Changing Voting Dimensions in the European Parliament, 2004-2021*

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Abstract

We investigate the main dividing lines in the voting behaviour of Members of the European Parliament and how they evolved from the eurozone crisis to the Covid-19 pandemic. To this end, we introduce a new database on the universe of plenary votes cast in the European Parliament from 2004 to 2021. Using principal component analysis, we identify the left-right and the pro-/anti-EU dimensions as the main dimensions of voting. We find that the pro-/anti-EU divide gained relevance during each crisis, becoming the most relevant pattern of alliance in the European Parliament. We show that this new dynamic affects all votes and is not limited to crisis-related votes. This evidence contributes to the debate on the emergence of a new cleavage in European politics.

Keywords: Ideology; Legislative Voting; European Parliament; Crisis; Party Politics.

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1 Introduction

The dimensionality of voting in the European Parliament (EP) is subject of great interest to political scientists. Since the EP is the only supranational assembly in the world that is directly elected (Hix and Høyland, 2013), each Member of the European Parliament (MEP) represents the countries where she is elected, but is also members of a national party and of a European cross-national groups. This institutional setting creates the potential for multiple dimensions that could affect MEPs' voting behaviour. MEPs could vote depending on their stance on the left-right axis, their position on European integration or their nationality. The seminal work of Hix et al. (2006) and subsequent updates (Hix et al., 2007; 2009; Høyland, 2010) showed that this is not the case. These studies showed that, since its inception in 1979 up until 2004, the EP has been dominated by the traditional left-right dimension of conflict. These findings led to the conclusion that the EP is 'surprisingly like all other democratic parliaments' (Hix et al., 2006; p. 509).

Since these studies, a number of crises shook Europe, reopening the debate on which dimensions drive the politics of the European Union (Ford and Jennings, 2020). The eurozone crisis, the refugee crisis, the terrorist attacks, Brexit and, more recently, the Covid-19 pandemic are all likely to have influenced the dividing lines across which MEPs vote. However, it is not clear in which direction. On the one hand, the crises could have strengthened the left-right divide as a result of a more polarized political environment. On the other hand, the asymmetric nature of the shocks could have reinforced cross-country differences, reshaping MEPs' voting across national interests rather than party ideology. A third potential trajectory is that the crises sharpened the cleavage dividing pro-European and Eurosceptic MEPs. These three perspectives revived the question on whether the EP is still dominated by a left-right divide, like all other democratic legislative assemblies.

Nevertheless, existing evidence on how the crises changed MEPs' voting behavior is mixed. Braghiroli (2015) shows that during the eurozone crisis MEPs clustered among national lines, dividing countries that members of the European Monetary Union and those that are not. By contrast, Blumenau and Lauderdale (2018) show that MEPs increasingly

voted along a pro-/anti-European integration dimension. However, both works identify this change to be limited to crisis-related votes. In a similar fashion, Otjes and van der Veer (2016) show that the pro-/anti-EU line of conflict gained relevance over the left-right rift, but only among economic votes. Their research, as they acknowledge, falls short in determining the durability of the new dimensionality over time. In addition, all these three works use data from the sixth (2004-2009) and seventh (2009-2014) parliamentary terms, but do not include the eighth (2014-2019). This limitation is relevant as it does not allow to observe whether the changes in voting during the crisis period were a temporary reaction to the shock (as suggested by Blumenau and Lauderdale, 2018) or whether they were structural and crystallised over time (as suggested by Otjes and van der Veer, 2016). Moreover, their period of analysis does not include important shocks that followed the euro crisis, such as the migration crisis, or the Covid-19 pandemic. These analyses are therefore insufficient to inform us on whether the EP has changed from the pre-crisis period.

In this paper we aim to address this question and investigate how voting in the EP has changed throughout these crises. To this end, we introduce a new database that includes the universe of plenary votes cast in the EP from 2004 to 2021. This period covers all the major shocks that affected European politics, including the euro crisis, the refugee crisis, the terrorist attacks, Brexit and the Covid-19 pandemic. Using a novel methodology, we identify the main dimensions of voting in the EP and how they changed over time. Combining these results with text analysis techniques, we compare votes related to each crisis (e.g. votes on migration during the refugee crisis) with votes that are not strictly related to it. This allows us to inspect whether the change generating from each crisis affected all votes or was rather limited to specific policy areas. Overall, our findings show that since the euro crisis the EP has changed substantially and cannot be considered any longer a 'normal' parliament.

2 Voting in the European Parliament

From the establishment of the EP in 1979 up until the crisis, two main dimensions of conflict structured MEPs' voting (Kreppel and Tsebelis, 1999; Hix et al., 2006; 2009; McElroy and

Benoit, 2011). The first dimension, statically more relevant, divided MEPs on a left-right axis. In practice, this means that MEPs tended to coalesce depending on their ideological location on this dimension: legislators of centre-left parties were more likely to vote together with those from radical left parties than with those from centre-right parties. The second dimension reflected MEPs' positions on a pro-/anti-EU axis: MEPs' voting coalitions were also based on their preferences for European integration. For a significant number of votes, pro-EU MEPs tended to coalesce against anti-EU MEPs (and viceversa), regardless of their positions on the left-right axis.[4] However, this dimension was secondary and considerably less salient, as it could explain a significantly lower amount of votes compared to the left-right dimension (Hix et al., 2006).

Since the onset of the eurozone crisis in 2009, a number of shocks have changed European politics substantially. These changes have likely influenced the dimensions of voting in the European Parliament. Two questions emerge from this consideration. First, what trajectory has the crisis given to the dimensionality of voting in the European Parliament? Second, was this change temporary and specific to crisis votes or did it affect all policy areas in a permanent way?

Scholars have identified three potential trajectories of change in the vote of MEPs to answer to the first of these questions: the polarization view, the national interest view and the Pro-/Anti-EU view.

Polarization view. According to the first interpretation, the crisis increased polarization, strengthening the already dominant left-right rift. The recession has deepened the economic differences between the winners and losers of globalization, widening the distance between parties on the left and on the right (Kriesi et al., 2008). Kriesi et al. (2008) argue that the reinforcement of the left-right divide is not limited to the economic sphere, but concerns policy areas such as identity and immigration. Polarization can be observed in

[4]Some observers may argue that positions on the left-right and pro-/anti-EU axis may permeate, making it difficult to identify a clear dimension. However, the statistical models employed to estimate the dimensions (as well as the one that is used in this paper) impose ex ante the orthogonality conditions on the dimensions. This restriction allows to estimate dimensions that are independent from one another. By the same token, if voting was the result of a combination of the two dimensions, then this would result in a single dimension of voting. The literature has therefore identified robust evidence on the independence of these two dimensions for what concerns MEPs' voting.

the electoral growth of fringe parties on both extremes of the left-right axis. The Spanish Podemos and the Greek SYRIZA are examples of radical left parties that grew during the crisis, whereas the German Alternative For Germany, the French National Rally, and the Italian League are examples of far right parties.

National Interest view. According to a second perspective, the shocks aligned MEPs' voting more closely to national interests. The euro crisis was an asymmetric shocks that had an heterogeneous impact on EU member states. In particular, Southern European countries suffered the eurozone crisis more intensely than Northern and Eastern European countries.[5] In addition, the refugee crisis favoured the surge of nationalist parties (Colantone and Stanig, 2019). While pre-crisis evidence showed that MEPs tend to vote along party lines rather than nationality (Hix et al., 2009), evidence in Braghiroli (2015) highlights the erosion of voting coherence along cross-national ideological lines in favour of membership to national delegations during the euro crisis. However, his analysis relies on a limited sample consisting of 33 votes held between 2009 and 2012.

Pro-/Anti-EU view The third view argues that the Pro-/Anti-EU divide has taken over the traditional left-right rift as the new main dimension (Jackson and Jolly, 2021; Hutter and Kriesi, 2019; Hooghe and Marks, 2018). This is reflected in the electoral success of a number of new parties that reject to be categorized as left-wing or right-wing, such as the Five Star Movement in Italy, En Marche in France, the United Kingdom Independence Party in the UK (Mosca and Tronconi, 2019; Lorimer, 2018; Goldhammer, 2018). However, evidence on the emergence of this new dimension in the MEPs' voting behavior is limited. Otjes and van der Veer (2016) find that the pro-/anti-EU dimension became dominant in MEPs' voting during the crisis, but only for economic votes. Similarly, Blumenau and Lauderdale (2018) show that pro-/anti-EU positions mattered more than those on the left-right axis, but only for those votes that are strictly related to the crisis, such as the establishment of a supranational banking supervisor (i.e. the Single Supervisory Mechanism) or the reform of the Stability and Growth Pact to bolster common fiscal rules.

[5] A clear indicator of the differentiated economic impact can be observed in the dynamic of government bond yields, which increased substantially in Greece, Italy, Portugal and Spain, while remaining relatively low in Northern and Eastern European countries (von Hagen et al., 2011).

The second question concerns whether this dimensional change affected only crisis-related votes or was pervasive across different types of votes. On the one hand, Blumenau and Lauderdale (2018) show that during the eurozone crisis the dimensional change of votes was limited to those votes on crisis-related reforms, but did not affect other types of votes. Similarly, Otjes and van der Veer (2016) observe a dimensional change in MEPs' voting during the eurozone crisis only for economic votes.

The occurrence of other shocks after the eurozone crisis provides for an ideal setting to test whether the dimensional change is specific to crisis-related votes or spill over other policy areas. Together with the eurozone crisis, also the other shocks contributed to shape European politics (Taggart and Szczerbiak, 2018; Pirro and Taggart, 2018; Caporaso, 2018). Suppose that, when a shock hits, MEPs change voting behaviour specifically for crisis-related votes, as in the framework described by Blumenau and Lauderdale (2018). Then, we would expect this voting behaviour to dissipate as a different crisis hits Europe. For example, as Europe is hit by the migration crisis, we would expect the dimension to change solely for migration-related votes. At the same time, as the focus shifts from economic votes to migration-related votes, the left-right dimension should become again the dominant dimension of voting. Conversely, if the change is pervasive, we would expect the new dimension to extend to a wider range of policy areas other than crisis-specific ones.

To summarize, there are two main questions that we aim to address based on the theory. The first is whether there has been a dimensional change in MEPs' voting during the crisis. According to the first hypothesis, there has not been a change in dimension. On the contrary, the left-right dimension gained even more valence during the crisis. The two other hypotheses support the view for which there has been a dimensional change, and the left-right dimension has been replaced by a new dimension. The second question we tackle is whether voting changed homogeneously across crisis-related and non-crisis votes, or whether this change was limited to crisis-related votes. In the next sections we outline the data and the methodology we use to address these questions.

3 Data

In order to explore the dividing lines of votes in the European Parliament, we collect the universe of public votes cast by MEPs between 2004 and 2021. To this end, we webscrape the website of the European Parliament, which regularly publishes the results of each vote. The document describes for each vote the stance of each individual MEP, i.e. whether she voted in favour or against a specific bill, or whether she abstained. The result is a large matrix that combines each MEP with each vote. We assign to each cell a score of 1 if the MEP voted in favour, -1 if against, 0 if the MEP abstained or was absent. If the MEP was not in office on that specific vote, the cell reports a missing value.

Our sample covers four parliamentary terms, namely the sixth (2004-2009), seventh (2009-2014), eighth (2014-2019), and ninth (2019-2024) terms. For the ninth parliamentary term, we have data available up until year 2021. Table 1 provides an overview of the number of MEPs, seats and votes for each term. For each term, the number of MEPs exceed the number of seats due to turnover.[6] Our matrix combines each MEP with each vote, yielding a total of 27,939,764 cells.[7]

Table 1: Composition of the European Parliament, by parliamentary term

	Sixth			Seventh			Eighth			Ninth		
Political Group (EP abbreviation)	MEPs	Seats	Votes	MEPs	Seats	Votes	MEPs	Seats	Votes	MEPs	Seats	Votes
Total	944	785	6,352	858	736	6,958	860	749	9,789	801	705	9,432
Christian Democrats (EPP/PPE)	341	288		304	265		242	216		192	186	
Socialists (S&D)	265	217		220	184		207	185		160	145	
Liberals (ALDE; Renew)	129	104		95	84		86	69		118	98	
Conservatives (ECR)	NA	NA		57	54		90	77		69	62	
Radical Left (GUE/NGL)	47	41		46	35		64	52		42	39	
Greens (Verts/ALE)	44	43		66	55		60	52		83	69	
Eurosceptics (EFDD; IND/DEM)	27	22		33	32		45	42		NA	NA	
Far Right (ENF; ITS; ID)	NA	NA		NA	NA		43	36		75	74	
National-Conservatives (UEN)	51	40		NA	NA		NA	NA		NA	NA	
Non-Attached (NI)	40	30		37	27		23	20		62	32	

Note: the column 'Seats' reports the number of seats allocated to each group in the last year of the term (or the last available year).

The centre-right (EPP/PPE) and the centre-left (S&D) have been respectively

[6] Moreover, due to changes in legislation, the number of seats changes across terms.

[7] The number of observations/cells for each term is the following: Sixth: 5,996,228; Seventh: 5,969,964; Eighth: 8,418,540; Ninth: 7,555,032.

the first and second most represented political groups in the parliament throughout the whole period. The liberals (ALDE; Renew) represent the third largest party historically (with the exception of the eighth parliament, when the conservatives had a larger share of seats than the liberals). The group of the Conservatives (ECR), which was the third largest group of the eighth term, comprehends the British Conservatives and the Polish Law and Justice, plus other smaller parties. The group was established after the withdrawal of the British Conservatives from the EPP in 2009, due to divergent positions on European integration (Lynch and Whitaker, 2007). The size of the group shrunk substantially following the withdrawal of the United Kingdom from the European Union, and the consequential loss of the party of the British Conservatives, the largest member in the group.

