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Hidden Networks within the European Parliament: a Spatial Econometrics Approach. *

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The European political spectrum can be modelled as a two-dimensional space, whose interpretation has been investigated in the spatial voting literature by regression analysis. However, data on legislators' positions display spatial clustering that is not explained by the standard models. We account for correlation among legislators by modelling spatial dependence across countries, using a new sets of geopolitical and cultural metrics. We confirm the well known result that the first dimension of the European political space is mainly explained by the Members of European Parliament's ideological position on a left-right scale, although correlation across legislators cannot be neglected. We show that spatial correlation plays instead a central role when interpreting the more controversial second dimension of the political spectrum. The most relevant proximity measures are based on geographical proximity, institutional similarities and on three cultural metrics related to which issues play a central role in the political debate.

Keywords: European political space, spatial autoregressions, NOMINATE, proximity matrices, economic distances.

JEL codes: D72, C21.

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1 Introduction

The European Parliament (EP) stimulates vivid interest in both economists and political scientists. It is relatively young and has increasingly gained power in terms of the set of issues that it is called to decide upon, the number of voters represented and the number of votes it casts. A peculiar characteristic of the EP is the strong heterogeneity of its components. Members of the European Parliament (MEPs) are elected in districts that do not cross national borders, from lists chosen by national parties and with proportional, but country-specific, electoral rules. Therefore, MEPs represent their countries and their national parties, as well as the European Political Group they belong to. Also, MEPs are only accountable to their national electorate, with widely diverse rules. Thus, politics in the EP are likely to be subject to both national and transnational influences, and the analysis of legislators' behaviour is likely to be more complex than its counterpart in national parliaments (Hix et al., 2007).

The drivers of legislators' behaviour in the EP is a fundamental building block to evaluate institutional changes (e.g., changes in the electoral rules in the EP and in its composition, or phenomena such as Brexit). Cross-influences among legislators may change the consequences of policies by enhancing or weakening their effects, and thus favouring or opposing the policy makers. The heterogeneous composition of the EP is likely to induce the formation of networks among MEPs, with respect to diverse similarity criteria, which we aim to explore. The aim of this paper is thus to shed light on which networks are relevant to determine the relative positioning of legislators in the so-called policy space, where policy consequences and policy preferences are usually represented. Thus, the novelty of our approach compared to that of, e.g., Hix, Noury and Roland (2006, HNR henceforth) is that the potential correlation across legislators is explicitly accounted for.

Following the existing literature, we postulate that the optimal representation of the (intrinsically multidimensional) policy space is bi-dimensional, and we investigate the possible spatial effects along the two dimensions separately. The first contribution of the paper is therefore the definition of what "neighbour" means in this context by presenting nine new proximity measures, based on various notions of country-specific, geopolitical and cultural distances. We then perform our regression analysis, under the assumption that each dimension of the MEPs' positions (aggregated at national party level), is described by a spatial autoregressive model (SAR), which are known to allow an effective and parsimonious description of correlation structures and to offer tractable socio-economic interpretation of the results.

We find that, after explicitly accounting for spatial effects, the first dimension is essentially explained by the ideological positioning on the left-right scale, consistently with HNR. We then provide further insights on the interpretation of the more controversial second dimension of the policy space, by highlighting the significant presence of spatial effects when several measures of proximity are adopted. Notably, the most relevant cultural proximities are those linked to issues that are deemed to be relevant in the political debate, and not those related to the nature of the policy-making process. Ultimately, we identify two macro-groups of proximities that impacts the positions of MEPs in the policy spectrum, and produce spatial spillovers of opposite sign.

Our work relates to two different areas of political economy and political science. First, we contribute to the recent literature who investigates spatial effects on the behaviour of politicians and parties (e.g. Böhmelt et al., 2016; Ezrow et al., 2017; Williams et al., 2016). Böhmelt et al. (2016) adopt a spatial econometrics approach to show that (national) election policies of political parties respond to ideological shifts of foreign political parties that have recently been in power, while Williams et al. (2016) find evidence of spatial contagion between parties that are ideologically close. In this paper we focus as well on national parties as unit of observation. However, we examine the spatial effects across national parties within the EP, rather than across parties in the domestic arena.

We also contribute to the strand of literature that analyses legislators' behaviour and its determinants. Over the past few decades, a growing literature in political economy has focused on the analysis of the determinants of legislators' behaviour in Congress by means of records of roll call votes (Poole and Rosenthal, 1997; Rosenthal and Voeten, 2004). Multidimensional scaling methods have been designed to map information from roll call votes to a policy spectrum, with a certain number of postulated dimensions, which contain legislators' relative ideal points (e.g., Poole, 2005; Poole and Rosenthal, 1997, and references therein). These techniques have been more recently employed to analyse other supranational settings such as the EP (HNR; Hooghe et al., 2002), even though, to the best of our knowledge, spatial correlation across legislators has never been explicitly accounted for.

2 Theoretical and methodological background

Spatial correlation among MEPs may have different sources. Intuitively, a spatial network may or may not have an effect on the legislators' response to exogenous shocks depending on the context and on the issue of the vote itself. A sensible starting point rests therefore in investigating which of these networks are truly relevant for legislators' behaviour and what are their main effects.

Our analysis relies on estimates of relative positions of MEPs along each dimension of the policy space, which have been obtained by the so-called NOMINATE procedure (Poole and Rosenthal, 1997). Then, we use spatial econometrics to investigate the substantive meaning of these dimensions and the possible clustering along each of them. Ultimately, we aim to test the following two hypotheses

A: Spatial correlation matters in order to explain the relative positions of MEPs in the policy space, and several alternative proximity measures generate spatial spillovers.

B: Among the relevant proximity measures, spatial spillovers have different sign depending on the intrinsic features of the measure itself.

