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DEMOCRACY, GEOGRAPHY AND MODEL UNCERTAINTY

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Abstract

We analyse the nature of robust determinants of differences in democracy levels across countries taking explicitly into account uncertainty in the choice of covariates and spatial spillovers. We make use of recent developments in Bayesian model averaging to assess the effect of a large number of potential factors affecting democratisation processes and account for several specifications of spatial linkages. Our results indicate that spatial spillovers are present in the data even after controlling for a large number of geographical covariates. Addressing the determinants of democracy without modelling such spillovers may lead to flawed inference about the nature of the determinants of democratisation processes. In particular, our results emphasise the role played by Muslim religion, population size, trade volumes, English language, natural resource rents, GDP per capita, being a MENA country and the incidence of armed conflicts as factors affecting democracy robustly.

I Introduction

Why do democracies emerge, survive, or fail and become autocracies? Social scientists have often drawn their attention to the quantitative assessment of driving factors of democratisation processes. Based on the large variety of democratisation theories, they have tested the impact of a vast number of covariates that were argued to be conducive to more democratic forms of political organisation, resulting in a variety of (sometimes contradicting) empirical findings.

In a seminal contribution, Lipset (1959) discussed the social prerequisites for democracy and concentrates on the role of economic development, wealth, education and religion. Since the inception of Lipset's hypothesis, the theoretical prerequisites for democratisation have been extended and refined in

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various dimensions. The abundance of natural resources is believed to hinder democratisation as autocratic rulers face high resource rents which they could use to sustain their power. It has often been argued that income generated by natural resources generates less pressure for democratisation than income generated through human capital accumulation.

The effect of education and human capital on democratisation has been examined in more detail and hypotheses concerning the distribution of education among different groups of the population have been added to the theoretical framework linking human development and democracy. Lutz *et al*. (2010) reasoned that female education affects fertility rates and has an additional impact on democratisation through this channel. The induced change in the proportion of young people in the population has been often argued to impact on regime stability in what has become known as the *youth bulge theory* (see Cincotta, 2008 2009). Inequality and heterogeneity of a country's population are also seen as a factor potentially affecting political outcomes. Studies have often focused on income inequality, and also on ethnic, linguistic and religious fractionalisation.

In addition, a country's colonial history is seen as influential for the rise of democracy, due to the role played by early institutions and legal traditions brought to colonies by Western settlers. A range of historical events and geographic variables have been used in empirical studies to explain and predict probabilities of democratic transitions. More recently, the attention has shifted towards taking into account also international factors when assessing the determinants of political regimes. In this respect, the influence of geography and international organisations has been reasoned to impact on the emergence and survival of democracy.

The variety of theories linking geographic, historical, demographic and socioeconomic developments with the democratisation process, together with the lack of an overarching theoretical framework, implies that empirical assessments of the determinants of democracy should explicitly address the problem of model uncertainty when performing inference. Neglecting the uncertainty associated to the choice of covariates within linear regression models results in an overestimation of the precision of estimates and thus potentially in an overconfident interpretation of the importance of particular predictors of democratisation (Fernández *et al*., 2001).

Gassebner *et al*. (2012) and Hegre *et al*. (2012) provided evidence on the empirical drivers of democratisation based on methods that take into account model uncertainty. Gassebner *et al*. (2012) performed extreme bounds analysis (EBA) in order to unveil the robustness of democracy determinants and conclude that GDP growth, past transitions, and OECD membership, as well as fuel exports, and the share of Muslims in the population are significant drivers of a transition to democracy. On the other hand, GDP per capita, past transitions, having a former military leader as chief executive, and having other democracies as neighbours are variables that have a robust significant effect on the survival of democracies. Hegre *et al*. (2012) applied a less stringent version of EBA based on considering the entire distribution of parameter estimates to determine the level of confidence in each of the explanatory variables (see Sala-I-Martin, 1997). In contrast to Gassebner *et al*. (2012), the authors find that more than half of the 85 variables included in the analysis are robust determinants of democratisation, while considerably fewer variables are robust determinants of democratic stability.

Our study builds on the work of Gassebner *et al*. (2012) and Hegre *et al*. (2012) and expands it in several respects. First, we move away from methods related to EBA and implement a fully Bayesian approach to model uncertainty, relying on recent advances of Bayesian model averaging (BMA) in the presence of spatially correlated data (Crespo Cuaresma and Feldkircher, 2013; Crespo Cuaresma *et al*., 2014). By basing inference on the posterior distribution across all possible model specifications, Bayesian methods, in contrast to EBA, present a natural framework to deal with the uncertainty in model specification, not holding neither model size nor a particular subset of the explanatory variables fixed. This allows not only to evaluate the statistical significance of the coefficients but also to quantify the uncertainty of belonging to the true data generating process for each covariate.

