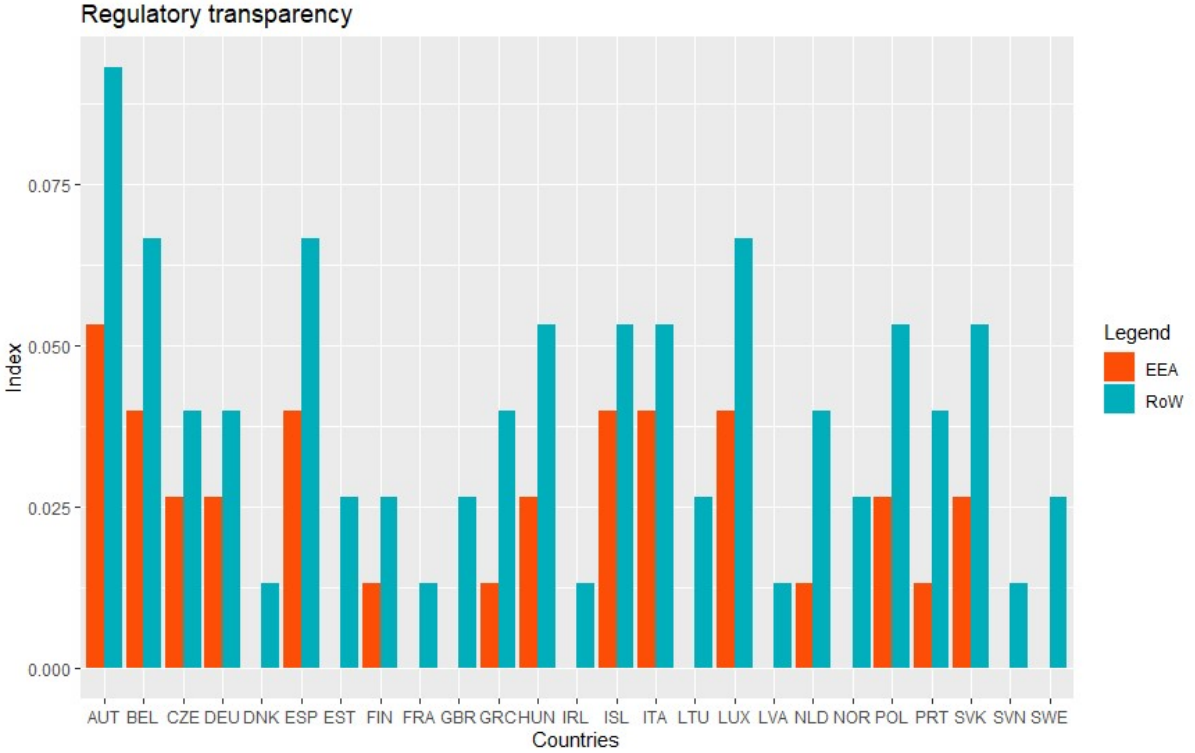
Figure 53. *FDI regulatory restrictiveness index for engineering services in 2018*

FDI restrictions
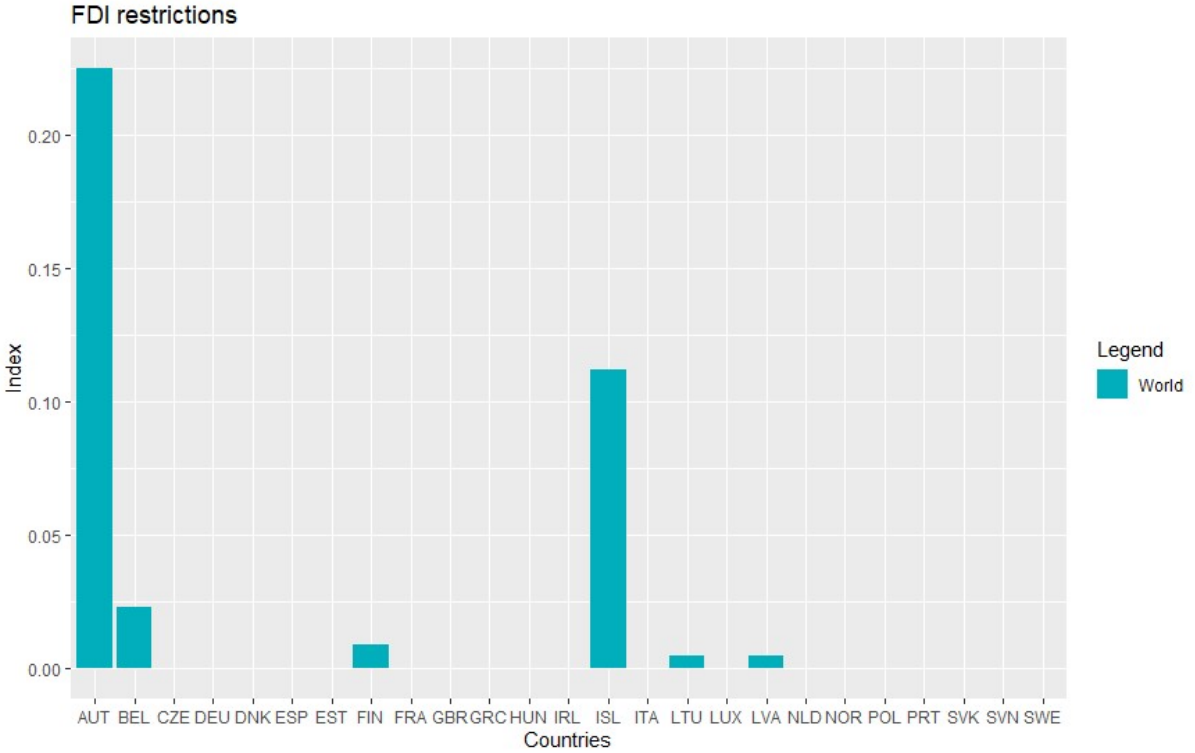
The situation regarding regulatory transparency for engineering services trade is the same as for architecture services trade (see Figure 52). Austria has the lowest level of transparency towards other EEA countries, followed by Belgium, Iceland, Italy, Luxembourg and Spain. Furthermore, several EEA countries still have room for more regulatory transparency vis-à-vis third countries, most notably Austria, followed by Belgium, Luxembourg and Spain.