4 Methodology

Our aim is to identify the patterns of alliance that summarise the information of thousands of votes and their relative importance in explaining MEPs' voting behaviour. To this end, we apply principal component analysis (PCA) to the voting data described in the previous section. PCA is a statistical dimensionality reduction method. It recovers the minimum amount of orthogonal dimensions able to summarise the maximum amount of information of a large multivariate dataset. The outcome of PCA is a small number of dimensions that provides a compact and meaningful representation of the underlying observations, while retaining most of the variance of the data. Applying PCA on MEPs' votes therefore yields a limited number of dimensions that summarise the main lines across which MEPs divide.

PCA assigns a score for each dimension based on the share of variance captured by each vote. Thanks to this property, we can extract a score for each MEP related to each dimension. This score reflects the MEP's position along a certain latent cleavage. For example, suppose that MEPs tend to divide across a North-South divide: e.g. MEPs from Southern Europe tend to vote in favour of those votes that MEPs from Northern Europe tend to reject and viceversa. In this case, PCA will assign a high score to MEPs from Southern Europe and a high score of opposite sign to MEPs from Northern Europe.

Like other methodologies of dimensionality reduction (e.g., NOMINATE), the PCA dimensions are latent. It is only by observing the allocation of scores across MEPs on such spectrum that we are able to infer that a certain dimension is about, for instance, a North-South divide. By the same token, PCA could also yield patterns of voting that are inexplicable. Therefore, the second step of our approach is to identify what political divide captures the latent dimensions yielded by the PCA. We first plot and inspect the location of MEPs based on their PCA scores. Through this face validity test[8] we can see if MEPs distribute along a divide based on nationality, or on left-right or pro-/anti-EU stances.

Second, we further unpack the latent dimensions using regressions. We regress the PCA scores against the scores on party positions from the Chapel Hill Expert Survey (CHES) database, which provides party-level scores on political stances, including stances on the left-right axis or on European integration. Based on this approach, we study the magnitude of the correlation between the latent dimensions and the dimensions of external data sources, providing for a test to validate or reject the inferences of the face validity test. Hix et al. (2006) and Otjes and van der Veer (2016) use similar regression techniques to validate their inferences on the latent dimensions.

PCA has a number of advantages compared to other methodologies used to estimate the dimensionality of voting behaviour in previous works, including NOMINATE (Potthoff, 2018), Optimal Classification and multi-dimensional scaling. In Appendix A. we analyze the benefits of using PCA over these other methods. In the same section we apply these different methods to our voting data, We show that the outcome of each method displays a high correlation with the results of PCA.

While all these methods identify a minimum number of dimensions to describe legislators' voting behaviour, under all methodologies the dimensions extracted are latent. This means that it is the task of the researcher to interpret the meaning of such cleavages/dimensions. Following Hix et al. (2006), we first develop an hypothesis on the meaning of each dimension of voting by plotting the PCA scores for each MEPs and observing how they locate on each dimension vis-a-vis their peers. Second, we test our hypothesis by look-

[8]Face validity can be defined as a quick and simple impression of the distribution of the estimates over time, and is helpful as an initial test to identify the results of latent dimensions (Goet, 2019).

ing at the correlation between MEPs scores and exogenous measures of ideological position of European national parties those MEPs belong to.

5 Main Results

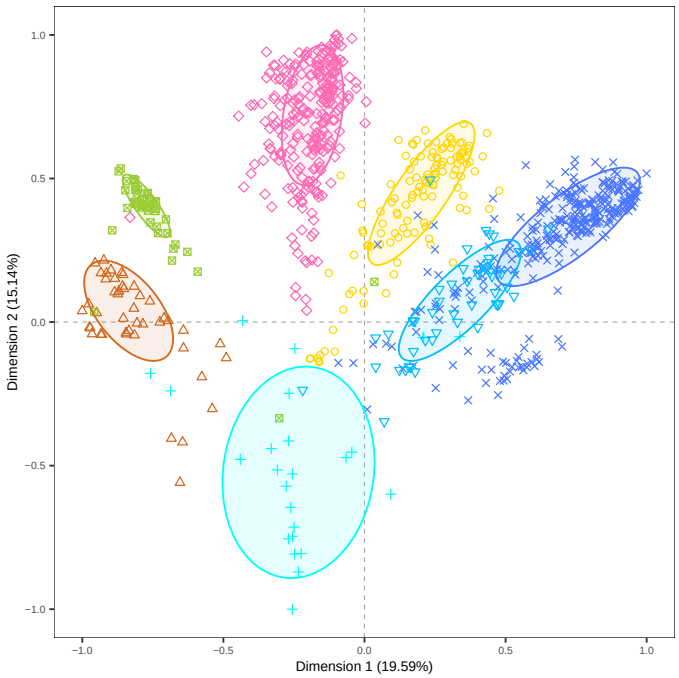
A. Principal Component Analysis Results

PCA yields two main dimensions that combined explain most MEPs' voting.[9] This result is in line with the literature that found MEPs' voting to be dominated by two dimensions (Hix et al., 2006; Hix et al., 2009; Høyland, 2010; Dalton, 2018). Panels 1a-1d in Figure 1 plot the PCA estimates for each MEP. Each dot corresponds to an MEP and is located on the chart depending on the MEP's score on each of the two dimensions. The shape and color of each dot varies denote the MEPs' political group. The two axes of the chart represent the two dimensions that explain most of the variance in the votes. We report the share of variance explained by each latent dimension on the axes of each chart. In panel 6 the main dimension is the horizontal dimension (19.59%), whereas in all the other panels the main dimension is captured by the vertical axis. The location of the axes capture the average MEP score on each dimension. Therefore, MEPs located on the axes (i.e. whose score on a dimension is equal to zero) are simply close to the average and occupy a centrist position relative to the locations of all the other MEPs along that specific dimension. For this reason, the axes should *not* be interpreted as cut-off points above or below which an MEP belongs to a certain side of the dimension.

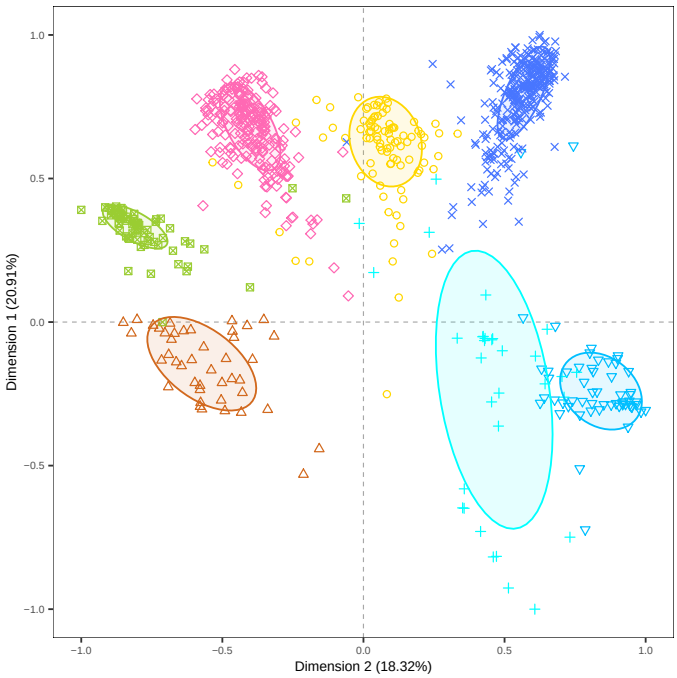
[9]In statistical terms, the PCA yields two principal components that combined explain a large share of the variance of the votes over time compared to the other components. The scree plots show that the share of variance explained by the third dimension is less than one third of the variance explained by the second dimension for all four parliamentary terms (Figures 6-9 in the Appendix). The scree plot displays the eigenvalues of the latent principal components, or dimensions, extracted using PCA. In our case, PCA yields ten components, which in the figures of the scree plots are ordered by the magnitude of their eigenvalues. This makes each dimension, or principal component, beyond the first two negligible for our analysis. The first two latent dimension capture 34.73% of the variance of the data 6th parliamentary term, 39.23% for the 7th and 46.45% for the 8th term. By estimating a baseline logistic classification model based on the latent dimensions, the two dimensions correctly classify around 93% of votes for all three parliamentary terms. For more details, see the Appendix. This amount is comparable to the share of votes correctly classified in previous works using other methods. Using MDS, Hix et al. (2019) correctly classify on average 91.67% of votes between the 6th and the 8th terms.

Figure 1: PCA results by parliamentary term

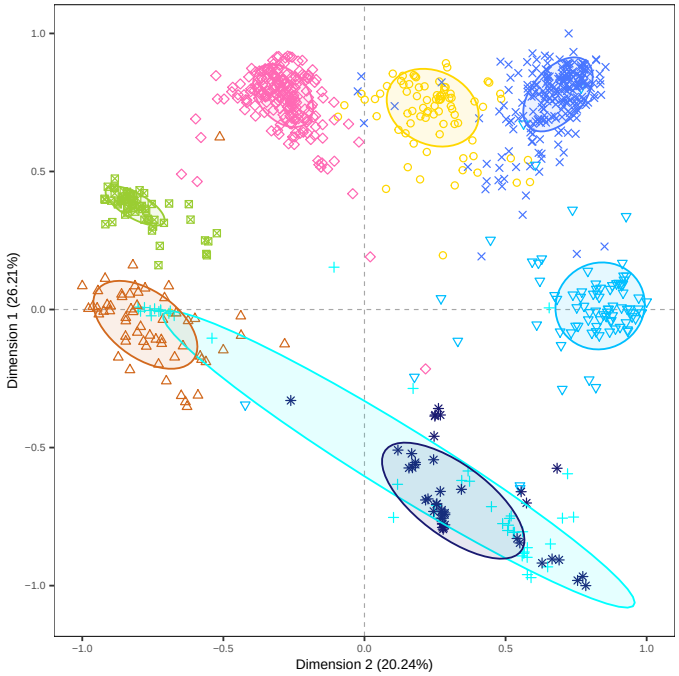
(a) *Sixth European Parliament (2004-2009)*



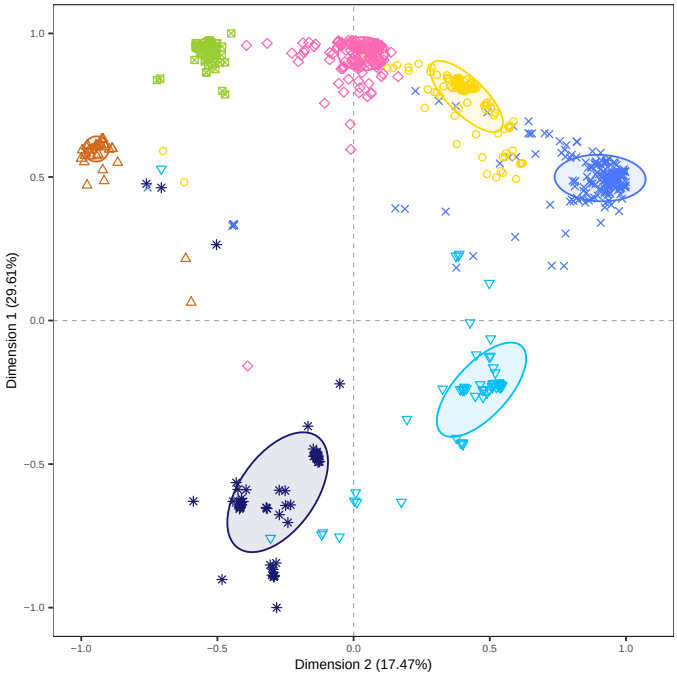
(b) *Seventh European Parliament (2009-2014)*



(c) *Eighth European Parliament (2014-2019)*



(d) *Ninth European Parliament (2019-2024)*



Political Groups:

- European People's Party group
- Progressive Alliance of Socialists and Democrats
- European Conservatives and Reformists (7−9th parliament)
- Union for Europe of the Nations (6th parliament)
- Alliance of Liberals and Democrats for Europe (6−8th parliament)
- Renew Europe (9th parliament)
- European United Left–Nordic Green Left
- Greens/European Free Alliance
- Europe of Freedom and Direct Democracy (7−8th parliament)
- Independence/Democracy (6th parliament)
- Europe of Nations and Freedom (8th parliament)
- Identity and Democracy (9th parliament)

Results for the sixth European Parliament are depicted in Figure 1a. The main dimension of voting captures 19.59 percent of the variance and is plotted on the horizontal axis. This dimension closely relates to the traditional left-right dimension. MEPs from right-wing groups, such as the christian-democrats (European People's Party) and the nationalist conservatives (Union for Europe of the Nations), are located on the right side of the chart. Left-wing groups, such as the radical left (European United Left), the greens (Greens) and the socialists (Progressive Alliance of Socialists and Democrats), occupy the other pole of the spectrum, on the left side of the chart. The centrist liberals (Alliance of Liberals and Democrats for Europe) are located between the centre-left (the socialists), and the centre-right (the christian-democrats and the conservatives).

The second dimension in the sixth term is plotted on the vertical axis and explains 15.14 percent of the variance. This dimension captures a pro-/anti-European integration divide. The hard Eurosceptic group Independence/Democracy (Brack, 2013) occupies the extreme bottom of the spectrum. Notable members of this group are the United Kingdom Independence Party, which supported Brexit in 2016, and the Italian Northern League, which campaigned against Italy's membership in the eurozone (Di Quirico, 2020). Pro-European integration groups, such as the socialists, the christian-democrats and the liberals, are on the opposite side. Groups that fall under the category of 'soft Eurosceptic', such as the radical left and the nationalist conservatives (Taggart and Szczerbiak, 2000; 2004; 2008), are between pro-European and anti-European groups. Our results on the sixth term are in line with previous findings on the EP's dimensionality before the euro area crisis, which described the left-right as the main dimension of voting and the pro-/anti-EU dimension as of secondary importance (Hix et al., 2006; 2007).