In addition, using spatial filtering methods, the recent developments put forward by Crespo Cuaresma and Feldkircher (2013) provide tools for the assessment of spatially correlated data in potentially very large model spaces. A further novelty of this study, thus, is that we expand the set of model specifications assessed hitherto in the literature that deals with robust correlates of democracy by explicitly taking into account spatial autocorrelation in democracy data. This is particularly important as previous studies controlling for such spillovers either indirectly by including information on democratic neighbours among their regressors (see e.g. Pevehouse, 2002a, b; Li and Reuveny, 2003; Gleditsch and Ward, 2006; Eichengreen and Leblang, 2008; Csordás and Ludwig, 2011; Gassebner *et al*., 2012) or directly by estimating spatial models (see Leeson and Dean, 2009; Seldadyo *et al*., 2010; Kelejian *et al*., 2013) find such domino effects to be statistically relevant.[1] In a more recent contribution, Bonhomme and Manresa (2015) allow for group-specific time-varying patterns of democratisation without imposing a particular spatial structure on group-membership. Their results suggest that group-membership in the detected waves of democratisation is geographically correlated, providing a further indication for potential spatial contagion. Not controlling for geographical spillovers in the presence of spatial dependence results in omitted variable bias and inconsistent parameter estimates (see LeSage and Pace, 2009). As spillovers in democracy might not only be based on geographical proximity (Leeson and Dean, 2009) we also consider models with spatial weighting matrices that are based on religious proximity additionally to different definitions of geographical linkages. In order to minimise potential reverse causality concerns, we move away from the panel structure used by Gassebner

[1] Acemoglu *et al*. (2008) included a democracy index of a country's trading partners among the regressors and do not find a statistically significant effect on democracy levels. For an extensive overview of potential mechanisms that cause democratic spillovers, see Kelejian *et al*. (2013) and Leeson and Dean (2009).

et al. (2012) and Hegre *et al.* (2012), who assume exogeneity of all explanatory variables, and instead use a cross-sectional data set containing information for 131 countries, where the regressors are measured with a lag of about 30 years with respect to the dependent variable (see e.g. Sala-I-Martin, 1997; Fernández *et al.*, 2001; Clague *et al.*, 2001, for a similar methodology).

The contribution of this work is twofold. First, we provide new evidence concerning the relative importance of factors that have been proposed in the empirical literature as robust determinants of democratic regimes using a method which is more comprehensive than those used so far. Second, we assess quantitatively the role that accounting for spatial spillovers in democracy plays in terms of changing the nature of robust democratisation determinants. Our results indicate that spatial spillovers play an important role even after controlling for a large number of geographical covariates and therefore need to be taken into account in the estimation to achieve reliable inference. In particular, our results emphasise the role played by Muslim religion, population size, trade volumes, English language, natural resource rents, GDP per capita, being a MENA country and the incidence of armed conflicts as factors affecting democracy robustly.

This article is organised as follows. The methodological framework used to assess the robustness of democratisation determinants in the presence of spatially correlated data is outlined in Section II. In Section III, we describe the data we use, motivate the choice of explanatory variables and present some descriptive statistics based on our sample. The results of the econometric exercise are presented in Section IV. Section V concludes.

II Econometric Framework

The determinants of democracy and spatial spillovers

When assessing the determinants of democracy, we follow previous literature[2] and base our inference on linear models of the form

$$y = X\beta + \epsilon \tag{1}$$

where y is the democracy index, X is the matrix of regressors (including the initial level of democracy) with its coefficient vector β, and ϵ is a homoscedastic error term with $E(\epsilon|X) = E(\epsilon) = 0$ and variance σ^2. Although the discrete nature of the democracy index does not introduce bias in the estimated coefficients, it induces a special type of heteroscedasticity. This does not create difficulty for inference as long as standard errors are corrected for heteroscedasticity (see Wooldridge, 2013, Sections 7.5 and 8.5). In our

[2] See also Acemoglu *et al.* (2005, 2008), Acemoglu *et al.* (2009), Crenshaw (1995), Eichengreen and Leblang (2008), Helliwell (1994), Li and Reuveny (2003), Muller (1995), and Olsson (2009) for linear regressions, Acemoglu *et al.* (2005, 2008), Bobba and Coviello (2007), Castelló-Climent (2008), Csordás and Ludwig (2011), and Lutz *et al.* (2010) for generalised method of moments (GMM) regressions, and Acemoglu *et al.* (2008), López-Córdova and Meissner (2008), and Olsson (2009) for instrumental variables (IV) estimations with a democracy index as dependent variable.

analysis, we account for heteroscedasticity performing robust model averaging. The specific method we use for inference is described in the next sub-section.

The linear specification allows to model spatial spillovers in the level of democracy y in a straightforward way. We consider model specifications that contain a spatial autoregressive (SAR) component and thus take the form

$$y = \rho W_N y + X\beta + \epsilon \tag{2}$$

where W_N is a normalised $n{\times}n$ spatial weights matrix representing spatial linkages of democracy across countries and ρ measures the strength of spatial dependence between the observations (see LeSage and Pace, 2009). In order to make sure that $I - \rho W_N$ is non-singular for all $\rho \in (-1,1)$, we implement the row–sum normalisation (following e.g. Kelejian *et al.*, 2013), where each element w_{ij} of the unnormalised weights matrix W is divided by $\sum_{j=1}^{n} w_{ij}$. In the empirical application we also allow the spatial linkage matrix to take on different forms accounting for different patterns of spillovers in democracy. Ignoring democratic spillovers if equation (2) represents the true data generating process leads to spatially autocorrelated errors as $W_N y$ is correlated with X by construction. Hence, the estimation of equation (1) in the presence of spatial spillovers would result in biased estimates of β.

Due to the high computational expense of estimating the non-linear equation (2) for a big number of models, we adopt a more efficient approach in terms of computational time. Griffith (2004) showed that the misspecification term $\rho W_N y$ can be substituted by eigenvalues of a transformed spatial weights matrix. In particular, it can be shown that the term $\rho W_N y$ in (2) can be approximated by $E\gamma$, where E is a matrix of eigenvectors of a transformation of W_N and γ is a vector of parameters.[3] This implies that the original specification given by equation (2) can be approximated using the specification

$$y = E\gamma + X\beta + \epsilon, \tag{3}$$

for which standard linear regression models provide consistent estimates of the parameters in β. In the case of the SAR model, the eigenvectors required in the spatially filtered approximation are independent of X and obtained as $E \equiv evec[M((W_N + W_N')/2)M]$, where $M \equiv I - \iota(\iota'\iota)^{-1}\iota'$ is a projection matrix and ι = (n ×1) vector of ones.