Finally, as already mentioned, the FDI regulatory restrictiveness index for engineering service is identical to that for architecture services. It rates only two EEA countries as relatively restrictive: Austria and, to a much lesser extent, Iceland, the rest being almost completely open (see Figure 53). As with architecture services, again this index does not exist in isolation. The correlation matrix in Figure 54 shows that it is significantly correlated with the lack of regulatory transparency both towards other EEA countries and third countries, and with restriction to foreign entry from other EEA countries.

Despite the similarity of the restriction indicators for the trade in architectural services and engineering services, the correlation matrix for the latter provides in Figure 54 some interesting additional insights. Firstly, all STRI sub-indices vis-à-vis other EEA countries are positively and significantly correlated with the corresponding sub-indices vis-à-vis third countries. Second, regulatory transparency vis-à-vis other EEA countries as well as vis-à-vis third countries are correlated with both the restrictions on the movement of people and the restrictions on foreign entry vis-à-vis other EEA countries. Thirdly, restrictions on foreign entry both towards other EEA countries and towards third countries are correlated with restrictions on the movement of people towards the corresponding group of countries.

Figure 54. *Correlation matrix for the engineering services' STRI indicators and FDI regulatory restrictiveness index (coloured cells highlights statistical significance of a correlation coefficient with a < 0.05)*

The numerous correlations between the various restriction indicators again suggest that they can be well approximated by a smaller number of principal components. As before in architecture services, the Intra-EEA sub-index for the barriers to competition is omitted in the further analysis because it is perfectly collinear with the corresponding sub-index vis-à-vis the rest of the world. The upper part of Table 20 shows that the first three principal components have eigenvalues greater than one, so they should be considered in the further analysis. The screeplot in the left panel of Figure 55 also does not prevent us from considering three principal components in the further analysis. The first principal component explains the variance of 3.6 variables or, in other words, 40% of the total variance. The second principal component account for 16% of

the total variance and the third principal component for 15%. Together, the first three principal components capture almost 71% of the total variance of the nine restrictiveness indicators included.

Table 20. *Results of the principal component analysis for the engineering services' STRI indicators and FDI regulatory restrictiveness index (first six principal components)*

Principal Component	1	2	3	4	5	6
Eigenvalue	3.600	1.428	1.318	0.973	0.743	0.553
Share of the variance explained	0.400	0.159	0.146	0.108	0.083	0.062
Cumulated share	0.400	0.559	0.705	0.813	0.896	0.957
	Eigenvectors (coefficients of the principal components)					
eea_entry	-0.373	0.347	-0.220	0.154	-0.201	0.533
eea_people	-0.365	-0.289	-0.321	-0.412	-0.230	0.087
eea_trans	-0.474	0.010	0.206	-0.236	0.139	0.034
all_entry	-0.295	-0.138	-0.090	0.765	0.204	0.203
all_people	-0.196	-0.505	-0.500	0.064	0.303	-0.365
all_odis	-0.012	-0.483	0.622	0.011	0.291	0.271
all_comp	-0.253	-0.280	0.305	0.227	-0.764	-0.288
all_trans	-0.464	0.100	0.176	-0.297	0.218	0.058
fdi_restr	-0.315	0.447	0.191	0.148	0.197	-0.610

Note: see Table 2

In the case of engineering services, the first principal component also reflects the overall restrictiveness, with the two sub-indices for the lack of regulatory transparency loading particularly strongly on this principal component (see the lower part of Table 20). This interpretation is also supported by the biplot in the right panel of Figure 55 since the arrows of all sub-indices point in the same direction with respect to the first principal component. The second principal component contrasts the STRI sub-index of restrictions on foreign entry from other EEA countries and the FDI regulatory restrictiveness index with all other STRI sub-indices with the exception of the sub-indices for regulatory transparency, which load only weakly negatively on the second principal component. The biplot in the right-hand panel of Figure 55 also shows this very clearly. It is obvious that in the second principal component the contrast between, on the one hand, restrictions on foreign entry from other EEA countries as well as FDI regulatory restrictiveness, and, on the other hand, other discriminatory measures and restrictions on the movement of people from third countries is the strongest. The third principal component captures the opposite loadings of, on the one hand, restrictions on the movement of people from third countries, and to lower extent, restrictions on the movement of people and foreign entry from other EEA countries, and, on the other hand, other discriminatory measures and barriers to competition. However, discriminatory measures and barriers to competition are small in absolute terms, while restrictions on the movement of people are substantial in absolute terms.

Let us next look at the cluster analysis for the restrictiveness indicators. The results of the k-means clustering with $K = 2$ clusters are shown in the Table 21. The first cluster comprises 13 EEA countries. The cluster means for all nine restriction indicators are below the respective overall means. The opposite is true for the second cluster, which includes twwlve countries. Here all cluster means are above the respective overall means. The differences between the two clusters are particularly large with respect to regulatory transparency both towards other EEA countries and towards third countries, followed by the restrictions on the movement of people from other EEA countries. They are still pronounced but clearly smaller for the absolutely most important restrictions on the movement of people from third countries, as well as for the restrictions on foreign entry and the barriers to competition.