The seventh parliamentary term coincided with the eurozone crisis. During this term the voting dimensions are inverted (Figure 1b). The main dimension (vertical axis) is now the one dividing pro-European groups (socialists, liberals and christian-democrats) from Eurosceptic groups. In the seventh term, the pro-/anti-EU dimension accounts for 20.91 percent of the variance. The left-right axis plays a secondary role, as it explains 18.32 percent of the variance. Works that examined voting in the seventh term also noticed a dimensionality

switch in favor of the European cleavage; however they claimed that this change was limited to crisis-related vote (Blumenau and Lauderdale, 2018; Otjes and van der Veer, 2016). On the other hand, our results suggest that the European dimension became dominant overall. Our results are not necessarily in contrast with the literature. The dimensional change we observe in the seventh term may be still driven by crisis-related votes, if they make up for a sufficiently high share of total votes. In the next section of this paper we split crisis-related votes from the rest, and find that this is not the case: in the seventh term the European dimension became more relevant for all votes, regardless of crisis-related votes. We also note that the seventh parliament the sum of the two dimensions capture a larger share of voting than in the previous parliamentary term. This increase is fully explained by the growing importance of the European dimension (from 15.14 to 20.91 percent), since the variance explained by left-right dimension decreases (from 19.59 to 18.32 percent).

The distance between political groups on the vertical axis is larger and more defined in the seventh term than previously. One of the major factors is the new divide between the conservatives and the christian-democrats. At the beginning of the seventh term, the British Conservative Party decided to leave the European People's Party group and established their own group, the European Conservatives and Reformists group, together with the Polish conservative Law and Justice party. We notice that in this term there is a more compact Eurosceptic front that gathers the radical left, the Eurosceptic right-wing (Europe of Freedom and Direct Democracy) and the British and Polish conservatives. The split between political groups on the left-right axis in the seventh term is similar to the sixth. The radical left and the greens are on the left side of the chart, the socialists in a centre-left position, the liberals at the centre of the axis, and the conservatives (European Conservatives and Reformists), christian-democrats, and Eurosceptics (Europe of Freedom and Direct Democracy) on the right.[10]

These two patterns of alliance strengthened in a number of ways in the eighth term (Figure 1c). First, the variance explained by each dimension increases (of six per-

[10]The largest parties that composed the Europe of Freedom and Direct Democracy group in the seventh parliament were the United Kingdom Independence Party (UKIP), the Italian Northern League, United Poland and the Greek Popular Orthodox Rally.

centage points for the European dimension and of two percentage point for the left-right). Second, the distance between pro-European and Eurosceptic groups widens substantially. The Eurosceptic front now counts a new political group: Europe of Nations and Freedom, which includes notable far right parties such as the French National Front (today known as National Rally), the Italian Northern League, the Dutch Party for Freedom, as well as those German MEPs that split from Alternative for Germany to establish the Blue Party.

Moreover, Figure 1c highlights a number of interesting facts on Eurosceptic political groups. First, Europe of Nations and Freedom (dark navy, asterisks) and Europe of Freedom and Direct Democracy (cyan, plus symbols), which are generally considered as far right, occupy a more centrist position than the christian-democrats and the conservatives. This does not necessarily mean that these parties undertook centrist stances at the expenses of a more radical approach. On the contrary, their location on the left-right axis is explained by the fact that, while maintaining very different positions on a number of policies, far right parties have gradually assumed positions similar to the left on economic issues, such as social protection and trade protectionism (Harteveld, 2016). For example, Ivaldi (2015) shows that the Front National has significantly shifted its economic platform toward more left-wing policies. Second, MEPs from the Europe of Freedom and Direct Democracy group range from strongly Eurosceptic and far right positions, which coincide with the ones of MEPs from the Europe of Nations and Freedom group, to radical left soft-Eurosceptic positions, which overlap with the ones of MEPs from the United Left group. This is explained by the fact that members of the Italian Five Star Movement, which were member of the Europe of Freedom and Direct Democracy group, voted more similarly to MEPs in the United Left group than to MEPs in their own political group. This finding contributes to previous analyses on the voting behaviour of Five Star Movement MEPs (Salvati, 2019; Franzosi et al., 2015).[11]

The polarizing pattern of the eighth parliament becomes more acute in the ninth parliament, that is the term that coped with the Covid-19 pandemic crisis (Figure 1d).

[11]The analysis in Franzosi et al. (2015) shows that the voting behaviour of Five Star Movement MEPs differs from the one of its main political group ally, the United Kingdom Independence Party, and is closer to the Green group. Salvati (2019) finds that Five Star Movement MEPs vote more similarly to the leftist parties within the EP, and in particular to Podemos. However, both these works rely on subsample of votes.

MEPs in the ninth term display a larger relative distance on the European dimension. In addition, this divide gains relevance relative to the previous term: the variance it explains increases of three percentage points, reaching a peak of 29.61 percent. The opposite holds for the left-right dimension, whose explanatory power decreases of around three percentage points.

The most striking results relate to the reconfiguration of political groups across both dimensions. The socialists, the greens and the liberals[12] occupy the pro-European pole of the dimension. On the opposite side we find hard Eurosceptic MEPs from Identity and Democracy (former Europe of Nations and Freedom) and from conservative parties. The christian-democrats, that tended to have similar voting positions to the socialists and the liberals in the previous terms, moved to a more eurosceptic position in the ninth parliament. The position of the christian-democrats on the European axis is now similar to the one of the radical left.

On the horizontal axis, we notice the shift of far right (MEPs from the political group Identity and Democracy) and conservatives MEPs toward the left of the spectrum. This indicates that far right and conservative parties gradually shifted away from centre-right parties, which used to vote very similarly to them in the sixth and seventh terms. Another striking result in the ninth parliament is the widening distance between pro-European and Eurosceptic parties on the main dimension of voting.

B. Regression Results

The distribution of political groups in Figures 1a-1d suggests that the main dimensions capture the pro-/anti-EU and left-right cleavages. In this section we test this hypothesis by matching our results with scores from the Chapel Hill Expert Survey (CHES) database (Polk et al., 2017; Bakker et al., 2015). The CHES database assigns to each party a score on a number of political dimensions. These scores are based on the opinion of political science experts. The advantage of CHES scores over manifesto-based indicators of ideology is that it

[12]In the ninth term, the liberals gathered in a new group named Renew Europe, which replaced the Alliance of Liberals and Democrats for Europe. The main party of this group is the French Republic on the Move! party.

reflects the scholarly consensus on parties' positions in general, and not only before elections (Otjes and van der Veer, 2016). The CHES database covers 277 parties based in 31 countries, including all the countries represented in the EP, for the years from 1999 to 2019.

We select the CHES variables *LRgen* and *EU_position*, which capture respectively the overall ideological stance of a party in the left-right spectrum and the overall orientation of a party towards European integration. The variable *LRgen* captures the position of a party in terms of its ideological stance based on a scale that goes from 0 for 'extreme left' to 10 for 'extreme right'. The variable *EU_position* captures the overall orientation of a party towards European integration. It goes from 1 for 'strongly opposed' to European integration to 7 for 'strongly in favour' (CHES, 2019).

We additionally test the estimates on voting against party positions on the *economic* left-right axis and party cultural values. These elements are relevant as the European party system can be described along economic and cultural cleavages, rather than a uni-dimensional left-right divide (Dalton, 2018). Economic positions have been historically relevant to determine the left-right axis, which is often considered as a surrogate for the economic cleavage (Dalton, 2018). We study positions on cultural values as a number of works pointed to their growing relevance in European politics, especially in light of the eurozone crisis, the migration crisis and Brexit, which reshaped the traditional cleavages of European parties across this new divide (Marks et al., 2021; Hooghe and Marks, 2018; Dalton, 2018; Kriesi, 2010). Cultural values can be summarized in a dimension that divides parties that embrace green, alternative and libertarian values against those that support traditional, authoritarian and nationalist values (Marks et al., 2021; Hooghe and Marks, 2018; Kriesi, 2010; Hooghe et al., 2002).

We capture these party positions on the economic and cultural cleavages using the following variables in the CHES database: *LRecon* for positions on the economic left-right, and *Galtan* for positions on cultural values. *LRecon* is constructed in the same ways as *LRgen*, with the difference that it focuses on stances on economic issues. *Galtan* opposes parties that 'favor expanded personal freedoms, for example, abortion rights, divorce, and same-sex marriage' (and that are assigned a score equal to 0 in the most extreme case)

against those that 'reject these ideas in favor of order, tradition, and stability, believing that the government should be a firm moral authority on social and cultural issues' (and that are assigned a score equal to 10 in the most extreme case) (CHES, 2019). While both variables are correlated with general left-right positions in the CHES database (80 percent for the economic left-right; 75 percent for Galtan), they capture different aspects of party positions that are worth exploring (Dalton, 2018; Hix et al., 2019). In addition, the correlation between economic and cultural positions is relatively low (42 percent).

In Tables 2 and 3 we regress the latent dimensions extracted through the PCA on the CHES's ideological scores for each parliamentary term. Since CHES provides scores for each party, and not for each MEP, we have to aggregate PCA scores at party-level. Therefore, the number of observations reported in the tables reflects the number of parties in that specific term. For each variable, we report the results of the coefficients of determination (R-squared), rather than the regression coefficients. The reason is that we are interested in the share of variation in the PCA latent scores that is explained by CHES ideological scores, which is captured by the R-squared. On the contrary, we are not interested in understanding of how much a variation in CHES ideological scores generates a variation in the latent dimensions, as described in the coefficients, since these estimates are sensitive to the different scaling approaches of the voting and CHES databases.

Table 2 reports the results for the latent dimension that we associated with the European cleavage. In line with our hypothesis, the R-squared indicates that this dimension is well captured by parties ideological positions on a pro-/anti-EU axis, represented by the *EU_position* variable. For instance, the R-squared of *EU_position* is 31 percent in the sixth parliament, that is substantially larger than the 4 percent of Galtan or the 0.4 and 0.3 percent of the general and economic left-right dimensions respectively. In the eighth term, the gap is even wider: the European dimension now explains 60 percent of the variance in the latent dimension, whereas the other variables account for no more than 0.3 of the variance. These results clearly indicate that the latent dimension of voting that dominated the EP from 2009 to 2019 (and that was the secondary dimension in the sixth term), is the pro-/anti-EU dimension.

However, the results for the ninth term point to a more nuanced dimension. While the R-squared of the pro-/anti-EU conflict remains the largest also in the ninth term (48 percent), its value is now very close to the one of the cultural dimension of conflict (43 percent) and, to a lesser extent, to the general left-right dimension (35 percent). This change can also be appreciated by looking at the vertical distribution of parties in Figure 1d. In the ninth term, the positions of the socialists and the greens on the European dimension are closer than ever compared to previous terms and compared to their previous allies on the same dimension, that are the liberals and the Christian-Democrats for the socialists and the far left for the greens.

This result is in line with the observation that the cultural cleavage plays an increasingly important role in shaping European politics (Dalton, 2018). The striking pattern uncovered by our analysis is that such cleavage is increasingly configured in a pro-/anti-EU dimension, rather than the traditional left-right dimension. The alliance emerging in the ninth term is one that combines parties that share a strong pro-European stance, but also similar cultural values associated with green and libertarian policy stances. In this context, the christian-democrats are farther from this coalition than ever before, due to their cultural conservative positions. It is worth noticing that these cultural positions are moderate compared to the ones of the conservatives[13] and, even more, of the far right.

Table 3 displays the estimated R-squared for the latent dimension that we associated with the traditional left-right axis. In the first three parliamentary terms, the general left-right dimension is the variable that best describes the positions on this latent dimension. This evidence supports our hypothesis that the second dimension captures MEPs' positions on the left-right axis.

It is worth noting that the variables associated with positions on the economic and cultural cleavages also display a strong, but weaker, association with this latent dimension. This is particularly informative since the literature often presents the left-right scale as a surrogate of an economic left-right divide (Dalton, 2018). We notice that for the votes in the EP this is not the case, as the explanatory power of the economic and cultural dimensions

[13]In the ninth parliament, the main parties in the conservative political group are the Polish Law and Justice and the Italian Brothers of Italy, two explicitly Catholic parties.

Table 2: European dimension as dependent variable

	6th parliament	*7th parliament*	*8th parliament*	*9th parliament*
LRgen	0.004	0.051	0.015	0.350
	(0 - 0.053)	(0.001 - 0.190)	(0 - 0.086)	(0.233 - 0.461)
LRecon	0.003	0.101	0.015	0.068
	(0 - 0.049)	(0.015 - 0.238)	(0 - 0.082)	(0.021 - 0.139)
Galtan	0.040	0.002	0.034	0.427
	(0.004 - 0.115)	(0 - 0.047)	(0.001 - 0.109)	(0.316 - 0.532)
EU_position	0.310	0.553	0.604	0.479
	(0.174 - 0.452)	(0.393 - 0.686)	(0.471 - 0.707)	(0.313 - 0.636)
Observations	156	152	178	171

Notes: Table reports R-squared of the regression of PCA dimensions on each CHES variable separately.
95% bootstrapped confidence intervals in parenthesis

change relevance over time. While secondary compared to the general left-right variable, in the sixth term, the economic dimension displays a higher association with left-right positions, whereas the cultural dimension presents a higher score in the seventh term.