2.1 NOMINATE and the dimensions of the policy space

In spatial voting models legislators' preferences are characterised by their ideal points located in a "policy space", which is a simplified representation of possible policy positions on which preferences are defined. When called to vote, legislators compare the outcome of an approved proposal to that of a rejected proposal, and vote Yes in case the policy outcome when the proposal is approved is closer to their ideal point than the one arising from the status quo (i.e., from the rejection of the proposal). Knowledge of legislators' ideal points would allow scholars to understand and predict legislators' voting behaviour. However, only legislators' votes are observed, and ideal points need to be inferred.

The dimensionality of the policy space is not observable and has to be postulated exogenously by the practitioner, who then validates the choice ex-post by some measure of goodness of fit. Existing literature (see HNR) shows that about 90% of legislators' choices in the EP are correctly classified assuming a bi-dimensional space. Thus, legislators' positions are bi-dimensional vectors.

In order to estimate the components of such vector, we rely on the methodology known as NOMINATE (Poole and Rosenthal, 1997, and references therein), which in a nutshell is a scaling method for the subset of votes that scholars can observe, the so-called roll call votes. Heuristically, NOMINATE is a multi-step technique that has been designed to deduce the position of each legislator's bliss point in the policy space given the information on how legislators voted in each roll call. NOMINATE relies on a criterion of similarity between legislators, where the pairwise similarity index is constructed from the number of times in which their votes match. Beyond the technical details of the methodology, we stress that the outcome of NOMINATE are estimates of legislators' relative positions rather than of their actual ideal points along the two orthogonal aforementioned dimensions.[1]

However, NOMINATE outcomes offer no insight about the economic/political meaning of the dimensions themselves, which has to be explored by regression analysis.

[1] Our results are derived by applying the weighted dynamic version of NOMINATE to take full advantage of the dataset. As we only deal with five legislatures, the standard static model would most likely deliver similar results.

2.2 Spatial autoregressions (SARs)

One novelty of our approach is the introduction of spatial autoregressive components in the regressions analysis to account for possible transnational networks across legislators.[2] In spatial econometrics, "space" is defined in broader terms compared to the standard geography literature, and it relies on the definition of a general economic distance. In SARs, the cross-correlation across agents is embodied in a matrix, denoted by W, which needs to be chosen ex-ante by the practitioner and cannot be estimated. Thus, the spatial structure is assumed to be known up to one (or few) parameter(s) that define the strength of the correlation. Conventionally, there is no spatial interaction of each legislator with himself, and hence the diagonal elements of W are set to zero. In order to estimate the parameters of SARs, W has to be suitably normalised. We choose the so-called spectral norm normalization, i.e., we scale each element of W by its spectral norm.[3] Unlike the commonly adopted row-normalization, our choice has the advantage of preserving the heterogeneity across different rows of W, as all elements of W are scaled by the same factor. Thus, the total exposure of subjects to the spatial stimulus may be heterogeneous, as legislators who belong to countries with a more active role in European politics may be more connected than legislators coming from peripheral countries.[4]

Let y and X denote, respectively, dependent and independent variables, while ϵ indicates a vector of independent and identically distributed, zero-mean, normal random variables. We adopt the variant of SAR known as Spatial Durbin model, i.e.

$$y = \lambda W y + X\beta + W X \gamma + \epsilon, \tag{1}$$

for some unknown vectors β and γ and unknown scalar λ. According to (1), the dependent variable of each unit is not only explained by its own vector of characteristics X, but it is also related to a linear combination of the features of neighbouring units. The component Wy allows each agent's ideal point to be potentially related to a combination of his/her neighbor's ideal points, while WX captures the explicit relationship between one agent's ideal point and his/her neighbour's characteristics.

In order to have a meaningful set of regressors we adopt the approach of HNR and aggregate individual data at the national party level.

[2]For an exhaustive survey of SARs see Elhorst (2014). Examples of the application of SAR models to political economy can be found in Williams (2015) and Böhmelt et al. (2016).

[3]The spectral norm is defined as the square root of the maximum eigenvalue of $W'W$, where prime denotes transposition.

[4]A discussion on the drawbacks of row-normalization of W is reported in Neumar and Plümper (2012, 2016).

3 Theoretical and empirical rationale of the proximity matrices

One fundamental contribution of this paper rests in the discussion of several between-country proximity measures, which may in turn influence the MEPs' (and hence national parties') behaviour within the EP. We construct several proximity matrices W based on our new definitions of distances. Each element of W is built from a pairwise distance d_{st} between countries s and t.[5] Since our analysis is performed at national party level, we set $w_{ij} = \frac{1}{d_{st}}$, where w_{ij} denotes the $i-j$th entry of W corresponding to national parties i and j, where national parties i and j belong to countries s and t, respectively. We impose $w_{ij} = 0$ if national parties i and j belong to the same country, as we are interested in the implication of transnational correlations across national parties. The resulting matrices form a new interesting set of between-country contiguity criteria that could be applied to different empirical problems.[6]

The reciprocal influence across national parties can be originated by several mechanism. Following Neumayer and Plümper (2016), the proximity matrix (what they call the "connectivity matrix") should not characterise a mere contiguity between national parties, but it should reflect the interaction channels across MEPs belonging to different national parties. The matrices we consider are based on geographical, linguistic, institutional and cultural distances.

3.1 Geopolitical proximities

The first set of matrices is based on distances that are related to observable country-specific characteristics.

Geographical proximity. We calculate d_{st} using the distance in kilometers between capitals of European member states, measured as the average of the shortest outbound and inbound routes suggested by Google Maps.[7] Although we acknowledge that geographical proximity may only be a proxy of the transmission mechanism, as Neumayer and Plümper (2016) argue, we recognise that it is also a well establish benchmark we need to confront with.

Linguistic proximity. The second proximity measure we adopt is based on a linguistic metric. We construct W using the lexicostatistical distance between countries

[5] In order to define W, national rather than individual characteristics are used as a more innovative and promising set of distances is available, and given that we aggregate observations at the national party level.

[6] Data and codes to generate such matrices can be obtained from the authors.