Including the whole set of eigenvalues of the corresponding transformed weight matrix in equation (3) would render the estimation impossible as the number of parameters to be estimated would exceed the number of observations. Tiefelsdorf and Griffith (2007) suggested to limit the searchable set of

[3] Notice that $\rho W_N y = \rho E\lambda E'y = \rho E\lambda I E'y = \rho E\lambda(E'E)^{-1}E'y = \rho E\lambda b = E\gamma$. $E\lambda E'$ in the first step is the eigenfunction decomposition of matrix W_N, where E is the matrix of eigenvectors, and λ is the vector of eigenvalues, $I = (E'E)^{-1}$ due to the orthogonality of E and $(E'E)^{-1}E'y = b$. ρ, λ and b can be aggregated into γ, the vector of estimated coefficients of a linear regression of y on the matrix of eigenvectors E. Therefore, we just have to introduce E, the matrix of eigenvectors of the transformed spatial weights matrix, in order to estimate the spatially filtered model.

relevant eigenvectors to those with an attached eigenvalue above some threshold, $\lambda \geq (\alpha\lambda_{\max})$. We set the value of α to 0.01 in order to be little restrictive. Then, we evaluate spatial autocorrelation using the standardised Moran's I statistic, which possesses good power against a wide range of autoregressive models and different distributions of the residuals (see Anselin and Rey, 1991; Tiefelsdorf and Griffith, 2007). We include as many eigenvectors in E as needed in order to make sure that the spatial autocorrelation in the residuals as measured by Moran's I drops below the pre-specified threshold.[4]

Bayesian Model Averaging

The Bayesian framework empowers us to treat both model and parameter uncertainty in a straightforward and consistent way. Under model uncertainty, materialised in the existence of a (large) number of specifications that can potentially be considered as the data generating process, posterior inference on the parameter vector β is carried out by weighting the posterior inference based on each model specification with its corresponding posterior model probability,

$$p(\beta|y) = \sum_{s=1}^{S} p(\beta|y, M_s)p(M_s|y). \tag{4}$$

As elicitation of a $K \times K$ prior covariance for the parameters vector β, $p(\beta)$, is a rather tedious task, the so-called g-prior is often elicited on the model-specific parameters (Fernandez *et al*., 2001) in order to obtain the posterior densities corresponding to the parameters of each individual model. This setting centres the *a priori* expectation of all coefficients in a given specification around zero, and scales the empirical covariance matrix of explanatory variables by considering both the number of estimated coefficients and the total number of observation in the sample. Due to the strong correlation across covariates in our application, we use a prior corresponding to the elastic net model (Li and Lin, 2010; Hofmarcher *et al*., 2015), which has been shown to perform particularly well in the presence of correlated regressors.

The particular prior on the parameters for the fully saturated model proposed by Li and Lin, 2010 is given by

$$\beta|\sigma^2 \sim \exp\left\{-\frac{1}{2\sigma^2}\left[\delta_1 \sum_{j=1}^{K} |\beta_j| + \delta_2 \sum_{j=1}^{K} \beta_j^2\right]\right\}. \tag{5}$$

where δ_1 and δ_2 are weights given to the penalties involved by LASSO and ridge regression estimators. A standard Gibbs sampler can be employed to estimate the corresponding posterior distributions of the parameters of interest.

[4] Tiefelsdorf and Griffith (2007) suggest a threshold value of Moran's I of 1 for $n < 50$ and a threshold of 0.1 for $n \approx 500$. Defining an even lower threshold we make sure that the residuals are free of spatial autocorrelation (which is the case when the standardised Moran's $I = 0$).

Posterior model probabilities are derived as

$$p(M_s|y) = \frac{p(y|M_s)p(M_s)}{p(y)} \propto p(y|M_s)p(M_s), \quad (6)$$

where $p(y|M_s)$ is the marginal likelihood of model s and $p(M_s)$ is its corresponding prior probability. The marginal likelihood of the model can be in turn obtained as

$$p(y|M_s) = \int p(y|\beta, M_s)p(\beta, M_s)d\beta. \quad (7)$$

In order to robustify inference, we follow the suggestion of Ley and Steel (2009) based on Brown *et al.* (1998) to impose a hierarchical prior on the prior inclusion probability π_k. $\pi_k \sim Be(a,b)$ with $a = 1$ and $b = \frac{K-m}{m}$, where b is specified in terms of the prior mean model size m, which is set to a value of 10. In combination with the penalty for highly collinear explanatory variables, this binomial-beta prior on model size allows us to relax the assumption that the inclusion of a specific covariate is independent of all other regressors included. Instead it reflects our intuition to support parsimonious models with rather uncorrelated explanatory variables in an elegant and very flexible way.

To take into account heteroscedasticity of unknown form and to handle outliers we apply *robust model averaging*, introduced by Doppelhofer and Weeks (2011), and assume that

$$y_i|X \sim t(X_i'\beta, \sigma^2, v) \quad (8)$$

where $t(\mu,\sigma^2,v)$ denotes the univariate Student t-distribution with mean μ, variance σ^2, and v degrees of freedom. Geweke (1993) shows that this model is equivalent to a normal mixture model with heterogeneous diagonal elements of the error term's covariance matrix. The lower the degrees of freedom, v, the thicker are the tails of the distribution. On the contrary, as $v \rightarrow \infty$, the t-distribution approaches the normal distribution (see Lange *et al.*, 1989). Thus, the choice of degrees of freedom alters the *a priori* probability of distant observations and limits the consequences of outliers on the estimated parameter vector and on the posterior model probability of a specific model. We set v equal to 2 for the baseline model and allow for bigger values in alternative specifications that serve as robustness checks. Although v can be estimated if sufficient data are available, a more convenient option for small samples is to set v equal to a fixed value *a priori*.