Figure 55. *Screeplot of the explained variance and biplot of the factor loadings for the engineering services' STRI indicators and FDI regulatory restrictiveness index*
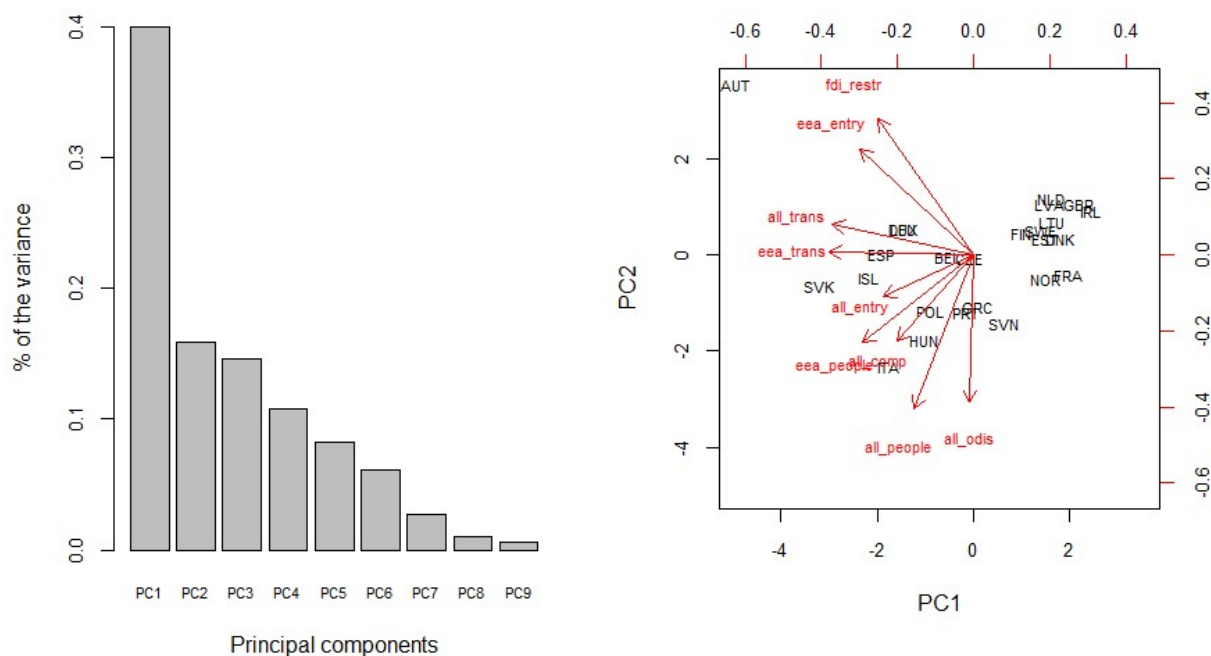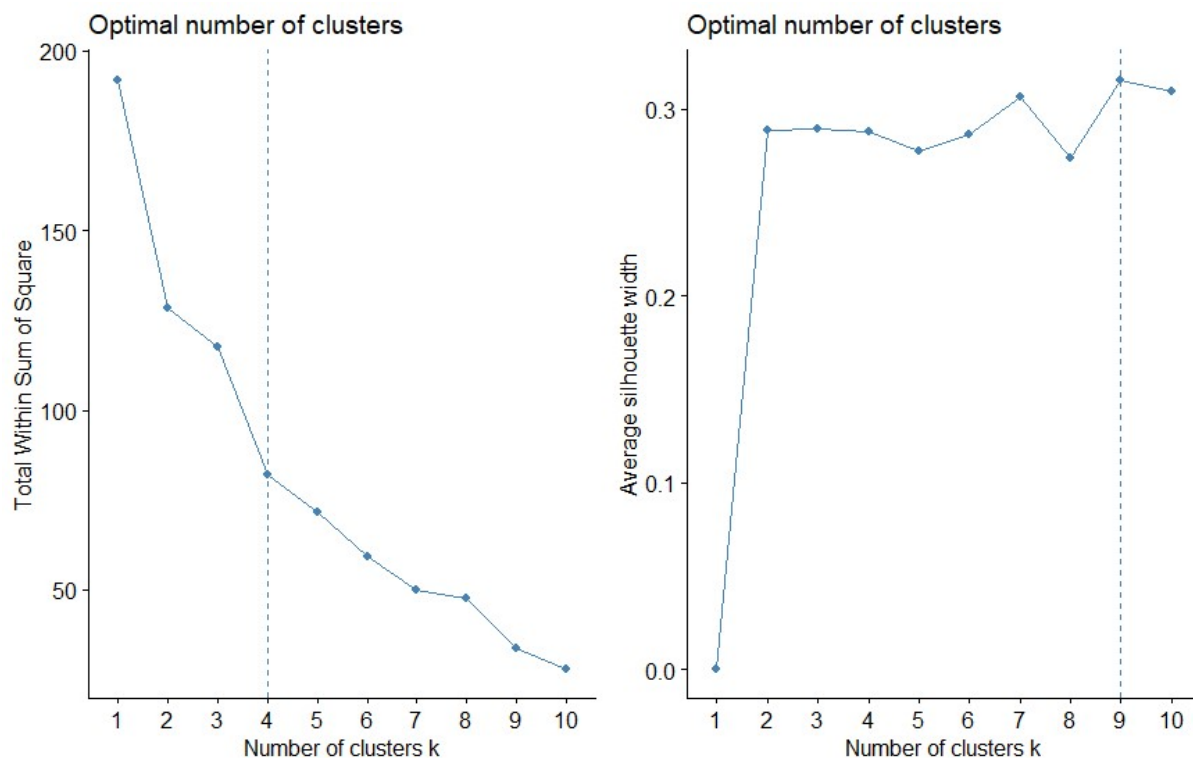
Table 21. *Results of the k-means cluster analysis for the engineering services' STRI indicators and FDI regulatory restrictiveness index with K = 2*