[7] For robustness, we also considered the distance between capitals as measured in terms of flight duration. The two distances are highly correlated and lead to the same considerations. Results are available from the authors upon request.

s and t (Dyen, Kruskal and Black, 1992).[8] Following Ginsburgh and Weber (2011), linguistic proximity has an effect on economic and political outcomes such as intensity and frequencies of trade between countries, immigration and voting behaviour. Spatial correlations implied by linguistic proximity may play a role on the interactions across MEPs due to the relative ease of communication among individuals who speak similar languages.

Institutional proximity. The third proximity measure is related to the MEPs' institutional background. To characterise the institutional environment that is familiar to each national party, we consider the score of its home country in terms of the Parliamentary Power Index (Fish and Kroenig, 2009), which is a measure of the strength of national parliaments. Using the PPI, we define $d_{st} = |PPI_s - PPI_t|$. We expect that two interacting legislators who share similar institutional backgrounds, and thus have experienced similar legislative decision-making environments, may find each other's information more valuable and each other's political actions more relevant, compared to two interacting legislators who experienced drastically different institutional backgrounds.

3.2 Cultural proximities

Neumayer and Plümper (2016) argue that W should reflect interaction, rather than contiguity, among agents. In this respect, among the three geopolitical matrices, only the Institutional matrix scores well, as it describes a possible channel which may affect the ability of MEPs to influence each other voting decisions, and, henceforth, their positions. The geographical and language measures, instead, can be considered as proxies of cultural proximities between MEPs, which may as well affect their ability of sharing information, and the effectiveness of the reciprocal influence they exert on each other. In order to shed light on which country-specific cultural characteristics drive legislators' interactions, we rely on Hofstede et al. (2010), who map six orthogonal dimensions of national cultures into six cultural indexes: Power Distance Index (PDI), Individualism vs. Collectivism (IDV), Masculinity Index (MAS), Uncertainty Avoidance Index (UAI), Long-Term Orientation (LTO) and Indulgence vs. Restraint (IVR). We define the distance between countries s and t based on Index k as $d^k_{st} = |Index^k_s - Index^k_t|$, with $k = PDI$, IDV, MAS, UAI, LTO, IVR.[9]

Both PDI and UAI are related to characteristics of the political process, while IDV, MAS, LTO and IVR are linked to the political issues perceived as being the most

[8] French Belgium and Flemish Belgium are considered as separate countries. The DKB distance is not available for pairs which involve Finnish legislators, as their official language is not Indo-European. We set all these w_{ij} values to 0 (minimal proximity).

[9] Cultural indexes IDV, MAS and UAI are available separately for French Belgium and Flemish Belgium, which have been treated as separate countries.

relevant. Therefore, there are two different mechanisms that may be captured by proximity matrices built from these cultural indexes: the tendency to interact more with legislators/parties that have a similar attitudes towards policy-making procedures, and the fact that interactions are easier among legislators/parties who care for similar issues.

Power Distance Index. PDI measures attitudes towards inequality, and specifically the extent to which less powerful members of institutions expect and accept unequal distribution of powers. European countries have a high variation of PDI, ranging from Slovakia ($PDI = 104$) to Austria ($PDI = 11$). High PDI is correlated with strong polarization of parties, weak centre, fewer parties and the tendency to have the same party in power. In low PDI countries, instead, the political system typically shows coalition governments where the power shifts from one party/coalition to a different one at every election. Moreover, in high PDI countries there is a tacit norm for which people who hold power have privileges and are expected to use them for their private interest, while no such norm is found in low PDI countries. Differences in PDI affect political processes. Proximity in terms of PDI may affect the interaction among MEPs through the effect of similar/dissimilar organization of the political decision-making process and through the perception of role and power of politicians.

Individualism Index. IDV classifies societies based on whether they display individualism (preference for a social framework in which individuals take care only of themselves and their close family) or collectivism (preference for a framework in which individuals expect their relatives or members of a particular group to look after them). European countries have a large variation in IDV, ranging from Great Britain ($IDV = 89$) to Portugal and Slovenia ($IDV = 27$). In high IDV countries privacy and individual freedom prevail over collective interests and equity concerns, and such countries are typically characterised by high human rights rating. Finally, opinions in collectivist countries tend to be predetermined by group membership while private opinions are important (and expected) in individualist ones. In policy-making, differences in IDV scores affect primarily the issues that will be defended. Thus, "Individualism implies concern with human rights, political democracy and market capitalism; collectivism implies concern with group interests."[10] Therefore spatial effects when contiguity is based on IDV arise from similar/dissimilar importance that national parties attach to such issues.

Masculinity Index. MAS classifies societies based on the distinction of emotional roles by gender. Masculine societies are characterised by the expectation that men are assertive, tough and looking for success, and females are modest and tender. In female

[10]Hofstede et al. (2010), p. 413.

societies roles overlap, and everyone is supposed to be modest, tender and concerned with the quality of life. European countries display a wide diversity, ranging from the masculine Slovakia ($MAS = 110$), to the feminine Sweden ($MAS = 5$). High MAS are correlated with preferences for large organizations (vs. small), with the tendency of resolving conflicts by letting the strongest win (vs. negotiation) and with low participation of women in politics and management. In policy-making, differences in MAS scores affect primarily the issues that will be defended, similarly to IDV. However, MAS is also related to political processes, as in masculine countries the political discourses are more adversarial, while they are more consensus-oriented in low-MAS countries. Therefore, spatial effects when W is based on d_{st}^{MAS} originate from the similarities/differences in the importance that national parties, controlling for their ideological orientation, assign to these issues, and in terms of the easiness of finding a common approach to political discussions.