In the ninth term, the variable that best captures the left-right dimension is the economic left-right. This change is due to the shift of the far right toward positions that are closer to the left on economic issues. As an illustration, the average score of far right parties is 6.96 on the economic left-right, and 9.12 on the general left-right, where higher values indicate a more right-wing position in both cases. While the shift of far right parties is visible in 1d, the regression analysis corroborates the idea that this change is mostly due to a change in economic positions, and not in the overall stance on left-right issues.

Table 3: Left-Right dimension as dependent variable

	6th parliament	*7th parliament*	*8th parliament*	*9th parliament*
LRgen	0.520	0.585	0.481	0.276
	(0.385 - 0.655)	(0.481 - 0.676)	(0.347 - 0.614)	(0.164 - 0.413)
LRecon	0.451	0.430	0.396	0.354
	(0.326 - 0.578)	(0.315 - 0.554)	(0.266 - 0.531)	(0.225 - 0.485)
Galtan	0.317	0.501	0.398	0.141
	(0.208 - 0.45)	(0.392 - 0.605)	(0.269 - 0.521)	(0.058 - 0.250)
EU_position	0.128	0.002	0.001	0.112
	(0.049 - 0.237)	(0 - 0.039)	(0 - 0.030)	(0.045 - 0.201)
Observations	156	152	178	171

Notes: Table reports R-squared of the regression of PCA dimensions on each CHES variable separately.
95% bootstrapped confidence intervals in parenthesis

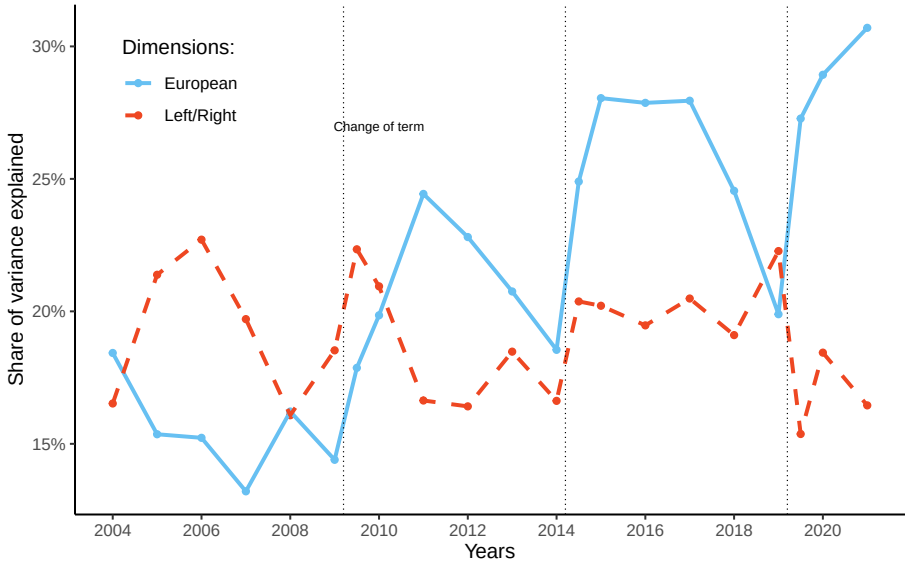
C. The evolution of the voting dimensions

In Figure 2, we plot the yearly share of variance of each dimension to study when the dimensional shift occurred. The blue solid line the variance explained by the European dimension over time, the red dashed does the same for the left-right dimension. In line with previous estimates (Hix et al., 2006; 2007), we find that the left-right divide was the dominant dimension during the pre-crisis period, which corresponds to the sixth parliamentary term (2004-2009).[14] At its peak, the left-right dimension explained around 23 percent of the variance. In turn, the European dimension played a secondary role and captured around 18 percent of variance by the end of the sixth term.[15]

[14]Hix et al. (2006) shows that the left-right divide was the main dimension from the first parliamentary term in 1971 to the sixth.

[15]The only exception is the first half of 2004, where the main dimension is the pro-/anti-EU cleavage. Nevertheless, estimates for year 2004 are based on a lower amount of votes as they include only six months of legislative activity, which coincide with the beginning of the sixth term in June 2004.

Figure 2: Historical trend of the dimensions of voting in the European Parliament, 2004-2021



The dimensional shift in favor of the European cleavage coincides with the start of the eurozone crisis in 2010. In this year, the European dimension increasingly gains relevance and eventually supersedes the left-right dimension in 2011. This chart is informative as it shows that the change we observed in Figure 1b (which displayed the voting dimensions of MEPs in the seventh parliamentary term) started during the eurozone crisis. This new configuration strengthens during the eighth parliamentary term. The gap between the two dimensions widens in the years of the refugee crisis, the terrorist attacks, and Brexit. As we show in the next section, during this period MEPs vote on a high share of bills related to these crises, and in particular the migration crisis. We observe the third and final surge of the European dimension during the Covid-19 crisis that starts in 2020. During this crisis, that is the first shock faced by the newly elected ninth parliament, the European dimension reaches its highest peak in the whole time series.

D. Robustness Checks

The main concern is whether the rotation of dimensions we identified is widespread, and not determined by the behavior of a few, influential political groups or concentrated on a specific type of voting procedure. We run a number of robustness tests to corroborate this evidence.

A factor affecting these results could be the influence of the coalition between christian-democrats and the socialists on the European Commission's legislative agenda. Since the Commission is the only institution empowered to initiate legislation, the dimensions may tend to divide MEPs between those that compose the coalition supporting the Commission (mainly represented by the christian-democrats, the socialists and the liberals)[16] and those that oppose it.

To mitigate this potential bias, we divide final votes and votes on amendments. Final votes determine the approval or rejection of a full piece of legislation, whereas votes amendments affect only a specific part of the final bill. The difference between the two is relevant for party dynamics: while final votes may be closer to the preferences of the coalition, since the legislation is proposed by the Commission, any MEP can propose an amendment. For this reason, amendments are more likely to represent the view of smaller parties. If the agenda-setting power of the coalition (through the Commission) was the main determinant of the evolution of the dimensions, we would expect the trends of the two subsets to divert. This is not the case. Figure 14 displays the dimensions on the subset of votes that are amendments. Figure 15 shows the reverse: the evolution of the dimensions for final votes only. While the gap between European and left-right dimension is higher for final votes, we notice that the two dimensions follow similar trends, which match with the trends of the full sample. Under all specifications, the European dimension grows substantially relative to the left-right axis in the years of the euro crisis and during the Covid-19 crisis. This result indicates a common trend in MEPs' voting behavior that is independent from the vote typology.

To further mitigate these concerns, we focus on those votes in which the two major political groups, the christian-democrats and the socialists, vote in the same or opposite way. These votes signal when a legislative proposal is the outcome of the agreement between the two main partners in the coalition or not. This test is particularly relevant as both political groups present relatively high pro-European scores, which might overemphasize the

[16]From 1992 to 2021 the Commission have always been supported by the christian-democrats, the socialists and the liberals. The greens supported the Prodi Commission for the period 1999-2004 and were in opposition during the following terms.

importance of the European dimension over the left-right axis.

Figure 16 shows the results only for those votes in which the christian-democrats (EPP group) and the socialists (S&D group) vote together. Figure 17 shows the dimensions for those cases in which the two main political groups vote one against the other. The fact that the level of the European dimension is always higher than the left-right dimension in Figure 16 and that the opposite holds in Figure 17 is not surprising. By construction, when two pro-European political groups, that differ in their left-right ideology, vote together on a bill, we should expect the European dimension to play a more prominent role. By the same token, when centre-right MEPs vote against centre-left MEPs should be capturing a higher left-right conflict, as in Figure 17. For this reason, our focus should not be on the levels of the two dimensions, but on their trends. The striking result of these figures is that the European dimension is growing over time in both cases. The relevance of the European dimension increases during the euro crisis and during the pandemic even among those votes where centre-right and centre-left MEPs are divided (Figure 17).

We further test whether resolutions on topical subjects drive the dimensional change. Within-group disagreement is higher for votes on resolutions than for other voting procedures, such as codecisions (Høyland, 2010). The presence of resolutions may hence inflate the degree of disagreement among MEPs, provide misleading estimates. For robustness, we recompute the PCA by excluding from the sample votes on resolutions and comparing the results with the ones of the full sample.

The results are displayed in Figure 10 in the Appendix. We plot the estimates on a yearly basis in order to allow a comparison with Figure 2. The PCA estimates remain substantially unchanged when we exclude resolutions from the sample, strengthening the robustness of our baseline results. Once we exclude resolutions, the left-right dimension remains the main component of votes in the sixth term. The shift to the European dimension takes place in the seventh term in line with the full sample estimates. The only difference compared to the full sample is that this shift takes place at the very beginning of the term. This difference signals that MEPs in the seventh term immediately adapted their voting behaviour to the new dimension on most votes, with the exception of resolutions, where the

left-right dimension persisted as main dimension for a longer time frame.

The evolution of the two dimensions over time suggests that the European dimension gains relevance when a shock occurs. The European dimension became the main dimension of voting at the start of the euro crisis, and reached its peak during the Covid-19 crisis. Although Figure 2 suggests that there is a relationship between MEPs' voting and crises, it does not provide information on whether these results are actually driven by crisis-related votes. This is relevant as previous research showed that during a crisis MEPs tend to vote along the European dimension but only on crisis-related votes (Blumenau and Lauderdale, 2018; Otjes and van der Veer, 2016). In this context, the left-right dimension may still be the main dimension of voting for all the other typologies of votes. If this was the case, the dominance of the European dimension may be temporary, and will fade away once the crisis is over. The next section explores this question by splitting the impact of crisis-related votes from the rest of the sample.

6 The impact of crisis-related votes on voting dimensions

We investigate whether the dimensional change is limited to crisis-related legislation or pervasive, as it expands to all policy areas. Existing findings in the literature support the first hypothesis. Blumenau and Lauderdale (2018) show that during the euro crisis the pro-/anti-EU dimension gained relevance only among crisis-related votes. Otjes and van der Veer (2016) present similar results, as they observe that the European dimension gains relevance only for votes on economic issues during the euro crisis.

We use text analysis to identify those votes that are related to a crisis. Then, we estimate again the trend of the European dimension by removing crisis-related votes from the sample. If the dimensional change was fully driven by crisis-related votes, we would expect the left-right axis to remain the main dimension of voting once we exclude these votes from the sample. If this was not the case, then the dimensional change would be pervasive and take over all types of MEPs voting.

We focus on the impact of five different crises: the euro crisis (from 2010 onwards),

the refugee crisis (2015-2017), the terrorist attacks (2015-2016), Brexit (2016) and the Covid-19 crisis (2020-2021). For each crisis we create a dummy variable that equals one if a vote is related to a crisis, and zero otherwise. By construction, since we associate each individual vote to a specific crisis, the overlap over time of some of these crises does not represent an issue.

To capture the votes related to the eurozone crisis, we follow Hix and Høyland (2013) and Otjes and van der Veer (2016) and select those votes whose committee of origin was the Committee on Economic and Monetary Affairs (ECON Committee).[17] We hence consider those votes prepared by the ECON committee that were tabled between 2009 and 2014 as votes related to the eurozone crisis. Figure 3a shows the share of votes prepared by the ECON committee for each year since 2004. While the ECON committee generally prepares around 5-6 percent of the votes in the EP, we observe a surge in economic votes in 2011, that is around the time of the eurozone crisis, when economic votes reach around 10 percent of the votes.

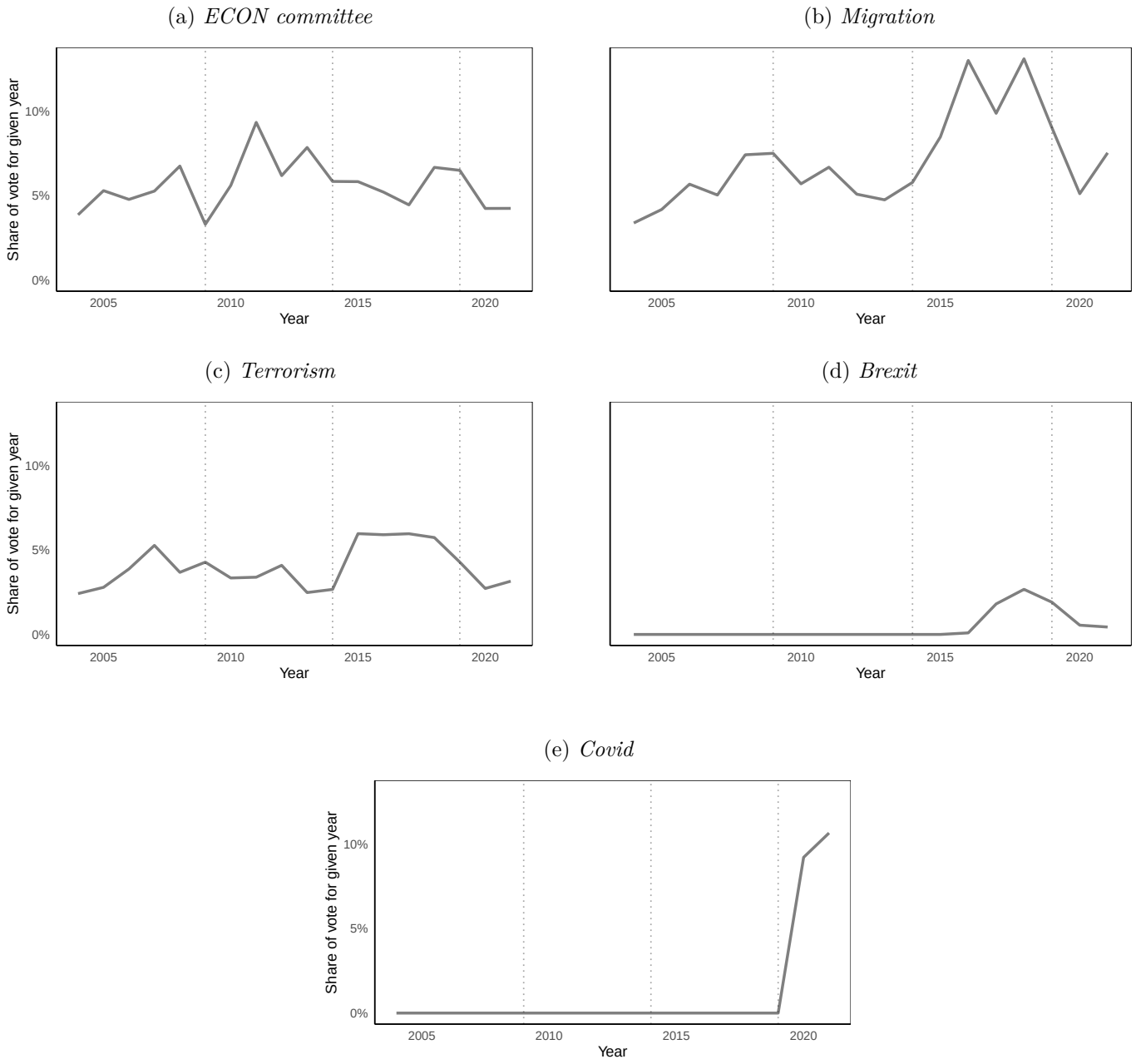
We use text analysis on the text of each vote to identify it is related to one of the other crises. To this end, we change all the titles of the votes and the key words to lower cases to ensure that the terms match. We classify a vote as related to the refugee crisis whenever its text contains one of the following key words: 'migrant', 'refugee', 'asylum' and 'migration'. Figure 3b shows the results of that identification. The topic of migration appears in around 5 percent of the text of the votes, except during the eighth parliamentary term, where it ends up being present in about 13 percent of the votes. We identified migration votes as related to the refugee crisis only if they were cast during the eighth parliamentary term, as this term coincides with the period of such shock.