Cluster	1	2
Cluster members	AUT, BEL, CZE, DEU, ESP, GRC, HUN, ISL, ITA, LUX, POL, PRT, SVK	DNK, EST, FIN, FRA, GBR, IRL, LTU, LVA, NLD, NOR, SVN, SWE
Cluster means		
eea_entry	0.380	−0.412
eea_people	0.718	−0.778
eea_trans	0.810	−0.877
all_entry	0.289	−0.313
all_people	0.348	−0.377
all_odis	0.200	−0.217
all_comp	0.462	−0.500
all_trans	0.762	−0.825
fdi_restr	0.255	−0.276
Within cluster sum of squares (SS)	120.04	30.45
Between SS / total SS	30.3 %	

The cluster plot in Figure 56 shows clearly that the division into two clusters leads to a quite good discrimination with respect to the first principal component as a measure of the overall restrictiveness (plotted on the horizontal axis). All countries of the second cluster have positive principal component scores

and almost all countries of the first cluster have negative principal component scores. However, the information of the second principal component remains largely unused if the countries are divided into only *K* = 2 clusters. However, Austria's extreme outlier position in the upper left-hand corner of the chart is striking, probably due to its poor rating by the FDI regulatory restrictiveness index. Altogether, the between sum of squares to total sum of squares ratio amounts to only 30.3%.

Since two clusters are obviously insufficient to exploit the available information to classify EEA countries in terms of their engineering services trade restrictions, the elbow and the average silhouette criterion are used to determine the optimal number of clusters (see Figure 57). The elbow criterion, which looks at the trade-off between the number of clusters and the total within clusters sum of squares, provides evidence that four clusters are appropriate. According to the average-silhouette criterion, which considers the quality of the clusters, nine clusters would be appropriate. Since nine clusters appear to be too many, the results of the analysis with *K* = 4 clusters are presented below.

Figure 56. Cluster plot of the EEA countries (k-means, K = 2) for the engineering services' STRI indicators and FDI regulatory restrictiveness index
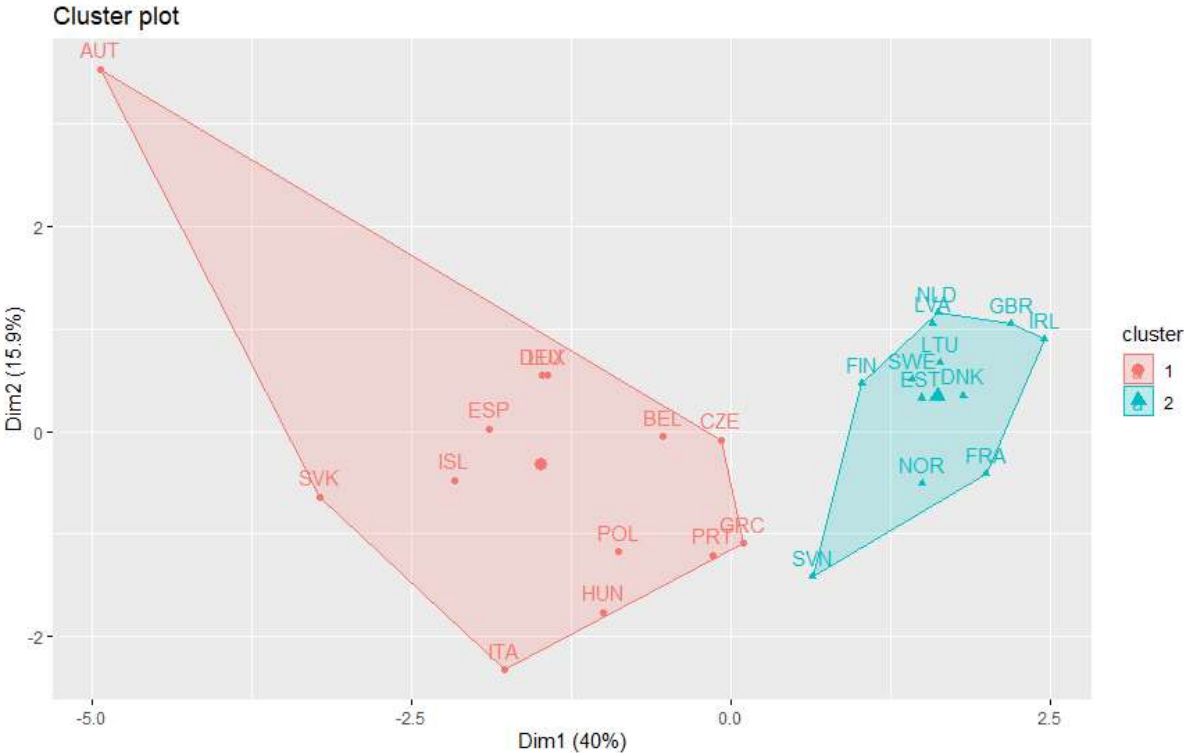
The first cluster covers eleven EEA countries and all its cluster means for the service trade restrictiveness indicators are below the corresponding overall means, which are standardised to zero. The cluster means are particularly low for the lack of regulatory transparency and restrictions on the movement of people, both vis-à-vis other EEA countries and third countries. The second cluster brings together eight EEA countries that are more restrictive in their trade in engineering services. Only the cluster mean for restrictions on the movement of people from third countries is below the corresponding overall mean. The cluster means for restrictions on foreign entry and the FDI regulatory restrictiveness index hardly deviate from the corresponding overall means, while all other cluster means are clearly above average. The third cluster also includes five restrictive EEA countries. In this cluster the means of restrictions on the movement of people are extremely high. In addition, there is also a high cluster mean for restrictions on foreign entry by third countries. As these are the restrictions that are relevant in absolute terms, this cluster must be considered even more prioritised than the second cluster in terms of the need for regulatory reforms. The fourth cluster consists only of Austria. Although this country has extremely high STRI scores for restrictions on foreign entry and the movement of people from other EEA countries, its unique position is probably due to the extremely high score of the FDI regulatory restrictiveness index.