Uncertainty Avoidance Index. UAI measures how national cultures are affected by the unknown and the extent to which citizens feel threatened by ambiguous/unknown situations. UAI in Europe is highly heterogeneous, ranging from Greece ($UAI = 112$), to Denmark ($UAI = 23$). High UAI are correlated with the presence of many precise laws, which may not be enforced properly, often due to a slow and/or inefficient judiciary system. Moreover, high UAI countries have low participation in politics, more conservatism and a stronger need for law and order. On the contrary, citizens in low UAI countries participate more in political decisions, are prepared to protest against them, and do not think that protests should be repressed. Therefore, accountability of politicians is perceived as being stronger, as politicians are closer to the citizens. Higher UAI are also related to more perceived corruption. In policy-making, differences in UAI affect political processes, as it is the case for PDI. A choice of W based on d_{st}^{UAI} reflects how similar/different is the idea that MEPs have of the optimal level of legislative and economic intervention, and of the number of laws that should be passed.

Long-Term Orientation Index. LTO measures the weight that societies give to virtues oriented towards the future (e.g. perseverance) as opposed to virtues related to past and present (e.g. respect for tradition). LTO scores are related to investment choices, nationalism and fundamentalism. LTO in European countries range from Germany ($LTO = 83$), to Ireland ($LTO = 24$). High LTO countries dislike the presence of wide socio-economic differences, while low LTO countries tend to be more meritocratic. LTO scores are related to pragmatism vs. fundamentalism in politics. Low LTO countries are typically focused on (possibly ineffective) principles and display a strong national pride, while high LTO countries have a tendency to import good practices from abroad and implement them. Therefore, proximity in LTO may affect legislators' approaches to policy-making and their ability to compromise and learn from each other.

Indulgence vs. Restraint Index. IVR measures whether a culture has a tendency to allow relatively free gratification as opposed to the conviction that such gratification needs to be regulated by strict social norms. IVR in European countries ranges from 78 (Sweden) to 13 (Latvia). IVR is related to the importance of freedom of speech, the importance of maintaining order and the number of police officers. Indeed, IVR measure the tension between "a need for freedom of speech versus a need for order."[11] Therefore similarity of MEPs' home country (and thus of national parties) IVR scores may affect their views on the underlying fundamental values of a country, and therefore the type of effort in place to preserve them.

An illustrative example of different choices of W in practical situations is reported in the online supplement.

4 Results

The estimates of legislators' positions on the two dimensions have been obtained by dynamic-weighted-NOMINATE. As in HNR, we focus on the first five legislatures and construct our dependent variables, y_d, where $d = 1, 2$ indicates dimension, as the averages of positions of legislators belonging to the same national party. Data pertaining to roll calls, national parties and European political groups have been obtained from http://personal.lse.ac.uk/hix/HixNouryRolandEPdata.HTM. We stack data for five legislatures, and our dataset consists of 347 observations. We refer to HNR for descriptive statistics of roll call votes data and legislators' respective positions in the political space.

We first replicate the analysis in HNR to test whether the spatial pattern of legislators' positions in the policy space is explained by an appropriate set of regressors or whether there is residual spatial correlation. In the latter case, accounting explicitly for spatial correlation within the regression is empirically justified. Results of such preliminary test, reported in Table S1 of the online supplement, indicate that residuals along both dimensions display severe spatial correlation for almost all the choices of W. Thus, the exogenous regressors are not able to explain the spatial clustering in y_d.

Let LR and $EUint$ be indexes of left-right political orientation and EU integration propensity, respectively. Let D be a set of variables containing country-specific and European political group-specific controls, as well as dummy variables to indicate whether the national party was in power during each legislature, and whether it had a European Commissioner during such period of time. LR and $EUint$ have been obtained from expert judgement data in Marks and Steenbergen (2004), while controls in D have been

[11] Hofstede et al. (2010), p. 413.

obtained from information offered by EP and European Commission websites. We also include P, a set of variables that controls for the legislature.[12] Henceforth, "Km", "Lang" and "Inst" denote geographical, linguistic and cultural proximity, respectively.

Our main specifications are

$$y_1 = \lambda W y_1 + \beta_{11} LR + \beta_{12} EUint + \beta_{13} W * LR + \gamma_1 D + \delta_1 P + \epsilon_1, \quad (2)$$

$$y_2 = \lambda W y_2 + \beta_{21} LR + \beta_{22} EUint + \beta_{23} W * EUint + \gamma_2 D + \delta_2 P + \epsilon_2. \quad (3)$$

Although data pertaining to different legislatures are pooled, W is constructed so that spatial correlation only affects units within the same legislature, resulting in W having a block diagonal structure where each block reflects interactions of national parties within each legislature. As previously mentioned, $w_{ij} = 0$ if national parties i and j belong to the same country. In specifications (2) and (3), we either include $W * LR$ or $W * EUint$ to avoid inflated standard errors, as $W * LR$ and $W * EUint$ are highly correlated.[13]

The dummy P allows to control for time trends, as we expect global political trends in Europe to generate ex-ante correlations across legislators along unobservable characteristics. Thus, (2) and (3) isolate the effects of genuine cross-correlations within each legislature from those of the time-varying composition of the Parliament. Without P, the spatial parameter estimates would be spuriously inflated if unobserved time trends led countries to elect similar candidates, since the magnitude of the estimates of the spatial parameters would erroneously account for both these time trends and the genuine within-parliament spatial correlation.

As a robustness check, we also estimate parameters in (2) and (3) with the set of cultural indexes (C, in the supplement) and the percentage of female legislators in each national party (G, in the supplement) explicitly included among the regressors. Results are reported in Tables S3-S6 of the supplement.

Estimation is performed by maximum likelihood. In addition to the standard estimates and t-statistics, we report average marginal effects of both LR and $EUint$ on y_d, as they are often more informative than actual coefficient estimates. We indicate as $MDE_{LR/EU}$ the average direct effect of a marginal change in $LR/EUint$ on the dependent variable, where $MDE_{LR/EU}$ measures how responsive y_d of unit i is to a marginal change of $LR/EUint$ in unit i itself, averaged across all $i = 1, ..., n$. $MDE_{LR/EU}$ contains not only the standard linear marginal effect captured by β_{d1}/β_{d2}, but also the feedback generated by the network structure, i.e., the change in $LR/EUint$ induced on all other regions by a shock in $LR/EUint$ of region i, and in turn their effect back

[12] The first European Parliament is considered as reference group.