We identify the votes related to the terrorist attacks, Brexit and the Covid-19 pandemic in a similar fashion. Using specific lists of key terms related to each crisis, we identify which votes are associated to each of them. For the terrorist attacks we select the

[17] Differently from Otjes and van der Veer (2016), we examine separately the votes of the ECON committee and those of the Employment and Social Affairs Committee to provide a clearer view on how different economic votes played a role. Robustness checks of the Employment and Social Affairs committee are available in the Appendix.

key words 'terrorist' and 'terrorism'. For Brexit we simply use the term 'brexit' and for the pandemic crisis we select votes containing the term 'covid'. Figures 3c-3e show the results for these three crises. Votes on terrorism were somewhat always present in the EP, but spike in 2015, the year of the Charlie Hebdo shooting, when votes represent around 7 percent of all votes. Brexit votes obviously feature in the sample only after the referendum on the withdrawal of the United Kingdom from the European Union. These votes account for a very low share of overall votes, reaching around 3-4 percent of all votes in the EP at their peak. On the other hand, votes related to the Covid-19 crisis increase very rapidly since the beginning of the pandemic crisis. These votes account for more than 10 percent of all the votes in the EP.

Figure 3: Share of crisis votes for each year

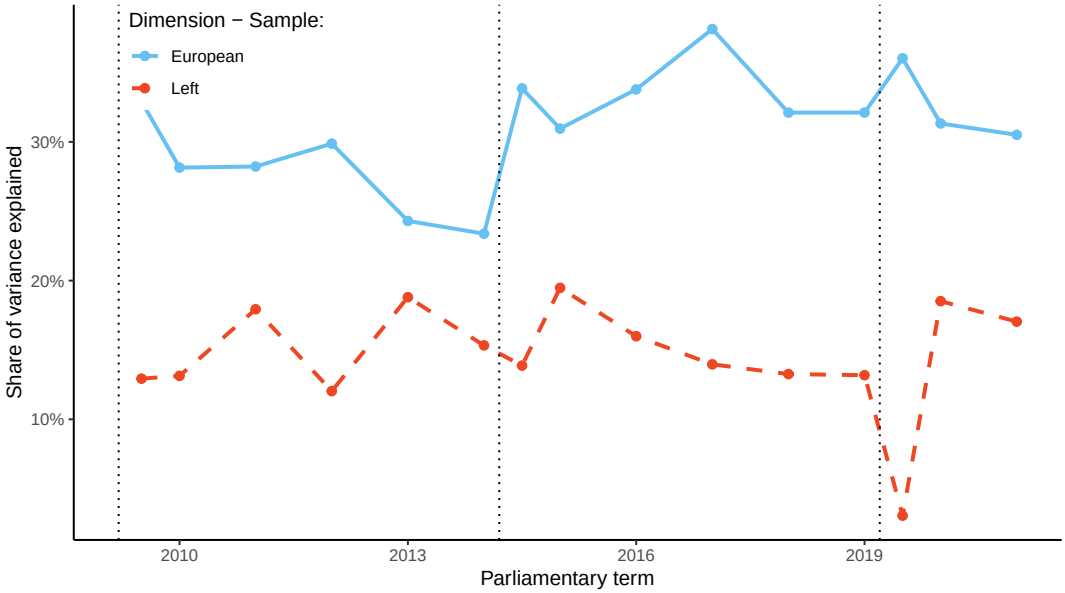


We aggregate crisis votes to investigate whether the dimensionality of voting on this subsample changes. Figure 4 plots the time series of the two main dimensions of voting for crisis votes only.[18] As evidenced, crises votes are heavily dominated throughout the sample

[18]PCA was not recomputed for this analysis. Using the PCA scores for these crises votes, we re-aggregated into overall yearly PCA scores.

by the European dimension. This evidence suggests that crisis votes may have had a direct impact on the overall dimensionality of the EP. In particular, crisis votes seem to account for the increase of the European dimension throughout the different shocks.

Figure 4: Dimensionality of voting: crisis subsample

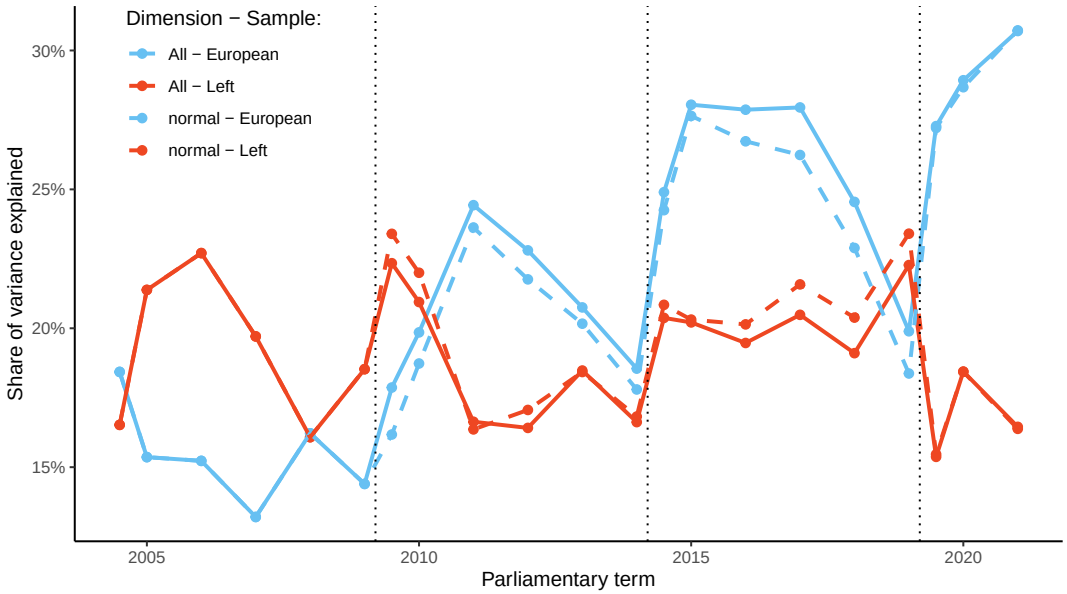


To test whether this is the case, we can compare how dimensions have evolved for the full sample of votes and for the sample of votes *without* crisis votes. The aim of this exercise is simply to track whether the change in the dimension of voting did not affect those votes that were not directly related to the crisis. The sample of votes without crisis votes should hence not be interpreted as a counterfactual, i.e. what would have happened to voting had the crises not happened. Figure 5 plots the evolution of the two dimensions in the full sample of votes (solid lines)[19] and in the sample of votes excluding crisis votes (dashed lines). If crisis votes played a significant role in the dimensional change, we would expect a wide gap between the solid and dashed lines, which represent respectively the voting dimensions with and without crisis votes.

Figure 5 shows that this is not the case. When we remove crises votes from the sample, the overall trend we observed in the previous section does not change. On the contrary, the results display very similar trends regardless of the presence of crisis votes.

[19]Therefore, the solid lines are the same plot in Figure 2.

Figure 5: Dimensionality of voting: subsample excluding crisis-related votes



Although the European dimension is overall less important once we remove crisis votes from the sample, the upward growing trend is clear and unmistakable.

This result suggests that during the crises the European dimension gained relevance among all votes, and not only crisis-related votes. This indicates that crises have a larger impact on MEPs' voting than previously described in the literature. Previous works identified the impact of the crisis to be limited to crisis-related votes only (Blumenau and Lauderdale, 2018; Otjes and van der Veer, 2016). Our results go in the opposite direction, showing that crises shaped MEPs' voting behavior in a pervasive manner, making the European dimension the main dividing line across all type of votes.

7 Conclusions

The resilience of the left-right dimension to the emergence of new cleavages has been debated for long in European politics. In his seminal book 'Neither Right Nor Left' Zeev Sternhell (1983) described how the merge of both left-wing and right-wing ideological traits in fascist parties left the impression that these categories had lost their relevance. A decade later, in his influential essay 'Left and Right', Norberto Bobbio (1996) reopened the debate, arguing for

the persistent relevance of these two categories to analyse contemporary politics. However, he also acknowledged that 'The ideologies of the past have merely been replaced by others which are new or claim to be new. The ideological tree is always green' (Bobbio, 1996, p. 3).

In this work we have documented how such replacement has taken place in the context of the European Parliament. In the years of the financial crisis, differences on the left-right spectrum lost their dominance in determining the voting behaviour in Parliament. In turn, pro-/anti-EU stances became increasingly more crucial in determining the MEPs coalition, bringing a change in the dimensionality of voting. The striking aspect is that this change repeatedly occurred for every other shock that hit Europe. The conflict over the European dimension gained relevance during every crisis that followed the eurozone crisis, including the migration crisis, the terrorist attacks, Brexit and, eventually, the pandemic crisis.

This evidence is particularly striking in the context of previous studies that described the EP as a parliament similar to other democratic parliaments due to the dominance of the left-right dimension (Hix et al., 2006). We show that this is no longer the case. The results we presented unveil a new dynamic of MEPs' voting. We show that the pro-/anti-EU dimension gain relevance during each shock.

This does not necessarily mean that the left-right divide has become irrelevant in European politics. First of all, our results are limited to the voting of the EP, and do not necessarily reflect a dimensional change in other European decision-making fora. Moreover, even in the context of MEPs' voting, we show that left-right still remains one of the two main dimensions that explain voting in the EP. After a rapid decline at the outburst of the crisis, this dimension regained explanatory power in 2014. The same happened in 2018. However, as we described, this division has become more blurred in the existing parliamentary term. Positions on this dimension have become gradually more associated with positions on cultural values, as described, among others, in Marks et al. (2021), rather than with traditional left-right divisions. Such evolving nature in the left-right dimension in the EP is certainly a subject of interest that will require future research.

The advantage of analysing the voting behaviour in a unique institution as the European Parliament, which hosts legislators from different parties and countries, is that it provides a comprehensive view on the dimensionality of European party politics. However, our results do not necessarily apply to other spheres of European politics. The increasing relevance of the European dimension in MEPs' voting may not be necessarily reflected in domestic politics, parties' rhetoric, or policy actions by national governments. In all these areas, other cleavages pointed out in the literature could be more relevant than the pro-/anti-EU divide. Given these considerations, our evidence is informative around the changing voting behaviour of MEPs in the last two decades.

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8 Appendix

A. Methodological Appendix

A..1 Principal Component Analysis

Principal component analysis (PCA) is one of the oldest and most widely used method of dimensionality reduction. It is an exploratory data analysis tool to find patterns in datasets (Jolliffe and Cadima, 2016). The effectiveness of PCA is best measured when the dataset analyzed is large and presents regularities, then it can be summarized into a small number of principal components that can be more easily interpreted. Rollcall datasets present these characteristics: patterns of alliance between MEPs repeat themselves over different votes many times. The outcome of PCA is composed of three matrixes whose dimensions depend on the number of principal components extracted. The first matrix describes the individuals of the dataset in terms of the principal components: each individual is assigned a score that reflects its tendency to coalesce along each dimension of the dataset. The second one describes the overall importance of each dimension in the dataset, namely the salience of the regularity afferent to the component. Finally the third matrix contains the scores of each votes, the scores reflect how well each vote is explained by each component.

The implementation of PCA in the framework of rollcall data requires to consider votes as numerical values. Rather than decomposing categorical variables, PCA focuses on continuous variables, we thus code voting yes as 1, voting no as -1, abstaining or being absent as 0. This amounts to coding abstention and absence as a mid-way point between yes and no.