Figure 57. *Selection of the optimal number of clusters for the engineering services' STRI indicators and FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)*
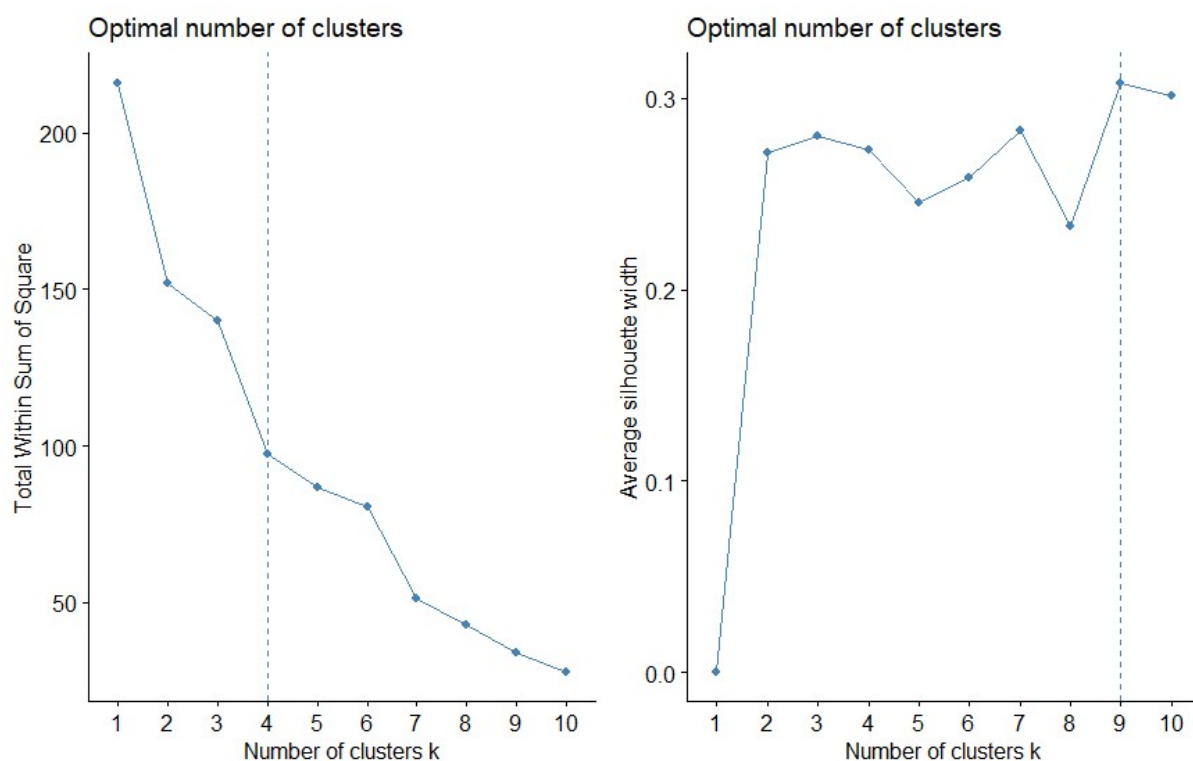
Table 22. *Results of the k-means cluster analysis for the engineering services' STRI indicators and FDI regulatory restrictiveness index with K = 4*

Cluster	1	2	3	4
Cluster members	DNK, EST, FIN, FRA, GBR, IRL, LTU, LVA, NLD, NOR, SWE	BEL CZE, DEU, ESP, GRC, HUN, ISL, LUX	ITA, POL, PRT, SVK, SVN	AUT
Cluster means				
eea_entry	-0.404	0.150	0.125	2.619
eea_people	-0.941	0.530	1.020	1.020
eea_trans	-0.866	0.803	0.212	2.040
all_entry	-0.330	-0.054	0.724	0.441
all_people	-0.583	-0.362	1.892	-0.150
all_odis	-0.188	0.541	-0.153	-1.494
all_comp	-0.545	0.750	0.000	0.000
all_trans	-0.786	0.664	0.153	2.578
fdi_restr	-0.273	0.035	-0.308	4.266
Within cluster sum of squares (SS)	20.66	45.41	28.80	0.00
Between SS / total SS		56.1 %		