[13] We chose to include $W * LR$ in (2), as LR is the most relevant regressor for the first dimension, and $W * EUint$ for (3), as $EUint$ is peculiar to the interpretation of the second dimension. However, results are robust to the replacement of $W * EUint$ with $W * LR$ in (3). Results of this additional specification are available from the authors upon request.

on y_d of region i itself. The average marginal total effect, $MTE_{LR/EU}$, measures the average responsiveness of unit i to a shift in $LR/EUInt$ level of all units, i.e., the average change of unit i's position due to a universal shock in $LR/EUInt$ levels. Also, the average marginal indirect effect $MIE_{EU/EU}$ indicates the average spillovers, i.e., the average change of y_d in region i for a marginal shift of $LR/EUint$ in all other regions apart from i itself (e.g., LeSage et al., 2013). We refer to local spillovers if $MIE_{LR/EU}$ is statistically significant even though the estimate of the spatial parameter λ is not statistically different from zero. In such case, the spillover only falls on units for which $w_{ij} \neq 0$, i.e., the network plays a role only on those units that are "neighbours" according to W. In contrast, we refer to global spillovers if $MIE_{LR/EU}$ is statistically significant in presence of a non-zero λ estimate. In this case, the network reaches all units. For clarity, even though magnitudes (although not significance) of the marginal effects satisfy $MDE + MIE = MTE$, we report all three quantities with their respective t-statistics. Standard errors of marginal effects and critical values have been obtained by bootstrap, and thus the latter differ from standard normal quantiles.

Tables 1 and 2 report estimates for specification (2) when W is constructed either from geopolitical or cultural distances, respectively. Tables 3 and 4 report corresponding estimates for the second dimension. For each model, the standardized Moran I statistic (denoted by LM, as Lagrange Multiplier) on the residuals is also reported. If the value of such statistic is smaller than the relevant quantile of a χ^2 distribution with one degree of freedom we fail to reject the null hypothesis of no spatial correlation in the residuals and conclude that all sources of spatial interactions have been accounted for.

4.1 First dimension

Results in Tables 1 and 2 confirm that the first dimension, as in HNR, can essentially be interpreted as the ideological position on the left-right scale, both for geopolitical and cultural proximity matrices. Geopolitical proximity matrices do not induce spatial spillovers on the first dimension. Indeed, marginal indirect effects are never significant, and, therefore, marginal total effects coincide with marginal direct effects, both for LR and for $EUint$. Results obtained from specification (2) are robust to the inclusion of cultural/gender controls (results in the online supplement).

When considering the cultural proximity matrices our findings differ, as cultural distances based on IDV, MAS, and UAI generate significant indirect effects. However, the significance of spillovers is robust to the inclusion of the cultural indexes as regressors only for W^{IDV}. In this case, MDE_{LR} is positive and significant, but it is contrasted by a negative and significant MIE_{LR}, resulting in MTE_{LR} being positive, but significantly lower than the direct one. The estimate of the λ coefficient is negative and significant, so that the (negative) spillovers are thus of global nature and fall on all units. On average, the position of unit i on the first dimension is less responsive to a universal change on the LR ideological scale, compared to what its responsiveness would be towards a shift in its own LR level. As a result, recalling that legislators' (and parties') positions are expressed only in relative terms, a universal change in LR results in a contraction of legislators positions due to the spatial network induced by IDV.

The IDV measures whether individuals of a country are expected to take care only of themselves and their immediate families, or whether there is in-group loyalty. This index is related to attitudes towards several policies such as healthcare and, more generally, welfare, that are typically related to the left-right orientation. Kallio and Niemelä (2014), for example, show that the left-oriented individuals are less prone to display individualistic attitudes in the attribution of poverty. Hence, we interpret the relevance of the IDV index as a cross-country underlying spatial correlation driven by unobservable characteristics that are related to each country's ideological attitude, so that the evidence that the first dimension is mainly related to the ideological position on the LR scale is confirmed.

4.2 Second dimension

From results in Tables 3 and 4, we observe that the second dimension is explained by the positioning on both the left-right scale and the EU integration scale (consistently with HNR). Unlike the first dimension, however, there is evidence of spatial network effects for several proximity measures. More specifically, focussing only on the effects that are robust to the inclusion of cultural/gender controls, we notice that geographical and institutional choices of W generate indirect marginal effects that are significantly different from zero, while, among the cultural proximities, the spillovers are significant for W^{MAS}, W^{IDV} and W^{LTO}. The weak significance of spillovers generated by UAI is not robust to the inclusion of additional controls C and G.

When the proximity matrix is either "Km" or "Inst", MDE_{LR} is negative and significant, but it is contrasted by a positive and significant MIE_{LR}, resulting in MTE_{LR} being negative and significantly lower than the direct one. Moreover, the estimate of λ is significant and negative, thus resulting in a global contraction of national parties' positions along the second dimension. More precisely, on average, the position of unit i on the second dimension is less responsive to a universal change on the LR ideological scale, compared to what its responsiveness would be towards a shift in its own LR level. However, for both W^{Km} and W^{Lang}, responsiveness of unit i is not affected by a shift in $EUint$ level of all other units (apart from i itself), and therefore the responsiveness of unit i to a universal change in $EUInt$ is not statistically different from the one to a shift in its own $EUint$ attitude. The unique exception within the geopolitical distances is given by the estimates obtained under W^{Inst}, where the responsiveness to a universal change on the $EUInt$ scale is attenuated by the network. However, this result is not robust to the inclusion of cultural/gender controls. Overall, results in Table 3 suggest

Table 1: Estimates for specification (2). The various choices of W are constructed using geopolitical distances and then normalized by their spectral norm.