The implementation of PCA is done through the use of singular value decomposition. Let X be the rollcall matrix, its dimension is $n \times p$ where n is the number of MEPs in a parliamentary term and p the number of votes. First, we center the matrix X and we normalize each column such that its variance is equal to one. Normalization allows to consider each vote as equal: more contentious votes are counted as much as the other ones, and not more. Denote the centered matrix X^*, we decompose it using singular value decomposition:

$$\underset{n\times p}{X^*} = \underset{n\times r}{U}\ \underset{r\times r}{L}\ \underset{r\times p}{A^T} \tag{1}$$

Matrix U is the left-singular vector, it contains the PCA scores of each MEP; the matrix A is the right singular vector, it contains the PCA loading value of each votes; matrix L is a diagonal matrix containing the eigenvalues of X^*, which also measure the importance of each dimension r.

Because rollcall matrixes are usually sparse, as many MEPs enters and leave in a given parliamentary term, an additional step must be included in our analysis to impute missing values. We rely on an iterative method that ensures that PCA results are unchanged by imputation. First, we impute missing values in X^* at the column mean. We estimate PCA, and re-impute those values using PCA results. We iterate until the values are unchanged.

The clouds plotted in Figure 1 are plots of the first two columns of the left singular vector matrix U multiplied by L, i.e the first two dimensions.[20] Figure 2 is computed from the correlation between the columns of X^* and UL. For each column, corresponding to each vote, we compute the correlation with each column of UL. The square of this column contains the R^2 of the regression, and measures how well a given column is captured by each dimension. We then averaged the R^{2}[21] of each votes by year and plotted the corresponding results.

We use the same method to compute the results on the subsamples of votes. Rather than recomputing the PCA on a new matrix X^* with less columns, we simply computed the averaged cosine squared values on sub-sample of votes. Doing so, the dimension interpretation remains unchanged.

A..2 Comparison between PCA and other methodologies

PCA has a number of advantages compared to other methodologies used to estimate the dimensionality of voting behaviour in previous works, including NOMINATE, Optimal Clas-

[20] Additionally, see https://personal.utdallas.edu/ herve/abdi-awPCA2010.pdf

[21] Also called squared cosines in the literature

sification and multi-dimensional scaling.

The most common method is NOMINATE, a three-step scaling method first proposed by Poole and Rosenthal (1985) and then applied by Hix et al. (2006) on European Parliament's votes. One drawback of this method compared to PCA is that it relies on a set of assumptions about legislators. NOMINATE assumes legislators to be rational utility-maximising agents whose preferences shift following independent and exogenous white noise shocks. In this way, common shocks to voting preferences, such as the ones that could stem from a financial crisis or a terrorist attack, are ruled out by assumption. Second, both NOMINATE and its Bayesian alternative alpha-NOMINATE (Carroll et al., 2013) lack identifiability of ideal points for a number of dimensions higher than one (Potthoff, 2018; Jackman, 2001). By contrast, Potthoff (2018) shows that this is not the case for PCA, whose ideal point estimates for a given dimension remain unchanged when the number of dimensions changes. Third, NOMINATE does not always produce reasonable results, as documented by Rosenthal and Voeten (2004) for the case of the French Fourth Republic. More importantly, as shown by Hix et al. (2019), NOMINATE fails to produce a smooth distribution of MEPs and to fill the policy space for the case of the 7th European Parliament.

PCA has also advantages compared to the non-parametric Optimal Classification (OC) method of Poole (2000) to scale legislators' ideal points. An advantage of OC compared to parametric methods such as NOMINATE is that it does not rely on distributional assumptions about the errors, and in some cases OC produces better estimates than NOMINATE (Rosenthal and Voeten, 2004). However, Spirling and McLean (2007) notice that OC fails to produce adequate ideal point estimation in the presence of strategic voting.[22] Another drawback of OC is that by construction abstentions and absences are dropped from the sample, omitting therefore potentially helpful information on legislators' voting behaviour.

PCA also provides a more detailed estimate than multi-dimensional scaling (MDS). MDS is an alternative spatial method used in political science (Jacoby and Armstrong, 2014) and recently applied to analyse MEPs' voting (Hix et al., 2019). By construction,

[22] As a consequence, when Spirling and McLean (2007) apply OC on votes the British House of Commons, left-wing members of the Labour Party such as Jeremy Corbyn are classified as closer to the Conservative government than their party peers.

MDS computes a dyadic proximity score among legislators based on their voting behaviour. While this method provides a clear overview of how legislators are located across the policy space, by focusing on their proximity it aggregates information around votes at legislator-level. In this manner, it discards precious information at vote-level, which would allow to explore how legislators' behaviour on different types of votes. By contrast, PCA preserves the information at vote-level and allows to further inspect on which specific types of votes legislators were divided.[23]

While PCA overcomes the pitfalls of these methodologies, it has some limitations itself. In particular, PCA cannot directly accommodate sparse data such as vote. To circumvent this issue, we resorted to two solutions. In a first exercise we imputed missing values of the dataset in a way that leaves PCA results unaffected. In a second exercise we use probabilistic PCA. Both methodologies yield very similar results.

For robustness, we apply MDS and OC to our database to check whether the results are in line with PCA estimates. Both MDS and OC yield results which strongly correlate with the ones for PCA, as shown in Table 4.

While all these methods identify a minimum number of dimensions to describe legislators' voting behaviour, under all methodologies the dimensions extracted are latent. This means that it is the task of the researcher to interpret the meaning of such cleavages/dimensions. Following Hix et al. (2006), we first develop an hypothesis on the meaning of each dimension of voting by plotting the PCA scores for each MEPs and observing how they locate on each dimension vis-a-vis their peers. Second, we test our hypothesis by looking at the correlation between MEPs scores and exogenous measures of ideological position of European national parties those MEPs belong to.

[23] In line with this, legislators' scores produced using multi-dimensional scaling are generally higher than the one produced using PCA, since the former method has less variance to explain due to the loss of granularity in the data.

Table 4: Correlation of MEPs dimension scores from PCA with other methodologies

	PPCA (1)	MDS (2)	OC (3)
6th European	0.99	0.69	0.77
6th Left/Right	0.99	0.93	0.92
7th European	0.99	0.95	0.79
7th Left/Right	0.99	0.90	0.90
8th European	0.99	0.97	0.85
8th Left/Right	0.99	0.71	0.88

Note: The table displays for each dimension and parliamentary term the correlation coefficients between the estimates of PCA and of Probabilistic PCA (PPCA), Multi-Dimensional Scaling (MDS), Optimal Classification (OC).

B. Scree Plots

Figure 6: Scree plot, Sixth European Parliament

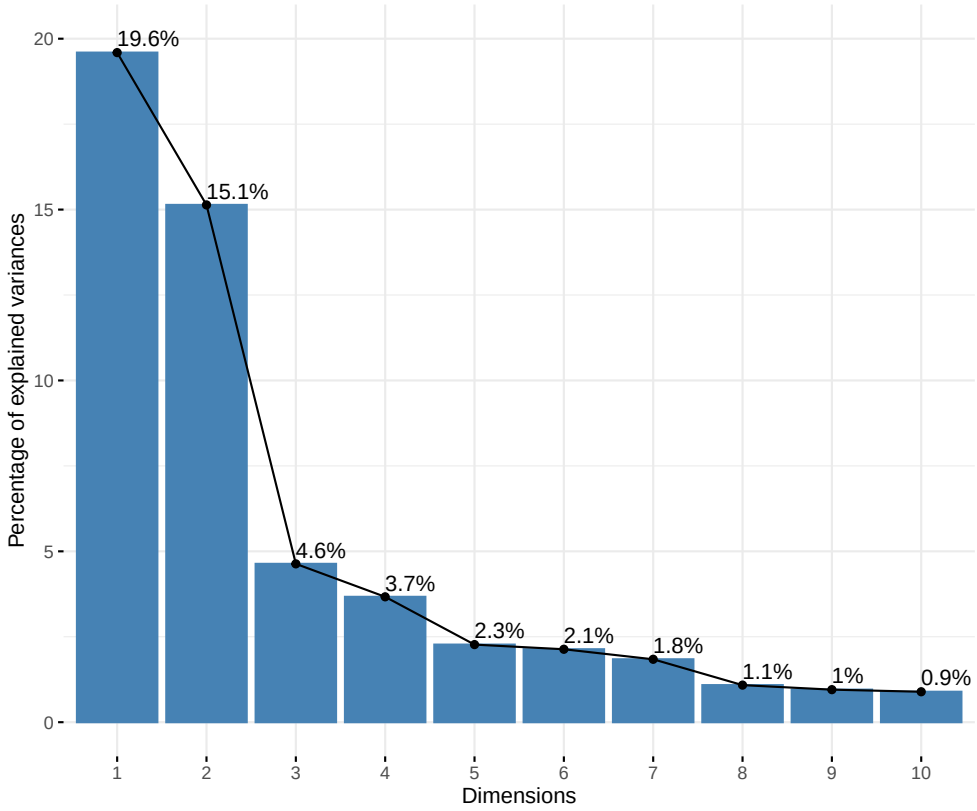


Figure 7: Scree plot, Seventh European Parliament

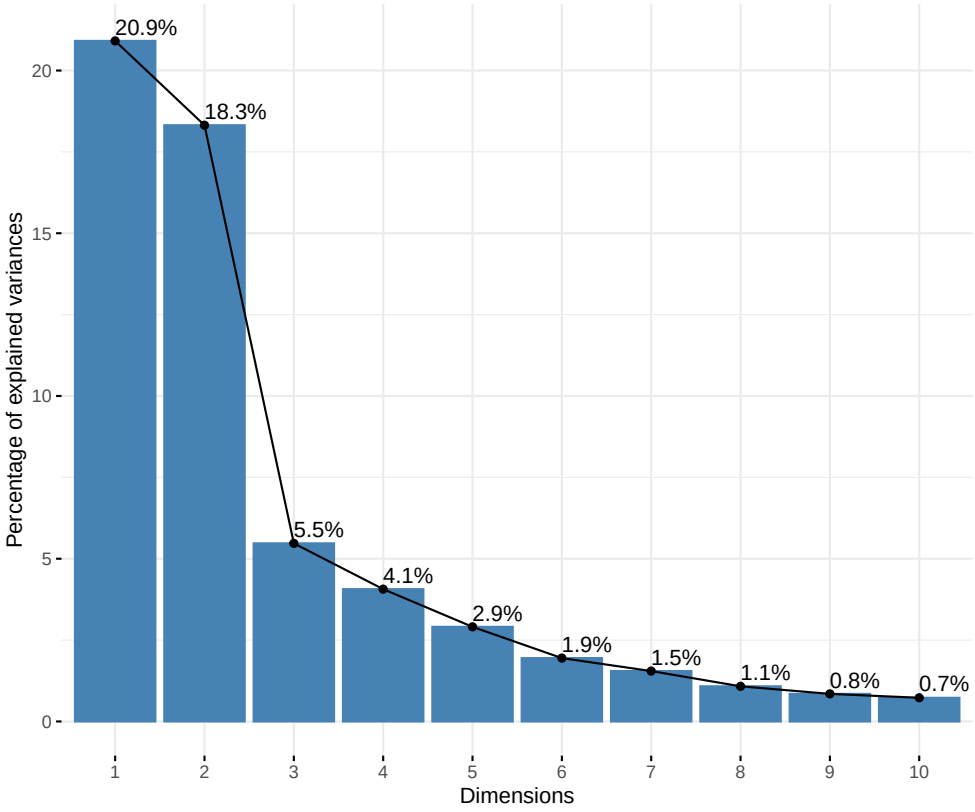


Figure 8: Scree plot, Eighth European Parliament

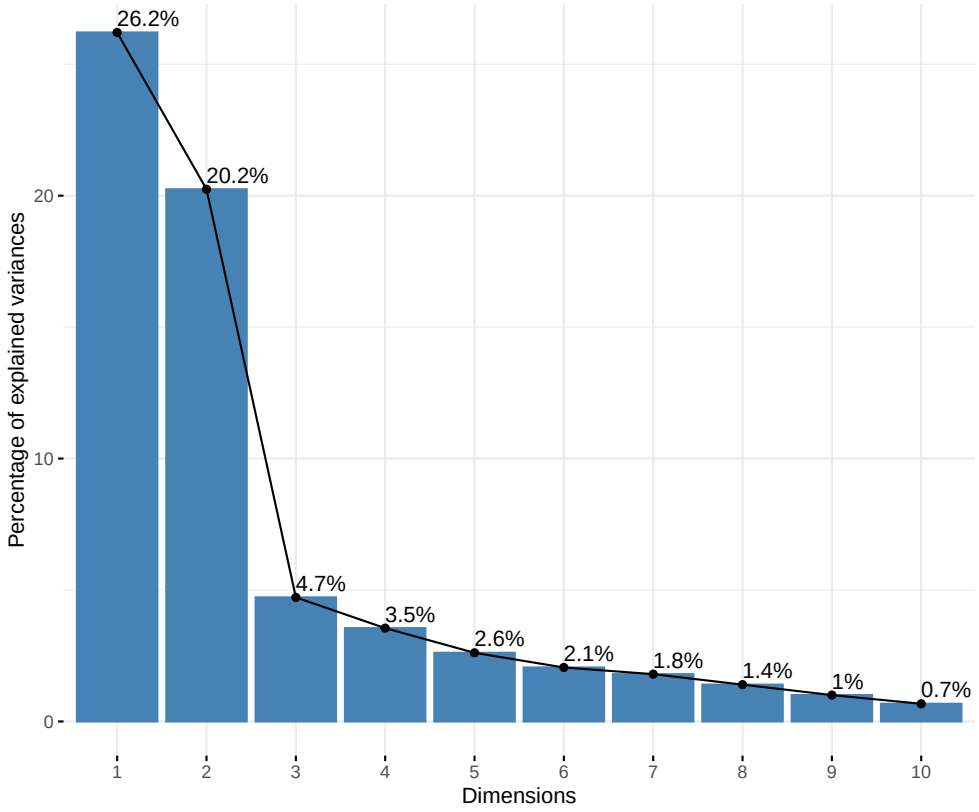
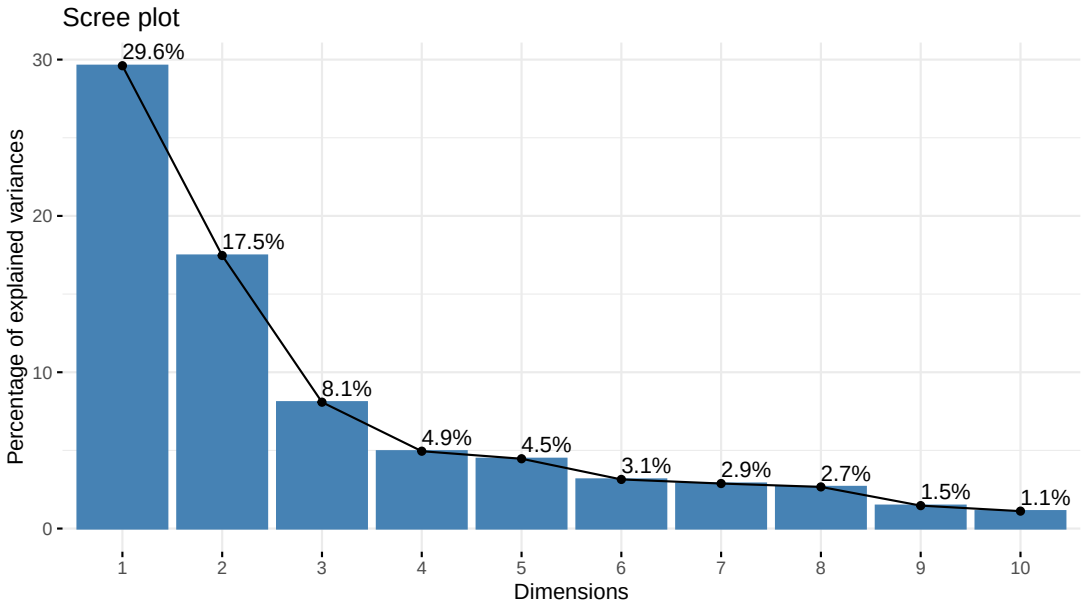