Figure 58. *Optimal clustering of the EEA countries (k-means, K = 4) for the engineering services' STRI indicators and FDI regulatory restrictiveness index*
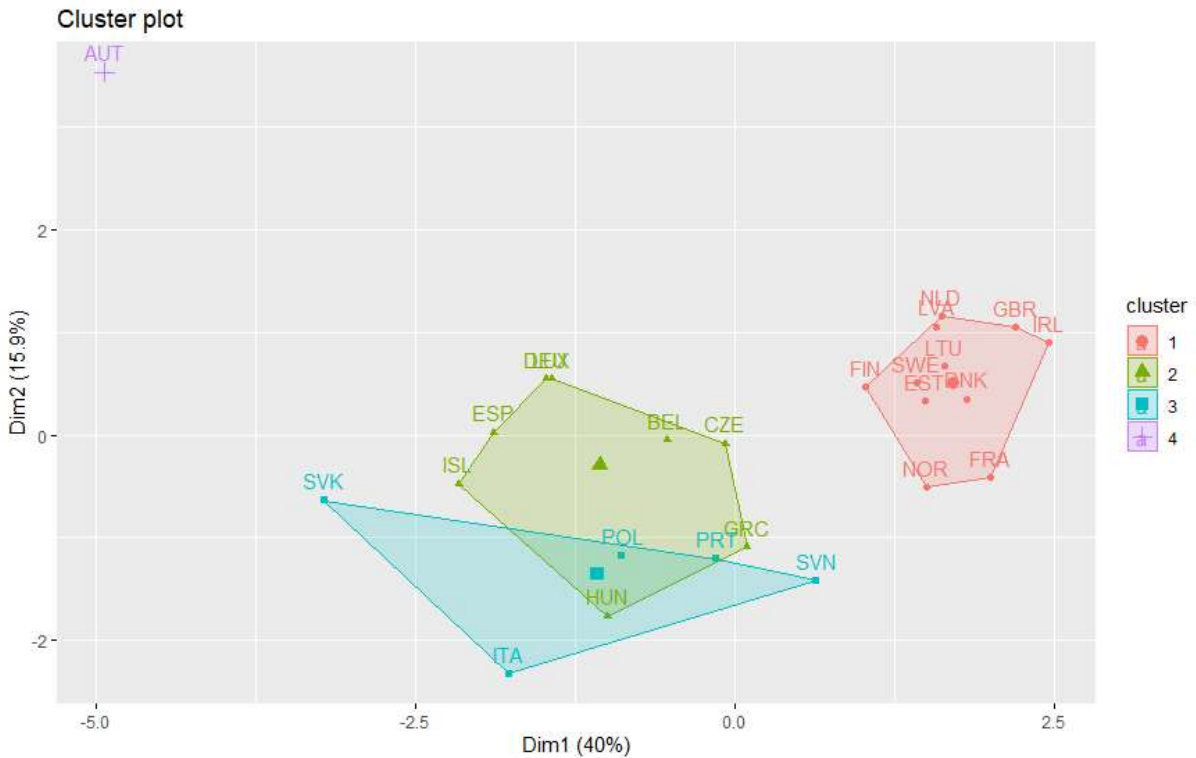
In the cluster plot in Figure 58, the extreme isolation of Austria in the upper left corner of the coordinate system of the two principal components is striking. It is also easy to see how close together the second and third clusters are on the horizontal axis with respect to the first principal component of the overall restrictiveness. However, as already mentioned, the third cluster shows more need for action as it has higher cluster means for the in absolute terms more important restrictions.

Since also in the case of engineering services Austria's isolated position is only due to its high FDI regulatory restrictiveness index score, the search for the optimal number of clusters was repeated here as well without the FDI index. The elbow criterion again suggests four clusters, while the average silhouette criterion keeps on insisting on nine clusters (see Figure 59). Hence, the cluster analysis without the FDI index was carried out again with $K = 4$ clusters.

The renewed clustering results in few but interesting shifts of countries between clusters (see Table 23). The first cluster of less restrictive countries remains unchanged. The Czech Republic moves from the second to the third cluster, while Italy conversely moves from the third to the second cluster. In the fourth cluster, Austria is now joined by Germany from the previous second cluster and Slovakia from the previous third cluster. The second cluster is now even more conspicuous for its lack of regulatory transparency, while the third cluster continues to be characterised by its severe restrictions on the movement of people both from other EEA countries and from third countries. The fourth cluster is characterised by the fact that the restrictions towards other EEA countries are comparatively stronger than towards third countries, although the latter are stronger in absolute terms. Moreover, similar to the countries in the second cluster, the regulatory transparency of the countries in this cluster is clearly below average.

The cluster plot in Figure 60 shows that Austria remains in the upper left corner of the cluster plot. The omission of the FDI index has therefore only led to a reduction of its score for the second principal components. At the same time, its negative score for the first principal component (the overall restrictiveness) has also been significantly reduced. However, Austria, now together with Slovakia, remains the country with the most negative rating in terms of an overall restrictiveness of the engineering services trade. Furthermore, the discriminatory power between the second and third cluster has increased with respect to both the first and second principal components.

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Figure 59. *Selection of the optimal number of clusters for the engineering services' STRI indicators and without FDI regulatory restrictiveness index according to the elbow method (left panel) and average silhouette method (right panel)*

Table 23. *Results of the k-means cluster analysis for the engineering services' STRI indicators and without FDI regulatory restrictiveness index with K = 4*

Cluster	1	2	3	4
Cluster members	DNK, EST, FIN, FRA, GBR, IRL, LTU, LVA, NLD, NOR, SWE	BEL, ESP, GRC, HUN, ISL, ITA, LUX	CZE, POL, PRT, SVN	AUT, DEU, SVK
Cluster means				
eea_entry	-0.404	-0.053	-0.499	2.271
eea_people	-0.941	0.459	1.020	1.020
eea_trans	-0.866	0.953	-0.055	1.023
all_entry	-0.330	0.239	-0.478	1.289
all_people	-0.583	-0.028	1.339	0.418
all_odis	-0.188	1.106	-0.536	-1.175
all_comp	-0.545	0.571	0.000	0.667
all_trans	-0.786	0.846	-0.134	1.089
Within cluster sum of squares (SS)	20.62	33.67	7.41	20.24
Between SS / total SS		57.3 %		