As we deal with an extremely large model space,[5] we adopt Markov chain Monte Carlo (MCMC) methods to search for and evaluate only regions of models which represent a relevant portion of the posterior mass. All posterior quantities of interest can be approximated by the output of the MCMC iterations.[6] We obtain the posterior inclusion probability (PIP) of variable k by

[5] In our analysis $K = 56$, thus the full model space consists of about 72 quadrillions (7.2×10^{16}) of models.

[6] We base our calculations on $I = 300{,}000$ saved iterations, after discarding the first 100,000 samples as burn-ins.

computing the share of models containing a given variable among the models sampled in our Markov chain,

$$PIP_k = \frac{\sum_{i=1}^{I} \gamma_{ki}}{I}$$

where I is the total number of iterations. The posterior distribution over β_k conditional on inclusion of variable k is obtained by

$$E(\beta_k|y) = \frac{\sum_{i=1}^{I} (\beta_{ki}|\gamma_{ki} = 1)}{\sum_{i=1}^{I} \gamma_{ki}}$$

and its standard error, conditional on the inclusion of variable k, is given by

$$\sigma(\beta_k|y) = \sqrt{\frac{\sum_{i=1}^{I} [(\beta_{ki}|\gamma_{ki} = 1) - E(\beta_k|y)]^2}{\sum_{i=1}^{I} \gamma_{ki}}}.$$

III Determinants of Democracy: Arguments and Data

Data

The analysis of democracy determinants under model uncertainty requires the construction of a data set that encompasses information on variables that capture the different channels highlighted by the literature. The dependent variable of interest, which measures the degree of democracy of existing political regimes, is available from the Polity IV database (Marshall *et al.*, 2013). Marshall *et al.* (2013) assigned political regimes into 21 categories ranging from −10 to +10, where higher figures represent more democratic systems (variable *polity2* in the Polity IV data set). Although also other regime indexes have been employed in research on the determinants of democracy, the Polity IV index has been recognised to be more comprehensive as compared to alternative indicators (see Glaeser *et al.*, 2004; Papaioannou and Siourounis, 2008a, b). In addition, the 21 categories provide a more detailed regime classification than any other indicator available. In a robustness check, we use the Freedom House indicators of political rights and civil liberties (Freedom House, 2013), and the FSD Measure of Democracy (Vanhanen, 2011), as alternative measures for democracy.[7]

The explanatory variables are sourced from different databases. We group the 56 candidate covariates that are included in our empirical study into seven categories: colonial heritage, demography and religion, economic development, education and inequality, geography, organisations and political history. A complete list of the variables included, as well as details on measurement and information on their sources are provided in the appendix S1.

[7] Measurement error that might be present in the construction of democracy indices is of minor importance if it is statistically independent of the covariates included in the analysis, as the regime classification is used as dependent variable (see Treier and Jackman, 2008; Wooldridge, 2013). As is usual in the literature, we assume that potential measurement error in the regime classification is a random error that is independent of the covariates.

Literature

Although an extensive review of the literature on democratisation is beyond the scope of this article, we motivate the inclusion of each of the concepts below and discuss existing empirical results related to the particular covariates proposed. Additionally, Table S.4 in the appendix summarises the findings of theoretical and empirical studies concerning the effect of each of the 56 variables on democracy. As this table shows, the heterogeneous nature and especially the sometimes contradicting effects found in the previous literature highlight the importance of explicitly dealing with model uncertainty when assessing which variables are robustly related to democracy empirically.

A large part of the literature on the determinants of democracy proposes historical explanations related to the colonial past of present nations to explain the evolution of democratic institutions. Former colonies of Western countries were exposed to the influence of Western institutions and legal systems in a relatively early stage of development, an exposure which would constitute the foundations of the present political systems in former colonies. As early institutions tend to persist, colonial relationships might have a direct effect on political regimes nowadays. Although many empirical studies find evidence for such a relationship, the results are strongest for UK colonies, while evidence is less conclusive for countries that were under other colonial powers.[8] The strong positive effect of UK colonies is often attributed to the English common law tradition with its more focused emphasis on the judiciary as a check on executive and legislative actors as compared to civil law countries. In parallel, some authors argue that the stronger protection for investment in countries with British legal origin has positive effects on democratisation (see e.g. Acemoglu *et al*., 2001; Nieswiadomy and Strazicich, 2004). These arguments are in line with the findings of Nieswiadomy and Strazicich (2004) who found a positive effect of British legal origin on democracy, and Clague *et al*. (2001), who unveiled a positive conditional correlation of democracy with English language.