Figure 9: Scree plot, Ninth European Parliament



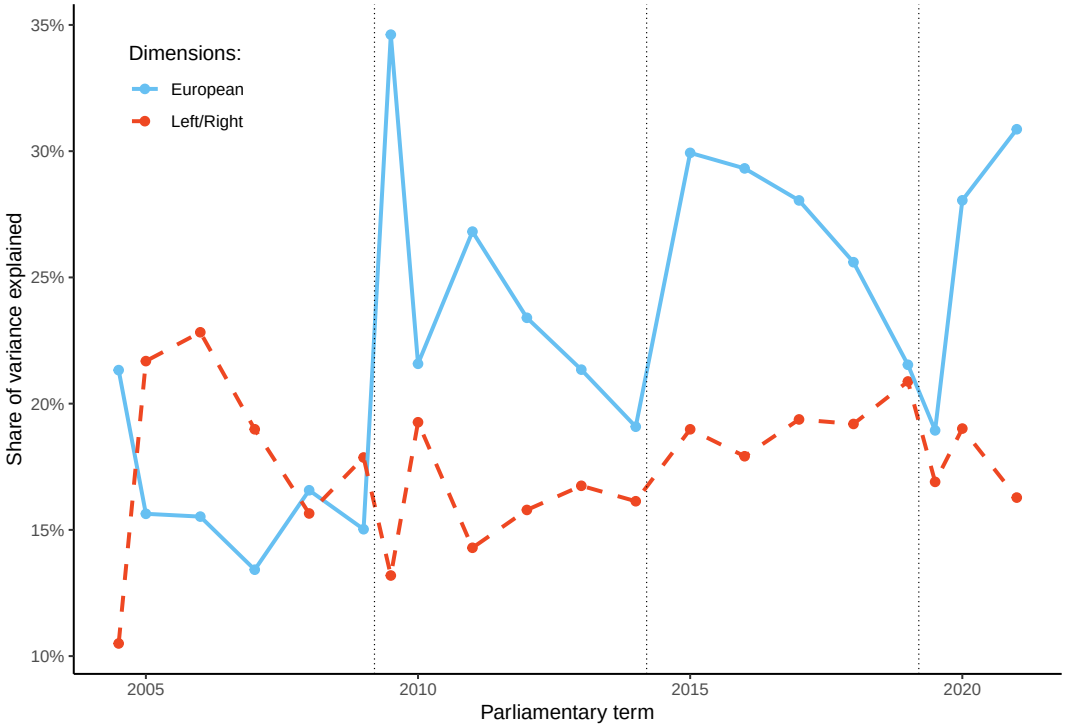
C. Other Figures

Table 5: Yearly coefficients for both dimensions

	European PCA		*Left/Right PCA*	
	Left/Right	European	Left/Right	European
2005	3.371^{***}	-5.537^{***}	-7.516^{***}	-5.165^{***}
2006	4.015^{***}	-5.017^{***}	-7.840^{***}	-5.186^{***}
2007	2.148^{***}	-7.862^{***}	-8.932^{***}	-3.445^{***}
2008	3.238^{***}	7.877^{***}	7.940^{***}	-1.248^{***}
2009	2.632^{***}	-5.370^{***}	-7.507^{***}	-3.495^{***}
2010	5.194^{***}	-7.455^{***}	-7.047^{***}	-7.768^{***}
2011	0.375	12.353^{***}	8.080^{***}	1.328^{***}
2012	-2.516^{***}	10.710^{***}	6.854^{***}	2.928^{***}
2013	0.210	14.797^{***}	10.976^{***}	0.906^{**}
2014	-2.496^{***}	11.228^{***}	9.138^{***}	3.457^{***}
2015	-1.585^{***}	15.949^{***}	11.796^{***}	4.775^{***}
2016	1.887^{***}	16.283^{***}	11.322^{***}	1.053^{***}
2017	-2.363^{***}	13.176^{***}	10.282^{***}	4.867^{***}
2018	-3.216^{***}	13.055^{***}	10.524^{***}	5.918^{***}
2019	0.924^{***}	-10.331^{***}	-9.917^{***}	-3.892^{***}

Note: *p<0.1; **p<0.05; ***p<0.01

Figure 10: Historical trend of the dimensions of voting excluding resolutions on topical subjects (RSP) from the sample

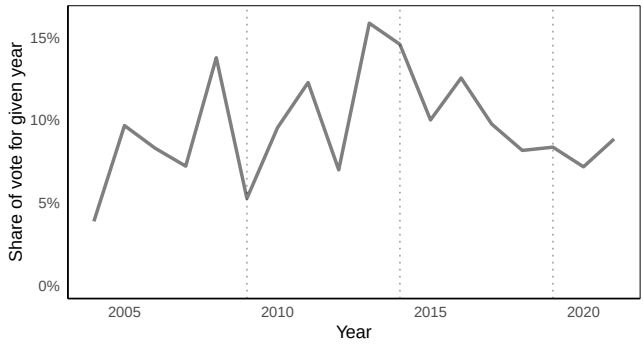


D. Structural changes: including committee on employment and social affairs

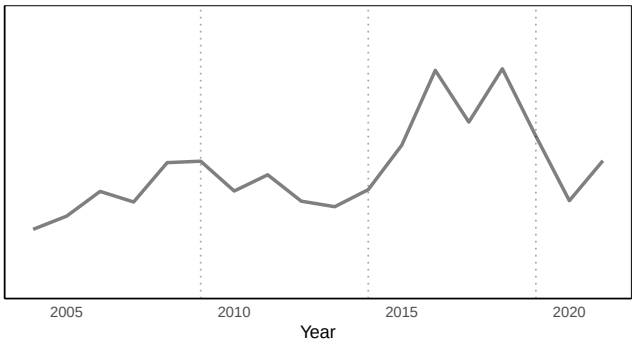
The following reproduces the results of section 6 adding the employment and social affairs committee as crises votes in teh 7th parliament.

Figure 11: Share of crisis votes for each year

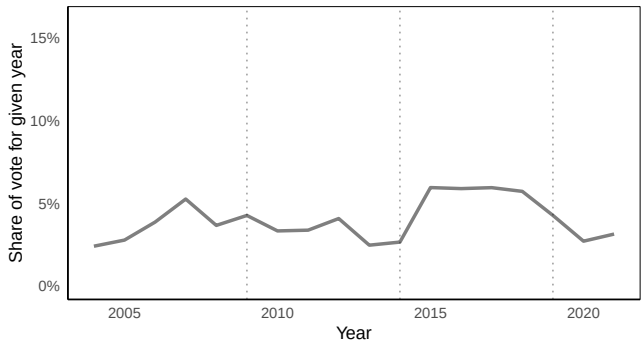
(a) *ECON & EMPL committee*



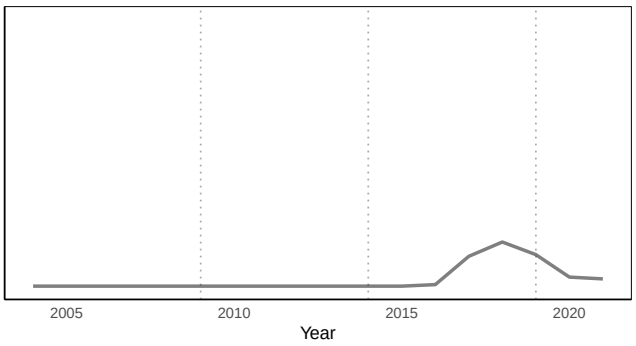
(b) *Migration*



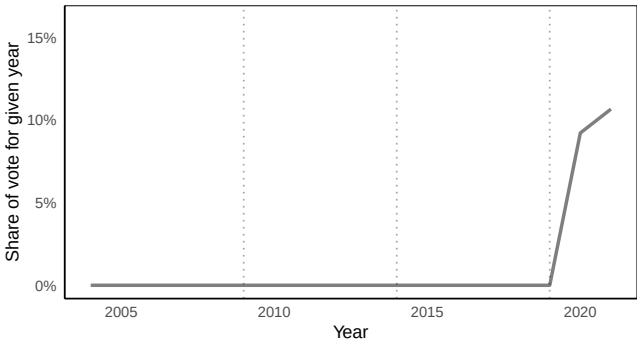
(c) *Terrorism*



(d) *Brexit*



(e) *Covid*



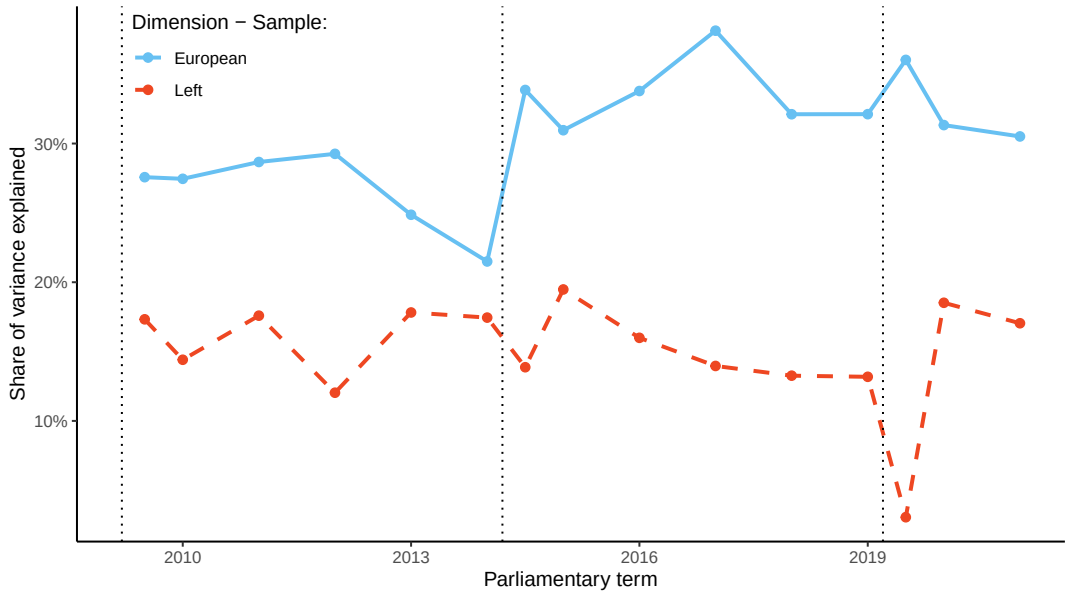


Figure 12: Dimensionality of voting: crisis subsample

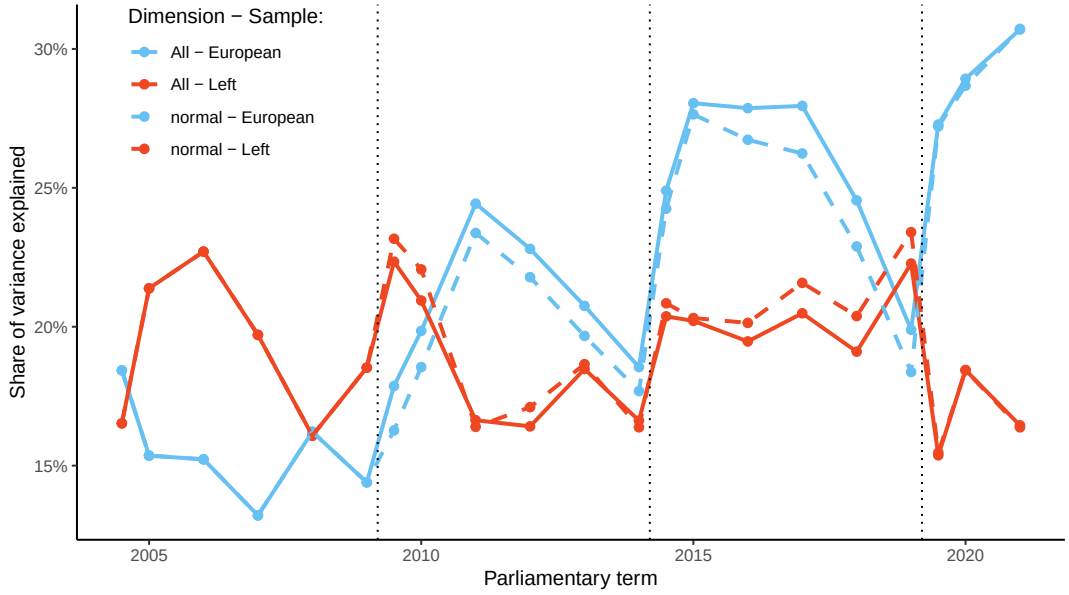


Figure 13: The impact of crisis-related votes: results on the dimensions of voting for the full sample (solid lines) and for the subsample excluding crisis-related votes (dashed lines)