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Figure 60. *Optimal clustering of the EEA countries (k-means, K = 4) for the engineering services' STRI indicators and without FDI regulatory restrictiveness index*
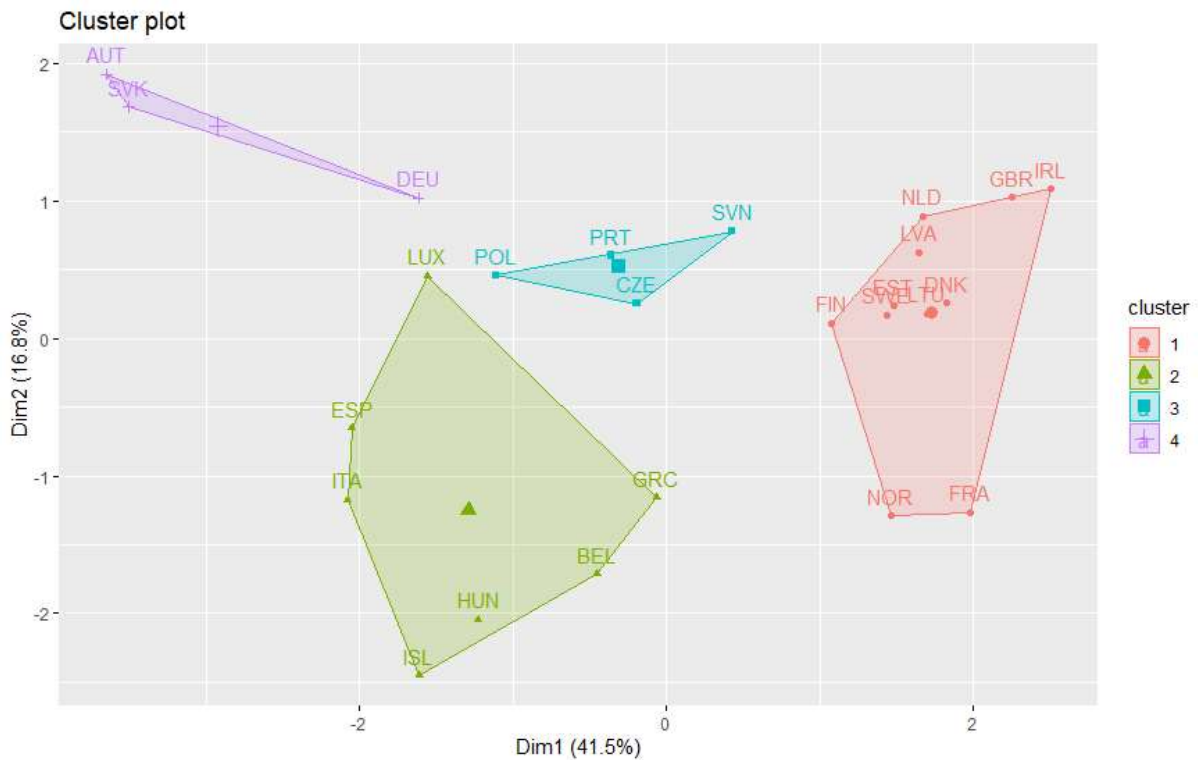
Also, for engineering services, the clustering provides quite clear policy implications. The countries of the second cluster should both reduce their overall restrictiveness and, in particular, increase their regulatory transparency. For the countries in the third cluster, the focus should be on reducing restrictions on the movement of people. This is also important because these kinds of restrictions dominate the overall STRI of the engineering services sector. In addition to the reduction of the overall STRI, the countries in the fourth cluster should pay more attention to the reduction of the remaining restrictions on trade in engineering services within the internal market. On the positive side, there is already a large cluster of eleven EEA countries with low overall restrictions on trade in engineering services.

8   Summary and Conclusions

This study provides a multivariate data analysis of the sub-indices of the original OECD STRI towards third countries without a PTA and the same sub-indices of the OECD Intra-EEA STRI. Additionally, the OECD FDI regulatory restrictiveness index is included in the analysis, which covers five business services sectors in 25 EEA countries. The multivariate data analysis is performed separately for each sector and is divided into five steps. The following results can be summarised across sectors.

The descriptive analysis in the first two steps shows that business services trade within the EEA is substantially less restricted than the business services imports of EEA member countries from non-members, but a certain level of restrictiveness remains within the Single Market of the EEA. Restrictions on trade in professional services are generally somewhat stronger than those on trade in computer services. Most relevant are the restrictions on free entry and movement of people, although these are much stronger in relation to third countries than in relation to other EEA members. In addition, there is a certain lack of regulatory transparency towards both other EEA countries and third countries. All other restrictions are of very little relevance. The FDI regulatory restrictiveness index plays a certain special role, because its rating of countries as open or relatively closed often contradicts the ratings by the STRI sub-indices. Therefore, a number of the multivariate analyses were carried out both with and without this indicator.

The correlation analysis in the third step also confirms the special role of the FDI index. Furthermore, this analysis generally shows that business service sectors of the EEA countries that are highly protected against third countries also are relatively highly protected against other EEA countries. It should also be emphasised that for three professional services there are statistically highly significant correlations between restrictions on foreign entry and movement of people. In the case of accounting services, this only applies to restrictions vis-à-vis third countries. In the case of legal services and engineering services, this is also the case for the restrictions vis-à-vis other EEA countries. These correlations are strongest for legal services.   This complementarity of the two restrictions on trade of skilled labour-intensive professional services once again justifies the multidimensional approach chosen in order to capture the interaction between the different facets of service trade restrictiveness.

Table 24: *Distribution of the EEA countries on the two clusters for a high and low overall service trade restrictiveness*

Service sector	Restrictiveness	
	high	low
Computer	AUT, BEL, ESP, HUN, ISL, ITA, LUX, POL, GRC, SVK	DNK, EST, FIN, GBR, IRL, LTU, LVA, NLD, CZE, FRA, NOR, SVN, SWE, DEU, PRT,
Accounting	AUT, BEL, ESP, ISL, ITA, GRC, PRT, FRA, NOR, SVN, SWE	DNK, EST, FIN, GBR, IRL, LTU, LVA, NLD, CZE, DEU, SVK, HUN, LUX, POL
Legal	HUN, LUX, POL	DNK, EST, FIN, GBR, IRL, LTU, LVA, NLD, CZE, FRA, NOR, PRT, SVN, SWE, DEU, GRC, SVK, AUT, BEL, ESP, ISL, ITA
Architecture	AUT, BEL, ESP, HUN, ISL, ITA, LUX, POL, SVK, DEU,	DNK, EST, FIN, GBR, IRL, LTU, LVA, NLD, CZE, FRA, NOR, SVN, SWE, PRT, GRC
Engineering	AUT, BEL, ESP, HUN, ISL, ITA, LUX, POL, GRC, SVK , DEU, PRT, CZE	DNK, EST, FIN, GBR, IRL, LTU, LVA, NLD, FRA, NOR, SVN, SWE

In the principal component analysis in the fourth step, especially the results concerning the first principal component can be generalized. It can be interpreted throughout as the overall restrictiveness of a country with regard to trade in the business services under consideration. This overall restrictiveness covers between 35% (architecture services) and 45% (legal services) of the total variance of the indicators included. A

generalizable interpretation of the second principal component, which covers between 16% (legal services) and 29% of the total variance, is not possible. However, it often contrasts the restrictions on the movement of people or the lack of regulatory transparency with the other types of restrictions.