Theoretical arguments related to youth bulge effects justify the use of controls related to the demographic structure of societies. An increase in the proportion of young people in the population, which is likely to lead to lower wages and higher unemployment, is thought to give rise to political violence, civil strife, and rising support for authoritarian regimes (see Cincotta, 2008, 2009). High fertility rates contribute to the emergence of youth bulges and are thus assumed to have a negative effect on the emergence of stable democratic

[8] Barro (1999) and Gassebner *et al*. (2012) found no significant relation between colonial history and democracy. Boix and Stokes (2003), Clague *et al*. (2001), Crenshaw (1995), Eichengreen and Leblang (2008), and Muller (1995) found a positive relationship between UK colonies and democracy. The findings of Hegre *et al*. (2012) suggest a positive relationship between Spanish colonies and democratisation but a negative one for French colonies, while Kelejian *et al*. (2013) found a positive correlation of UK and French colonies with democratisation but a negative one for Spanish colonies. Olsson (2009) found negative effects of UK, French and Spanish colonies.

regimes. Yet, many empirical studies failed to find evidence for this effect (e.g. Lutz *et al*., 2010; Gassebner *et al*., 2012). We include age structure variables, as well as fertility and child mortality in order to assess arguments related to the youth bulge hypothesis. Given the relation of these variables to poverty, we also assess Lipset's (1959) theory that the mass of the population could intelligently participate in politics only in societies with low levels of poverty. Concerning the size of the population, Hegre *et al*. (2012) argued that democracy could operate more smoothly in smaller communities, a mechanism also hypothesised by Dahl and Tufte (1973), but that the net effect of population size on democracy is ambiguous. This ambiguity is confirmed by the empirical literature whose results range from positive over insignificant to negative effects of population size on democracy.[9] The existing empirical literature tends to include religious variables in regression models for democracy indices and tends to find that the proportion of Muslims has a negative impact on democratisation.[10] This finding is usually attributed to the close links between religion and the state in Muslim countries, but might also be attributed to the effect of Muslim law on democracy (see Lipset, 1994; Nieswiadomy and Strazicich, 2004).

According to the modernisation hypothesis, economic development has to precede democratic systems (see Lipset, 1959). We therefore include a set of variables that are frequently used as modernisation indicators. It is often argued in theoretical models of democratisation processes that rural, agrarian societies are not as conducive to democracy as urban, industrialised ones. Wealth (proxied by GDP *per capita*) is often considered a requirement for democratisation or a stabiliser for already democratic regimes. While many studies confirmed the positive effect of income on democracy, this finding has been challenged by Acemoglu *et al*. (2008) and Acemoglu *et al*. (2009) who showed that the positive correlation might be driven by omitted factors that simultaneously affect both variables. Also the results of other authors do not confirm a statistically significant and positive influence of income on democracy.[11] The effect of globalisation on political regimes is ambiguous from a theoretical point of view. While on the one hand globalisation might promote

[9] Crespo Cuaresma *et al*. (2011), Hegre *et al*. (2012), López-Córdova and Meissner (2008), and Ross (2001) found positive effects, Barro (1999) and Kelejian *et al*. (2013) found negative effects, and Acemoglu *et al*. (2005, 2008), Acemoglu *et al*. (2009), Bobba and Coviello (2007), Gassebner *et al*. (2012), and Nieswiadomy and Strazicich (2004) failed to find significant effects of population size on democracy.

[10] See e.g. Barro (1999), Clague *et al*. (2001), Gassebner *et al*. (2012), Hegre *et al*. (2012), Kelejian *et al*. (2013), Nieswiadomy and Strazicich (2004), Papaioannou and Siourounis (2008b), and Ross (2001) for a negative correlation between Muslim religion and democracy and e.g. Boix and Stokes (2003) and Muller (1995) for a relationship that is statistically insignificant.

[11] See e.g. Bobba and Coviello (2007), Crespo Cuaresma *et al*. (2011), Csordás and Ludwig (2011), Hegre *et al*. (2012), López-Córdova and Meissner (2008), Lutz *et al*. (2010), Olsson (2009), and Pevehouse (2002a) for an insignificant relationship and Barro (1999), Boix and Stokes (2003), Crenshaw (1995), Eichengreen and Leblang (2008), Epstein *et al*. (2006), Gassebner *et al*. (2012), Gleditsch and Ward (2006), Kelejian *et al*. (2013), Helliwell (1994), La Porta *et al*. (1999), Li and Reuveny (2003), Muller (1995), Nieswiadomy and Strazicich (2004), Papaioannou and Siourounis (2008b), Pevehouse (2002b), Ross (2001), and Wu and Davis (1999) for a positive relationship between income and democracy.

democracy by encouraging economic development and by increasing contacts with other democracies, trade and foreign direct investment flows might also worsen wage disparities and deepen ethnic and class cleavages, and therefore adversely affect democratisation (see e.g. Li and Reuveny, 2003; López-Córdova and Meissner, 2008). Also in this case the results of empirical studies range from positive over insignificant to negative effects.[12] The abundance of natural resources is believed to hinder democratisation because autocratic rulers in natural resource rich countries face high resource rents, which they can use to sustain their power. Furthermore, the availability of natural resources is found to crowd out human capital, and income generated by natural resources is considered to generate less pressure for democratisation than income generated through human capital accumulation (see e.g. Barro, 1999; Gylfason, 2001; Crespo Cuaresma *et al.*, 2011). Empirical studies usually confirm this negative effect of natural resources on democracy.[13]

Education as a promoter of civic duty is often found to have a positive effect on democratisation.[14] Education provides people with tools to interact with others and makes them develop a greater interest in politics. By doing so, it raises the benefits (or reduces the costs) of political activity, including voting and organising, and increases the demand for democratic participation (see Dee, 2004; Milligan *et al.*, 2004). Still, the positive effect of education on democracy has been challenged by the results in Acemoglu *et al.* (2005, 2008), Acemoglu *et al.* (2009), Crespo Cuaresma *et al.* (2011), Gassebner *et al.* (2012), and Ross (2001), who do not find a statistically significant relationship.[15] The results of Lutz *et al.* (2010) and Wyndow *et al.* (2013) point toward the important role of female education on democratisation. Lutz *et al.* (2010) further reasoned that female education, additionally, has an indirect effect on democracy through lowering fertility rates, thus impacting on demographic structures. Lower educational inequality due to improved access to education by the poor is also argued to prop efforts to democratise (see e.g. Glaeser *et al.*, 2007; Lutz *et al.*, 2010). Inequality in various socioeconomic dimensions