Table 6: European dimension as dependent variable

	6th parliament			*7th parliament*			*8th parliament*			*9th parliament*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
lrgen	0.010			0.011			0.091***			0.092***		
	(0.014)			(0.011)			(0.009)			(0.011)		
lrecon		0.004			0.027*			0.080***			0.079***	
		(0.014)			(0.011)			(0.009)			(0.013)	
galtan			0.024			−0.018			0.069***			0.080***
			(0.013)			(0.010)			(0.010)			(0.013)
eu_position	0.179***	0.179***	0.189***	−0.193***	−0.205***	−0.199***	−0.141***	−0.174***	−0.120***	−0.185***	−0.227***	−0.142***
	(0.019)	(0.021)	(0.019)	(0.016)	(0.016)	(0.016)	(0.012)	(0.012)	(0.014)	(0.016)	(0.017)	(0.020)
R^2	0.372	0.371	0.384	0.504	0.519	0.510	0.632	0.586	0.537	0.603	0.545	0.548
Adj. R^2	0.365	0.363	0.377	0.497	0.513	0.503	0.628	0.581	0.531	0.598	0.539	0.543
Num. obs.	165	165	165	152	152	152	177	177	177	171	171	171

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 7: Left-Right dimension as dependent variable

	6th parliament			*7th parliament*			*8th parliament*			*9th parliament*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
lrgen	0.195***			0.191***			0.158***			0.158***		
	(0.015)			(0.014)			(0.015)			(0.013)		
lrecon		0.177***			0.177***			0.143***			0.156***	
		(0.017)			(0.017)			(0.015)			(0.015)	
galtan			0.168***			0.187***			0.165***			0.174***
			(0.015)			(0.013)			(0.014)			(0.014)
eu_position	0.044*	−0.012	0.144***	0.062**	0.000	0.163***	0.156***	0.098***	0.221***	0.182***	0.107***	0.287***
	(0.021)	(0.025)	(0.022)	(0.020)	(0.024)	(0.020)	(0.020)	(0.021)	(0.021)	(0.019)	(0.020)	(0.022)
R^2	0.542	0.442	0.483	0.579	0.456	0.594	0.464	0.412	0.506	0.527	0.472	0.554
Adj. R^2	0.537	0.435	0.476	0.573	0.449	0.588	0.458	0.405	0.501	0.521	0.466	0.549
Num. obs.	165	165	165	152	152	152	177	177	177	171	171	171

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Figure 14: Voting dimensions based on votes on amendments only (excluding final votes).

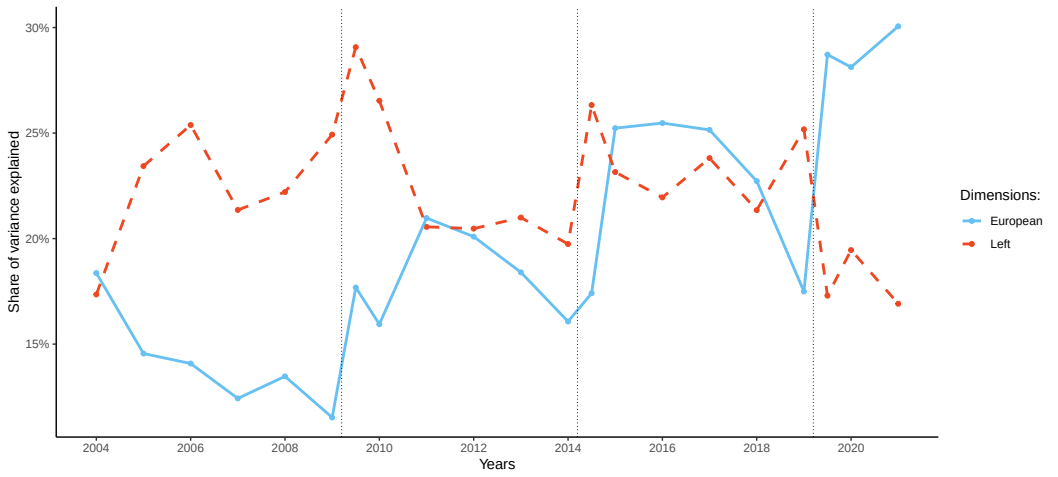


Figure 15: Voting dimensions based on final votes only (excluding votes on amendments).

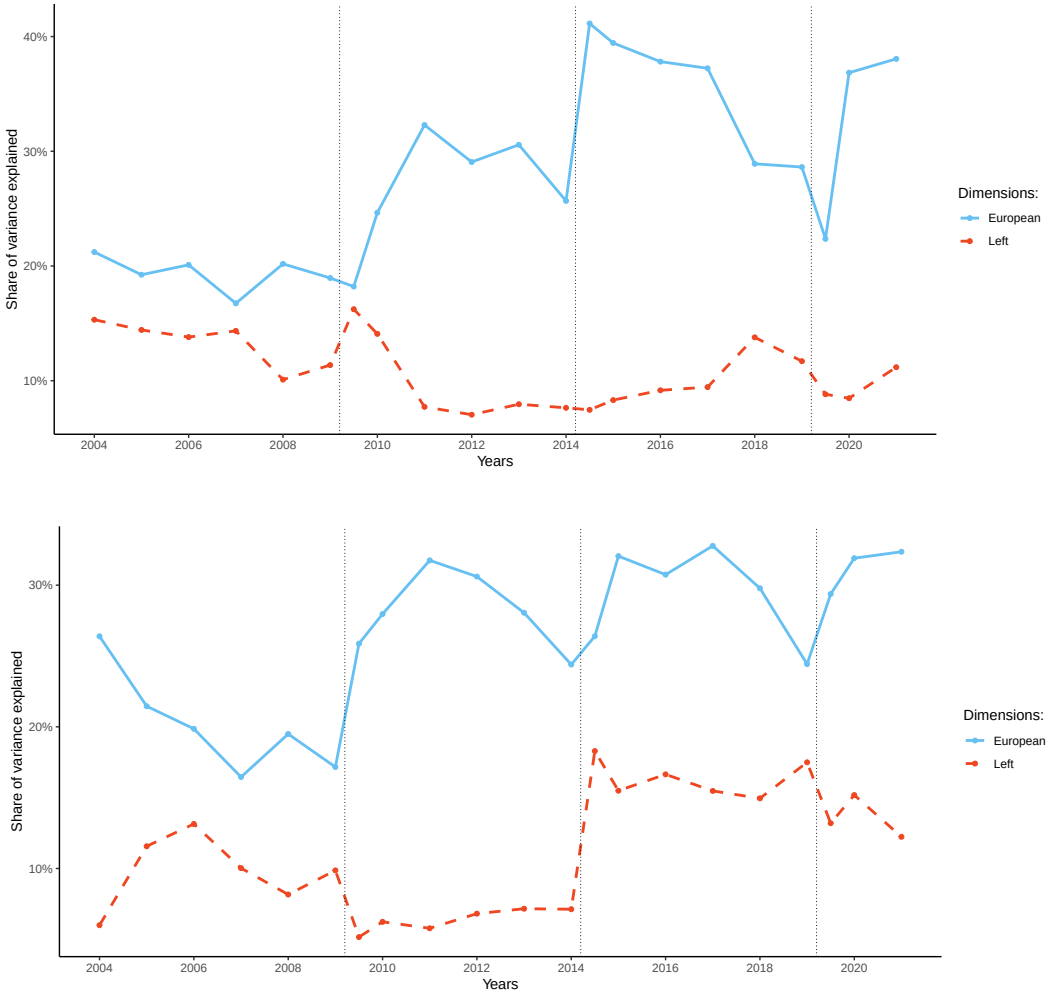


Figure 16: Var Evolution with only votes where coalition votes together

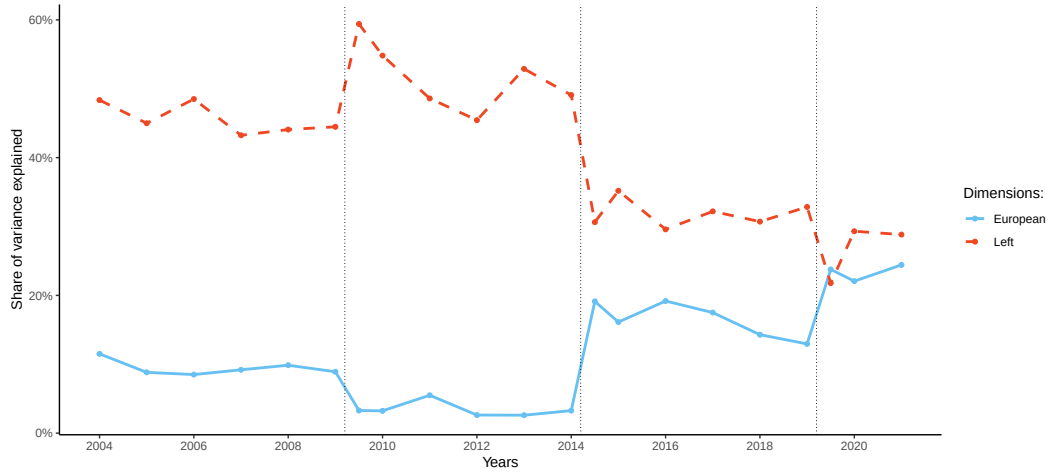


Figure 17: Var Evolution with only votes where PPE votes against S&D

Table 8: European dimension as dependent variable

	6th parliament	*7th parliament*	*8th parliament*	*9th parliament*
LRgen	0.004	0.051	0.015	0.350
	(0 - 0.053)	(0.001 - 0.190)	(0 - 0.086)	(0.233 - 0.461)
LRecon	0.003	0.101	0.015	0.068
	(0 - 0.049)	(0.015 - 0.238)	(0 - 0.082)	(0.021 - 0.139)
Galtan	0.040	0.002	0.034	0.427
	(0.004 - 0.115)	(0 - 0.047)	(0.001 - 0.109)	(0.316 - 0.532)
EU_position	0.310	0.553	0.604	0.479
	(0.174 - 0.452)	(0.393 - 0.686)	(0.471 - 0.707)	(0.313 - 0.636)
Observations	156	152	178	171

Notes: Table reports R-squared of the regression of PCA dimensions on CHES variables individually.
95% bootstrapped confidence intervals in parenthesis

Table 9: Left-Right dimension as dependent variable

	6th parliament	*7th parliament*	*8th parliament*	*9th parliament*
LRgen	0.520	0.585	0.481	0.276
	(0.385 - 0.655)	(0.481 - 0.676)	(0.347 - 0.614)	(0.164 - 0.413)
LRecon	0.451	0.430	0.396	0.354
	(0.326 - 0.578)	(0.315 - 0.554)	(0.266 - 0.531)	(0.225 - 0.485)
Galtan	0.317	0.501	0.398	0.141
	(0.208 - 0.45)	(0.392 - 0.605)	(0.269 - 0.521)	(0.058 - 0.250)
EU_position	0.128	0.002	0.001	0.112
	(0.049 - 0.237)	(0 - 0.039)	(0 - 0.030)	(0.045 - 0.201)
Observations	156	152	178	171

Notes: Table reports R-squared of the regression of PCA dimensions on CHES variables individually.
95% bootstrapped confidence intervals in parenthesis

E. Only amendments

F. Robustness Hix

G. Data Formatting

We apply standard methods to normalize the data before applying principal component analysis (PCA) and probabilistic PCA. Since the data is going to be treated as continuous numerical values, we need to fix a convention to code votes. We set voting yes as 1, voting no as -1 and abstaining/absence as 0. As long as voting yes and no are symmetrically fixed around 0, this convention does not change results.

Additionally, and following regular techniques in data scaling techniques, we eliminate from the sample MEPs that voted for less than 20% of the roll-call votes in a given parliamentary term. This make sure that MEPs that did not stay for long in the parliament and might exhibit unusual behaviors are discarded from the dataset. In practice, this condition does not change the results.

Conventional techniques include the removal of lopsided votes: when the minority side is too small relative to the majority side. These votes are per essence a bit different, as they often represent procedural votes of little ideological value. We removed votes where the size of the minority side represents less than 2.5% of the majority side. Changing this threshold marginally has little effect on the overall results.

Finally, as PCA is a variance decomposition technique, we need to equalize the variance of all votes to make sure they each contribute equally in the determination of the principal components. Since we treat the data as continuous, the smaller the minority side will be respective to the majority side, the lower will be the variance of a bill (if close to everyone votes 1, the mean is also 1 and the variance very small). If we were not to apply any normalization to the data, these low-variances votes will be relatively less important in determining principal components.