First Dimension	Km (1)	Lang (2)	Inst (3)
λ	-0.2272	-0.1814	0.2958
	(-0.69)	(-0.83)	(1.16)
LR	1.0693	1.0645	1.0585
	(14.71)***	(14.61)***	(14.43)***
EUint	0.0118	0.0122	0.0121
	(1.31)	(1.36)	(1.35)
$W * LR$	0.3885	0.0110	0.2317
	(1.05)	(0.06)	(1.09)
Controls	Yes	Yes	Yes
Constant	Yes	Yes	Yes
MDE_{LR}	1.0690	1.0653	1.0607
	(16.89)***	(12.16)***	(14.32)***
MTE_{LR}	1.1513	1.0355	1.4724
	(6.02)***	(11.35)***	(2.69)***
MIE_{LR}	0.0823	-0.0298	0.4116
	(0.42)	(-0.81)	(0.77)
MDE_{EU}	0.0118	0.0122	0.0121
	(1.30)	(1.76)	(1.10)
MTE_{EU}	0.0103	0.0119	0.0148
	(1.51)	(1.79)	(1.43)
MIE_{EU}	-0.0015	-0.0003	0.0027
	(1.51)	(-0.91)	(1.16)*
LM	0.87	0.01	0.03
N	347	347	347

Notes. t-statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

that the network does not play an active role for the diffusion of shifts/shocks in $EUInt$ levels when the definition of network relies on geopolitical distances. In such cases, the network effect on the second dimension is limited to the diffusion and propagation of changes related to the ideological orientation.

Table 2: Estimates for specification (2). The various choices of W are constructed using cultural distances and then normalized by their spectral norm.

First Dimension	PDI (1)	IDV (2)	MAS (3)	UAI (4)	LTO (5)	IVR (6)
λ	-0.0898	-0.8708	0.1186	0.2327	0.0074	-0.1808
	(-0.39)	(-2.52)**	(0.48)	(0.98)	(0.03)	(-0.67)
LR	1.0661	1.0676	1.0536	1.0535	1.0706	1.0695
	(14.64)***	(14.78)***	(14.66)***	(14.56)***	(14.74)***	(14.70)***
EUint	0.0124	0.0118	0.0111	0.0121	0.0120	0.0120
	(1.37)	(1.33)	(1.25)	(1.36)	(1.34)	(1.34)
$W * LR$	-0.0501	0.0352	0.6947	0.5468	-0.2772	0.1301
	(-0.21)	(0.16)	(3.21)***	(2.42)**	(-1.47)	(0.56)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
MDE_{LR}	1.0663	1.0742	1.0551	1.0565	1.0705	1.0697
	(14.35)***	(13.24)***	(18.43)***	(16.36)***	(15.58)***	(15.49)***
MTE_{LR}	0.9773	0.7766	1.4930	1.5803	0.8996	1.0363
	(5.57)***	(7.84)***	(4.47)***	(6.56)***	(5.47)***	(4.92)***
MIE_{LR}	-0.0891	-0.2975	0.4379	0.4238	.0.1709	-0.0334
	(-0.55)	(-2.65)**	(1.30)**	(1.88)***	(-1.04)	(-0.16)
MDE_{EU}	0.0124	0.0119	0.0111	0.0121	0.0120	0.0120
	(1.33)	(1.30)	(1.37)	(1.48)	(1.39)	(1.25)
MTE_{EU}	0.0117	0.0085	0.0118	0.0136	0.120	0.0108
	(1.40)	(1.29)	(1.46)	(1.50)	(1.52)	(1.26)
MIE_{EU}	-0.0001	-0.0034	0.0001	0.0015	0.0001	-0.0011
	(-0.39)	(-1.20)	(0.42)	(0.92)*	(0.02)	(-0.55)
LM	0.05	0.63	0.03	0.01	1.70	0.06
N	347	347	347	347	347	347

Notes. t-statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

The findings on the relevant cultural proximities are very different. For W^{IDV} and W^{MAS}, the spatial effect works through $EUint$. Indeed, MDE_{EU} is positive and significant and it is reinforced by a positive and significant MIE_{EU}, resulting in MTE_{EU} being positive and significantly larger than MDE_{EU}. This means that, on average, the position of unit i on the second dimension is more responsive to a universal change in $EUint$, compared to what its responsiveness would be towards a shift in its own $EUint$ level. When the proximity matrix is built from the LTO index, the spatial effect works through LR, but unlike what discussed for the geopolitical choices of W, the negative and significant MDE_{LR} is reinforced by a negative and significant MIE_{LR}, so that MTE_{LR} is negative and significantly larger in absolute value than MDE_{LR}. For all choices of W based on cultural indexes, the estimate of λ is not significantly different from zero. This implies that the network effect induced by a marginal change in $EUint/LR$ is local and thus falls only on direct neighbours. In our data, a local effect of the network is associated to larger (in absolute value) responsiveness to a universal shift in either LR or $EUInt$ compared to responsiveness to an individual shift, and this translates to an expansion of national parties' positions in the policy spectrum. This is in contrast to the contraction in the policy spectrum that results from the aforementioned global effects.

Overall we infer that cultural distances generate strong spillover effects along the second dimension that reinforce individual responsiveness, to either $EUint$ or LR marginal shifts, as opposed to what happens when the network is induced by geopolitical distances. The cultural proximity matrices that produce spatial spillovers are those related to the issues which are relevant in the political process (see discussion in Section 3). Therefore the mechanism that seems to be in place for cultural proximity is related to salience. A shift in the level of the relevant variable (either $EUint$ or LR) moves the interest of MEPs of a specific national party towards specific policy issues (direct effect). This in turn makes members of other national parties more responsive to the same issues, so that the resulting total response is reinforced. For IDV and MAS the spillovers work through $EUint$, while for LTO they act through LR. This can be explained by the fact that the various issues of interest whose salience is transmitted locally through the network might be more related to $EUInt$ (for W^{MAS} and W^{IDV}), or to LR (for W^{LTO}).