[12] See Epstein *et al.* (2006), Eichengreen and Leblang (2008), Kelejian *et al.* (2013), and López-Córdova and Meissner (2008) for positive effects, Li and Reuveny (2003) and Olsson (2009) for negative effects, and Csordás and Ludwig (2011), Gassebner *et al.* (2012), Hegre *et al.* (2012), and Papaioannou and Siourounis (2008b) for insignificant effects.

[13] See Crespo Cuaresma *et al.* (2011), Epstein *et al.* (2006), Hegre *et al.* (2012), Helliwell (1994), Kelejian *et al.* (2013), Nieswiadomy and Strazicich (2004), Papaioannou and Siourounis (2008b), and Ross (2001) for the negative effect of natural resources and Barro (1999), Gassebner *et al.* (2012), Hegre *et al.* (2012), Helliwell (1994), Papaioannou and Siourounis (2008b), and Ross (2001) for a negative effect of fuel exports on democracy. Eichengreen and Leblang (2008) and Gassebner *et al.* (2012) finding no significant effect of natural resources on democracy.

[14] See e.g. Barro (1999), Bobba and Coviello (2007), Boix and Stokes (2003), Castelló-Climent (2008), Clague *et al.* (2001), Crenshaw (1995), Glaeser *et al.* (2007), Hegre *et al.* (2012), Helliwell (1994), Kelejian *et al.* (2013), Li and Reuveny (2003), Lutz *et al.* (2010), Nieswiadomy and Strazicich (2004), and Papaioannou and Siourounis (2008b).

[15] The finding of a significantly positive effect of education on democracy could be driven by omitted variable bias (Acemoglu *et al.*, 2005). Furthermore, transitions to democracy might occur also with low levels of education, whereas the education level matters for regime stability (see Papaioannou and Siourounis, 2008b).

is likely to provoke social unrest, recurrent violence and institutional distortions, leading to political instability and preventing a consolidation of democracy. Social equality, perceived as equality of status and respect for individuals regardless of economic condition, is argued to be highly conducive to democratic institutions, and incentives for various groups of citizens to capture and monopolise power might be stronger if there is a high degree of ethnic heterogeneity. On the other hand, in economically unequal societies, the poor have much to gain from democratisation due to the expectation of adoption of redistributive policies by democratic governments, which leads them to support democratic regimes (see e.g. Lipset, 1994; Hegre *et al.*, 2012). The results of many empirical studies point towards a positive relationship between equality and democracy, while other studies failed to find significant effects.[16]

Independently of whether spatial econometric models are used to account for the geographic spillovers in democratic regimes, empirical models of democracy often include geographical variables as controls, partly to account for unobservable factors. We follow previous literature by including a country's area, a dummy variable for landlocked countries, and world region dummies. Latitude is included as it is argued to be correlated with Western influence, which might lead to better institutions (see e.g. Acemoglu *et al.*, 2001). Kelejian *et al.* (2013) provided evidence for such a positive effect.

Membership in international organisations can support political liberalisation due to democratic pressures (both diplomatic and economic) generated by these institutions. Homogeneously democratic organisations are more likely to place conditions on membership, and members are likely to pressure one another to accept democratic values. Gassebner *et al.* (2012), Helliwell (1994) and Ross (2001) provided evidence for a positive relationship between OECD membership and democracy, and Li and Reuveny (2003), Pevehouse (2002a) and Pevehouse (2002b) found a positive effect of being member of international organisations with democratic members. Provided that natural resource abundance is negatively connected with democratisation, OPEC membership may also be expected to be correlated with democratic indices at the global level (Pevehouse, 2002a, b; Gassebner *et al.*, 2012). Yet, a statistically significant relationship between OPEC membership and democracy could not be detected by either Gassebner *et al.* (2012) or Nieswiadomy and Strazicich (2004).

Finally, we include political history variables to account for the persistence of past institutional structures. A country's past experience with political regimes is likely to strongly impact on the present regime type. Many authors

[16] Barro (1999), Li and Reuveny (2003), and Muller (1995) found negative effects of higher income inequality on democracy, while Crenshaw (1995), Gassebner *et al.* (2012) and Hegre *et al.* (2012) did not find significant effects. Barro (1999), Hegre *et al.* (2012), Kelejian *et al.* (2013), and La Porta *et al.* (1999) found a negative effect of a higher ethnolinguistic fractionalisation on democracy, but Crespo Cuaresma *et al.* (2011), Nieswiadomy and Strazicich (2004), and Papaioannou and Siourounis (2008b) failed to find significant effects. For religious fractionalisation Boix and Stokes (2003) and Hegre *et al.* (2012) found negative effects on democratisation, while Crespo Cuaresma *et al.* (2011) and Papaioannou and Siourounis (2008b) did not detect a significant relationship.