Table 25. *Policy recommendations based on the optimal clustering of the STRI restrictions*

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Computer services					
Cluster members	DEU, GBR, IRL, NLD	BEL, ESP, GRC, HUN, ITA	AUT, CZE, LUX, POL, PRT, SVK	DNK, EST, FIN, FRA, LTU, LVA, NOR, SVN, SWE	ISL
Policy implications	Reduction of restrictions on the movement of people from third countries	Increase of regulatory transparency, reduction of remaining other discriminatory measures and barriers to competition	Increase of regulatory transparency	Reduction of restrictions on foreign entry and the movement of people from third countries	Reduction of strong service trade restrictions in all areas
Accounting services					
Cluster members	CZE, DEU, DNK, FIN, GBR, IRL, LTU, LUX, LVA, NLD, POL, SVK	EST, FRA, PRT, SVN, SWE	ESP, GRC, HUN, ISL, ITA, NOR	AUT, BEL	
Policy implications	No need for action	Reduction of restrictions on foreign entry from both EEA members and third countries, reduction of restrictions on the movement of people, reduction of remaining barriers to competition	Reduction of restrictions on movement of people from both EEA members and third countries, reduction of restrictions on foreign entry, increase of regulatory transparency	Reduction of strong service trade restrictions in all areas	
Legal services					
Cluster members	FIN, LVA, SWE	AUT, BEL CZE, DEU, ESP, HUN, ISL, ITA, SVK	LUX, POL	DNK, EST, FRA, GBR, GRC, IRL, LTU, NLD, NOR, PRT, SVN	
Policy implications	No need for action	Reduction of barriers to competition and reduction of restrictions to foreign entry and movement of people from other EEA	Reduction of strong service trade restrictions in all areas	Reduction of restrictions to the movement of people from both EEA members and third countries	

Architecture services

Cluster members	FRA, SVK	CZE, EST, GBR, IRL, LTU, PRT, SVN	AUT, BEL, DEU, ESP, LUX	DNK, FIN, LVA, NLD, NOR, SWE	GRC, HUN, ISL, ITA, POL
Policy implications	Reduction of strong restrictions on foreign entry from both other EEA members and third countries, reduction of restrictions on the movement of people from third countries	Reduction of restrictions to the movement of people from both other EEA members and third countries	Reduction of restrictions on foreign entry and movement of people from other EEA members, reduction of barriers to competition, increase of regulatory transparency	No need for action	Reduction of service trade restrictions in all areas, except of restrictions to foreign entry from other EEA members

Engineering services

Cluster members	DNK, EST, FIN, FRA, GBR, IRL, LTU, LVA, NLD, NOR, SWE	BEL, ESP, GRC, HUN, ISL, ITA, LUX	CZE, POL, PRT, SVN	AUT, DEU, SVK
Policy implications	No need for action	Increase of regulatory transparency, reduction of restrictions on the movement of people from other EEA members and restrictions to foreign entry from third countries, reduction of other discriminatory measures and barriers to competition	Reduction of restrictions on the movement of people from both other EEA members and third countries	Reduction of mostly strong restrictions on foreign entry and the movement of people from both other EEA members and third countries, increase of regulatory transparency, reduction of barriers to competition

In the cluster analyses in the fifth step, all 25 EEA countries were first divided into two clusters. The k-means algorithm usually achieved a good subdivision according to the general service trade restrictiveness of a country in the sector under consideration. Table 24 illustrates for the five business services sectors how the 25 EEA countries are distributed across the two clusters. Eight countries (highlighted in dark orange) show a high overall service trade restrictiveness in four of the five sectors (the clusters on the left-hand side of the table). For these countries, it would be advisable to reduce their general restrictiveness across the whole board of business services. Further two countries (marked light orange) are generally highly restrictive towards trade in services in three sectors. Finally, there are two countries that are assigned to this cluster in two sectors (marked very brightly in turquoise) and five countries that are only in one cluster (marked brightly in turquoise). On the right-hand side of Table 24, there are eight EEA countries with a low overall

restrictiveness for the five business services (marked dark turquoise). These are Denmark, Finland, the United Kingdom, Ireland and the Netherlands in the north and west of Europe and the Baltic countries Estonia, Latvia and Lithuania. The other 17 countries are of course always the respective complements, so that each EEA country is represented in either the left side or the right side cluster for each business services sector.

Detailed policy recommendations can be made based on the optimal number of clusters for each business services sector. These are compiled in Table 25 and range from very high need for action (marked dark orange) to medium and low need for action (marked light orange and light turquoise) to no need for action (marked dark turquoise). For each cluster, the identified policy areas are based on the cluster means, indicating where there is potential for reducing restrictions on trade in services.

Finally, the discrepancies between the OECD STRI indicators, for example for restrictions on foreign entry, and the OECD FDI regulatory restrictiveness index show that there is need for stronger efforts to objectively quantify the different aspects of countries' FDI and service trade regimes in the area of business services. More and better data, both across countries and in terms of the policy areas that significantly affect trade, are needed for better-informed policy discussions. If attention is to focus on specific policies rather than just indicators, summary measures of the openness of countries and sectors to trade in services and FDI are needed (see also Cerdeiro and Nam, 2018). Here, simply summing up the sub-indices is not enough and our results of the principal component and cluster analyses might have pointed to a direction for addressing this problem.

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