Finally, robustness checks reported in the supplement show that the inclusion of G among the regressors does affect neither the interpretation of the second dimension nor the size and significance of the coefficients. Moreover, all spatial effects and in particular that induced by W^{MAS}, are robust to the inclusion of G. Incidentally, the coefficient of G is strongly significant itself, showing that female participation in national parties contributes to the interpretation of the second dimension itself.

4.3 Is one W enough?

Results in Tables 3 and 4 suggest that geopolitical W on one side, and W^{IDV}/W^{MAS} on the other side, could jointly play a role in explaining the interactions across national parties within the EP. Indeed, estimates obtained using either geopolitical or cultural proximities reflect respectively very different transmission mechanisms of shifts/shocks

Table 3: Estimates for specification (3). The various choices of W are constructed using geopolitical distances and then normalized by their spectral norm.

Second Dimension	Km (1)	Lang (2)	Inst (3)
λ	-0.7456	0.0889	-0.8429
	(-2.04)**	(0.36)	(-2.38)**
LR	-0.7282	-0.7128	-0.6855
	(-5.50)***	(-5.35)***	(-5.19)***
EUint	0.0343	0.0326	0.0327
	(2.10)**	(1.99)**	(2.03)**
$W * EUInt$	0.0834	0.0318	-0.0540
	(0.93)	(0.77)	(-1.31)
Controls	Yes	Yes	Yes
Constant	Yes	Yes	Yes
MDE_{LR}	-0.7323	-0.7129	-0.6901
	(-5.91)***	(-5.53)***	(-4.37)***
MTE_{LR}	-0.5007	-0.7251	-0.4770
	(-4.99)***	(-5.18)***	(-3.37)***
MIE_{LR}	0.2316	-0.0121	0.2131
	(3.61)***	(-0.37)	(2.79)***
MDE_{EU}	0.0039	0.0326	0.0333
	(2.25)*	(1.62)	(2.12)**
MTE_{EU}	0.0586	0.0393	0.0032
	(1.96)*	(1.76)*	(0.14)
MIE_{EU}	0.0247	0.0066	-0.0301
	(0.70)	(1.14)	(-1.59)***
LM	1.29	0.43	0.01
N	347	347	347

Notes. t-statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

on LR scale and on $EUInt$ attitude, and therefore could capture complementary effects.

Table 4: Estimates for specification (3). The various choices of W are constructed using cultural distances and then normalized by their spectral norm.

Second Dimension	PDI (1)	IDV (2)	MAS (3)	UAI (4)	LTO (5)	IVR (6)
λ	-0.0703	-0.4959	-0.3844	-0.1027	0.2437	-0.0422
	(-0.28)	(-1.30)	(-1.36)	(-0.41)	(1.33)	(-0.16)
LR	-0.7262	-0.7014	-0.7242	-0.7277	-0.7210	-0.7209
	(-5.46)***	(-5.32)***	(-5.47)***	(-5.49)***	(-5.41)***	(-5.41)***
EUint	0.0355	0.0345	0.0327	0.0326	0.0335	0.0330
	(2.16)**	(2.13)**	(2.00)**	(2.00)**	(2.05)**	(2.03)**
$W * EUInt$	-0.0467	0.1762	0.0853	0.0721	-0.0074	0.0204
	(-0.96)	(3.07)***	(1.89)*	(-0.41)	(-0.19)	(0.45)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
MDE_{LR}	-0.7263	-0.7030	-0.7257	-0.7278	-0.7220	-0.7209
	(-6.46)***	(-5.48)***	(-5.65)***	(-7.31)***	(-5.62)***	(-5.16)***
MTE_{LR}	-0.6947	-0.5667	-0.6142	0.0320	-0.8586	-0.7033
	(-4.20)***	(-6.38)***	(-4.41)***	(-6.53)***	(-5.75)***	(-4.58)***
MIE_{LR}	0.0316	0.1363	0.1115	-0.6958	-0.1366	0.0176
	(0.34)	(2.11)	(1.44)	(0.45)	(-1.35)**	(0.18)
MDE_{EU}	0.0356	0.0338	0.0323	0.0325	0.0335	0.0333
	(1.74)*	(2.68)**	(2.11)**	(2.31)**	(2.31)**	(1.98)*
MTE_{EU}	0.0051	0.0962	0.0614	0.0620	0.0341	0.0442
	(0.13)	(5.19)***	(3.67)***	(3.12)**	(1.06)	(1.43)
MIE_{EU}	-0.0304	0.0623	0.0291	0.0295	0.0006	0.0110
	(-0.96)	(3.82)***	(2.66)**	(2.05)*	(0.02)	(0.35)
LM	0.01	2.03	1.28	0.28	0.16	1.53
N	347	347	347	347	347	347

Notes. t-statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

This justifies the extended model

$$\begin{aligned} y_2 =& \beta_0 + \lambda_{K_1} W^{K_1} y_2 + \lambda_{K_2} W^{K_2} y_2 + \beta_1 LR + \beta_2 EUInt \\ &+ \gamma_{K_1} W^{K_1} * EUInt + \gamma_{K_2} W^{K_2} * EUInt + \text{controls}, \end{aligned} \tag{4}$$

where “controls” stands for the same set of dummy variables defined after (3) and the set (W^{K_1}, W^{K_2}) represents the possible combinations of interest, i.e., (W^{Km}, W^{IDV}), (W^{Km}, W^{MAS}), (W^{Inst}, W^{IDV}) and (W^{Inst}, W^{MAS}). Estimates of (4) are reported in columns (1)-(4) of Table 5. Sign and magnitude of coefficients are consistent with results in Tables 3 and 4. However, the loss of efficiency caused by a less parsimonious model such as (4) as opposed to (3) inflates the standard errors and some of the estimates are no longer significant.