provide empirical evidence for the positive influence of past democracy on current democracy levels, and a significant effect of past regime transitions, which motivates the inclusion of former regime changes and past regime types as part of the set of potential determinants of democracy.[17] Current and past interventions of the military in politics, in addition, are usually found to have a destabilising effect on democracy (see e.g. Pevehouse, 2002a; Gassebner *et al.*, 2012; Hegre *et al.*, 2012). Lipset (1959)'s hypothesis that democratic regimes are less tenable in societies with high levels of social instability motivates the use of variables measuring the incidence of conflict. Acemoglu and Robinson (2000) and Acemoglu and Robinson (2001) on the other hand, argued that the threat of revolution and social unrest may force the elite to democratise. Thus, revolutions and conflicts are likely to negatively affect the survival of both types of political regimes.[18]

The inclusion of spatial spillovers is motivated by democratic domino theory, which suggests that changes in a country's democracy level tend to spill over to its neighbouring countries, which in turn will spread to their neighbours (see Simmons *et al.*, 2006; Leeson and Dean, 2009). Arguments for this process range from Tiebout competition, in which countries that strengthen their democratic institutions attract more foreign direct investment, which motives neighbouring countries to follow, over demonstration effects, in which countries observe what happens to their neighbours and import successful ideas, to economic communities that harmonise the political arrangements of their members. Furthermore, democratisation in individual influential countries might have an important effect on follower countries that subsequently may improve their democratic institutions. Although this emulation effect might be geographically concentrated, it can also act through other, non-geographic, spillover channels (see Leeson and Dean, 2009, for more details). Empirical evidence suggests such contagion effects to be statistically important (e.g. Leeson and Dean, 2009; Seldadyo *et al.*, 2010; Kelejian *et al.*, 2013) and that accounting for democracy spillovers in empirical models is required.

[17] Acemoglu *et al.* (2005, 2008), Acemoglu *et al.* (2009), Barro (1999), Bobba and Coviello (2007), Castelló-Climent (2008), Csordás and Ludwig (2011), Epstein *et al.* (2006), Glaeser *et al.* (2007), Li and Reuveny (2003), López-Córdova and Meissner (2008), Lutz *et al.* (2010), Pevehouse (2002a), and Ross (2001) found a positive and statistically significant correlation between current and past regime types, while Crenshaw (1995), Hegre *et al.* (2012), and Muller (1995) did not find a statistically significant relationship. For regime transitions, Eichengreen and Leblang (2008), Epstein *et al.* (2006), and Gassebner *et al.* (2012) found a positive influence of past regime transition on democracy levels, while Boix and Stokes (2003) and Gassebner *et al.* (2012) found that past transitions make the transition to dictatorships more likely and impact negatively on regime stability. Pevehouse (2002b) did not find evidence for a significant influence of past regime transitions on the stability of democracy.

[18] The empirical evidence concerning the effect of conflict on democratisation is ambiguous. Gleditsch and Ward (2006) and Pevehouse (2002b) did not find significant effects of civil war or regional conflict, respectively, on democracy, while Hegre *et al.* (2012) found a positive influence of various measures of political instability on democratisation, and Pevehouse (2002a) detected a negative impact of regional conflict but a positive impact of internal violence on the probability of democratic transitions.

Descriptive statistics

Descriptive statistics for the full set of variables used in this analysis are reported in Table 1. They refer to the cross-section of countries for which data on all variables are available. Our dependent variable is the democracy level in 2010, while the explanatory variables are measured with a time lag of about 30 years. We take the log of population, population density, GDP per capita and area, and standardise all continuous variables to make their coefficient estimates directly comparable.[19]

Figure 1 shows the democracy index in 1980 and 2010. It reveals that the world on average has become much more democratic in the period 1980–2010 and offers clear evidence that political regimes appear to be geographically clustered.

In order to assess the statistic evidence of spatial autocorrelation in the democracy data, we make use of the standardised Moran's *I* statistic (see Anselin and Rey, 1991). As the exact form of spatial dependence of democratic regimes is not known, we construct different spatial weight matrices, whose detailed specification is described later in the text, to model the pattern of spatial dependence. Independently of the spatial weights matrix used, we find strong evidence for spatial autocorrelation in democracy levels, a result that justifies the modelling approach presented in the previous section.

IV Bayesian model Averaging Results

We start our analysis by performing BMA on normal linear regression models using the full set of covariates but without taking spatial spillovers into account. Table 2 summarises the results. The variables with the highest PIP are arranged in descending order. To save space, only the variables with a PIP over 0.33 are shown.[20] The mean of the posterior of the parameters associated to these variables (conditional on inclusion), as well as its standard deviation and the ratio of the two (t stat.) are reported. The last column provides an additional evaluation of the precision of the coefficients by reporting the proportion of times the coefficient has been found to be of the same sign as the posterior mean over all models visited by the Markov chain.

The most robust determinants of democracy levels in terms of PIP when considering a model space that does not include spatial autoregressive structures are the proportion of Muslims in the population, natural resource rents, GDP per capita, conflicts with at least 1000 deaths, belonging to the Middle East and North African (MENA) region, and former colonial relationships with the United Kingdom, France, Portugal or Spain. Furthermore, also population size, trade volumes, the age distribution of at individuals with at least

[19] Details on the definition of the variables and their data sources are reported in Table S1 in the online appendix.

[20] This is equivalent to showing only the variables that are included in at least about one-third of all the models estimated by the Markov chain. The results for the full list of variables is shown in Table S1.