On the other hand, W^{Km} and W^{Inst} in the geopolitical set, and W^{IDV} and W^{MAS} in the cultural group, respectively produce similar results. Thus W^{Km} and W^{Inst} act as substitutes within the geopolitical measures, while W^{IDV} and W^{MAS} are substitutes within the cultural measures (Neumayer and Plümper, 2016). There is therefore scope for estimating

$$y_2 = \beta_0 + \lambda_{K_1+K_2} W^{K_1+K_2} y_2 + \beta_1 LR + \beta_2 EUInt + \gamma_{K_1+K_2} W^{K_1+K_2} * EUInt + \text{controls}, \quad (5)$$

where, again, “controls” stands for the same set of dummy variables defined after (3) and (K_1, K_2) represents either $(Km, Inst)$ or (IDV, MAS). Results are reported in columns (5) and (6), respectively, of Table 5. Column (5) shows that the estimate of $\lambda_{Km+Inst}$ is negative and significant, while that of $\gamma_{Km+Inst}$ is not significant, consistently with results of Table 3. Column (6) in Table 5, instead, reports a strongly significant $\gamma_{IDV+MAS}$ and an insignificant $\lambda_{IDV+MAS}$, similarly to what reported in Table 4.

5 Conclusions

In this paper we highlight how spatial interactions are crucial to understand determinants and clustering of the policy space, and therefore to explain the underlying factors that drive legislators’ behaviour. Following existing literature, we postulate a bi-dimensional policy space and investigate the substantive meaning of each dimension. The novelty of our approach is twofold: first we construct new proximity measures and corresponding proximity matrices, and second we employ them to introduce a spatial autoregressive component in the regressions that aim to shed light on the underlying meaning of the policy space itself.

The first dimension of the policy spectrum, consistently with the existing literature, is explained by the ideological left-right orientation. There is evidence of spatial spillovers across national parties’ ideological positions when proximity is defined according to the individualism index, and we discuss how the latter is related with the LR ideological scale.

Results on the second dimension show a stronger role of the spatial network, when “neighbours” are defined in terms of geographical and institutional matrices, as well as three of the cultural measures. When W is based on the three relevant cultural proximities (IDV, MAS, LTO), direct and spillover effects of a change in $EUInt$ (for IDV and MAS) or in LR (for LTO) reinforce each other. Such reinforcement is related to salience, i.e., a universal shift in $EUint/LR$ level may originate changes in the importance that national party i attaches to various issues. In turn, the new awareness of national party i towards some issues might stimulate similar interest and awareness towards the same issues in "neighbouring" national parties, reinforcing the net outcome of the initial shift in $EUint/LR$. This peculiarity is realistically expected to depend on the type of issues, and more specifically we expect a more striking reinforcing network effect on issues where legislators' interests are of highly national nature (e.g., agricultural policies).

In order to fully confirm our interpretation, we will need estimates of legislators' positions obtained from roll call votes on separate issues, and a regression analysis performed at individual rather than at national party's level. Moreover, this extended analysis will help us to understand whether the underlying mechanism is related to the evolution of the importance of specific issues over time, and how they may or may not integrate with the left-right dimension.[14] On the other hand, revealing the underlying determinants and the potential transnational correlations along the second dimension, and hence the underlying legislators' preferences on different issues, might help scholars to understand how European Union as a whole responds to important issues that are generally dealt with separately by individual countries. This is currently under investigation in separate work.

Finally, the relevance of spatial effects on the second dimension when the proximity is based on the MAS index suggests that the gender composition of national parties is an important factor. We show that indeed gender composition plays a role in explaining the second dimension of the policy spectrum, and that the spatial spillovers are robust to its explicit inclusion.

This paper opens up a line of research that is worth exploring. In particular, the extension of our analysis to individual level data, and to an issue by issue investigation will allow an even deeper understanding of the transmission mechanism of spatial spillovers.

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Table 5: Estimates for specification (4) (Columns 1-4) and specification (5) (Columns 5 and 6).

Second Dimension	(1)	(2)	(3)	(4)	(5)	(6)
λ_{Km}	-0.4230	-0.5154	-	-	-	-
	(-1.10)	(-0.85)	(-)	(-)	(-)	(-)
λ_{Inst}	-	-	-0.5335	-0.7253	-	-
	(-)	(-)	(-1.44)	(-1.53)	(-)	(-)
λ_{IDV}	-0.3778	-	-0.4280	-	-	-
	(-1.30)	(-)	(-1.05)	(-)	(-)	(-)
λ_{MAS}	-	-0.2907	-	-0.1624	-	-
	(-)	(-1.12)	(-)	(-0.43)	(-)	(-)
$\lambda_{Km+Inst}$	-	-	-	-	-0.6500	-
	(-)	(-)	(-)	(-)	(-1.68)*	(-)
$\lambda_{IDV+MAS}$	-	-	-	-	-	-0.4337
	(-)	(-)	(-)	(-)	(-)	(-1.26)
LR	-0.7036	-0.7316	-0.6708	-0.6890	-0.7258	-0.7144
	(-5.38)***	(-5.54)***	(-5-10)***	(-5.21)***	(-5.48)***	(-5.43)***
EUint	0.0365	0.0338	0.0336	0.0322	0.0351	0.0331
	(2.27)**	(2.08)**	(2.10)**	(2.00)**	(2.16)**	(2.05)**
γ_{Km}	-0.0645	0.0092	-	-	-	-
	(-0.71)	(0.09)	(-)	(-)	(-)	(-)
γ_{Inst}	-	-	-0.0578	-0.0532		
	(-)	(-)	(-1.38)	(-1.25)	(-)	(-)
γ_{IDV}	0.1883	-	0.1444	-	-	-
	(3.20)***	(-)	(2.33)**	(-)	(-)	(-)
γ_{MAS}	-	0.0816	-	0.0474	-	-
	(-)	(1.69)*	(-)	(0.79)	(-)	(-)
$\gamma_{Km+Inst}$	-	-	-	-	-0.0354	-
	(-)	(-)	()	()	(-0.40)	(-)
$\gamma_{IDV+MAS}$	-	-	-	-	-	0.1493
	(-)	(-)	(-)	(-)	(-)	(2.97)***
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N	347	347	347	347	347	347

Notes. t-statistics in parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$