Table 1
Descriptive statistics (standardised variables)

Variable	Min	μ	σ	Median	Max
Colonial heritage					
Colony	0.000	0.817	0.388	1.000	1.000
Colony: UK, FR, PT, or ES	0.000	0.580	0.495	1.000	1.000
Colony: UK	0.000	0.244	0.431	0.000	1.000
Colony: FR	0.000	0.191	0.394	0.000	1.000
Colony: PT	0.000	0.031	0.173	0.000	1.000
Colony: ES	0.000	0.137	0.346	0.000	1.000
English language	0.000	0.252	0.436	0.000	1.000
French language	0.000	0.183	0.388	0.000	1.000
Portuguese language	0.000	0.031	0.173	0.000	1.000
Spanish language	0.000	0.137	0.346	0.000	1.000
Legal Origin French	0.000	0.450	0.499	0.000	1.000
Legal Origin German	0.000	0.038	0.192	0.000	1.000
Legal Origin Scandinavian	0.000	0.031	0.173	0.000	1.000
Legal Origin Socialist	0.000	0.214	0.412	0.000	1.000
Legal Origin British	0.000	0.267	0.444	0.000	1.000
Demography and religion					
Age dependency <15	−1.674	0.000	1.000	0.250	1.742
Proportion young	−2.280	0.000	1.000	0.084	2.248
Fertility	−1.388	0.000	1.000	−0.088	1.926
Infant mortality	−1.260	0.000	1.000	−0.073	2.208
Life expectancy	−2.191	0.000	1.000	0.248	1.421
Population	−2.162	0.000	1.000	−0.086	3.131
Muslim	−0.653	0.000	1.000	−0.568	2.467
Economic development					
Arable land	−1.143	0.000	1.000	−0.346	3.639
Population density	−2.653	0.000	1.000	0.054	3.317
GDP pc	−1.853	0.000	1.000	0.000	1.826
Urbanisation	−1.812	0.000	1.000	0.028	2.307
FDI	−0.867	0.000	1.000	−0.348	6.027
Trade	−1.318	0.000	1.000	−0.231	6.822
Fuel exports	−0.619	0.000	1.000	−0.430	3.458
Natural resources	−0.686	0.000	1.000	−0.377	5.767
Education and inequality					
Education: primary+	−2.223	0.000	1.000	0.372	0.966
Education: tertiary	−0.946	0.000	1.000	−0.410	3.996
Age difference: primary+	−1.206	0.000	1.000	−0.083	3.097
Age difference: tertiary	−7.342	0.000	1.000	0.052	3.106
Gender gap: primary+	−3.241	0.000	1.000	−0.322	2.008
Gender gap: tertiary	−2.857	0.000	1.000	−0.230	4.489
Gini: Education	−1.461	0.000	1.000	−0.206	1.932
Gini: Income	−1.644	0.000	1.000	−0.151	2.963
Ethnolinguistic fract	−0.856	0.000	1.000	−0.505	2.833
Religious concentration	−1.644	0.000	1.000	−0.313	1.730
Geography					
Landlocked	0.000	0.229	0.422	0.000	1.000
Latitude	−1.515	0.000	1.000	−0.033	2.075
Africa	0.000	0.282	0.452	0.000	1.000
Latin America	0.000	0.153	0.361	0.000	1.000

Table 1 (*Continued*)

Variable	Min	μ	σ	Median	Max
MENA	0.000	0.069	0.254	0.000	1.000
East Asia	0.000	0.061	0.240	0.000	1.000
South Asia	0.000	0.046	0.210	0.000	1.000
Europe	0.000	0.137	0.346	0.000	1.000
Organisations					
IO Score	−1.605	0.000	1.000	−0.110	1.423
OECD	0.000	0.237	0.427	0.000	1.000
OPEC	0.000	0.046	0.210	0.000	1.000
Political history					
Past military leader	0.000	0.328	0.471	0.000	1.000
Past transitions	−0.413	0.000	1.000	−0.413	5.472
Conflict (>1000)	0.000	0.069	0.254	0.000	1.000
Conflict (25 – 999)	0.000	0.244	0.431	0.000	1.000
Regime classification					
Regime index (2010)	−2.587	0.000	1.000	0.361	0.914
Regime index (1980)	−1.359	0.000	1.000	−0.377	1.382

primary education, membership in the OECD and English language are found to be robust determinants, although with a slightly lower inclusion probability.

The coefficient estimates are in line with theory and former empirical studies. For the set of variables mentioned above, the estimates are of the same sign in at least 90% of the model specifications visited by the Markov chain. As in previous empirical studies we find high shares of Muslims in the population to be connected on average to a lower level of democracy (for recent studies see Gassebner *et al.*, 2012; Hegre *et al.*, 2012; Kelejian *et al.*, 2013). Our results suggest that a one standard deviation higher share of Muslims in the population of a country corresponds on average to a lower level of democracy by 0.3 standard deviations. Natural resource abundance is found to be connected to lower levels of democracy – a one standard deviation increase in natural resource rents leads to a 0.22 standard deviations lower level of democracy on average after controlling for all other factors (see Crespo Cuaresma *et al.*, 2011; Hegre *et al.*, 2012; Kelejian *et al.*, 2013, for recent studies). GDP per capita is found to have a positive effect on the level of democracy – a one standard deviation increase in GDP *per capita* leads to a 0.27 standard deviations increase in democracy levels (see Gassebner *et al.*, 2012; Kelejian *et al.*, 2013, for recent studies). The hypotheses of Lipset (1959) and Pevehouse (2002a) are backed by the fact that countries that have experienced armed conflicts with over 1000 deaths tend to have a lower level of democracy by around 0.42 standard deviations. *Ceteris paribus*, countries in the MENA region have on average 0.43 standard deviations lower levels of democracy (see Eichengreen and Leblang, 2008; Li and Reuveny, 2003; Ross, 2001) than other world regions, while former colonies of the United Kingdom, France, Portugal or Spain are found to have a higher level of democracy than other countries by approximately 0.22 standard deviations on average (in line

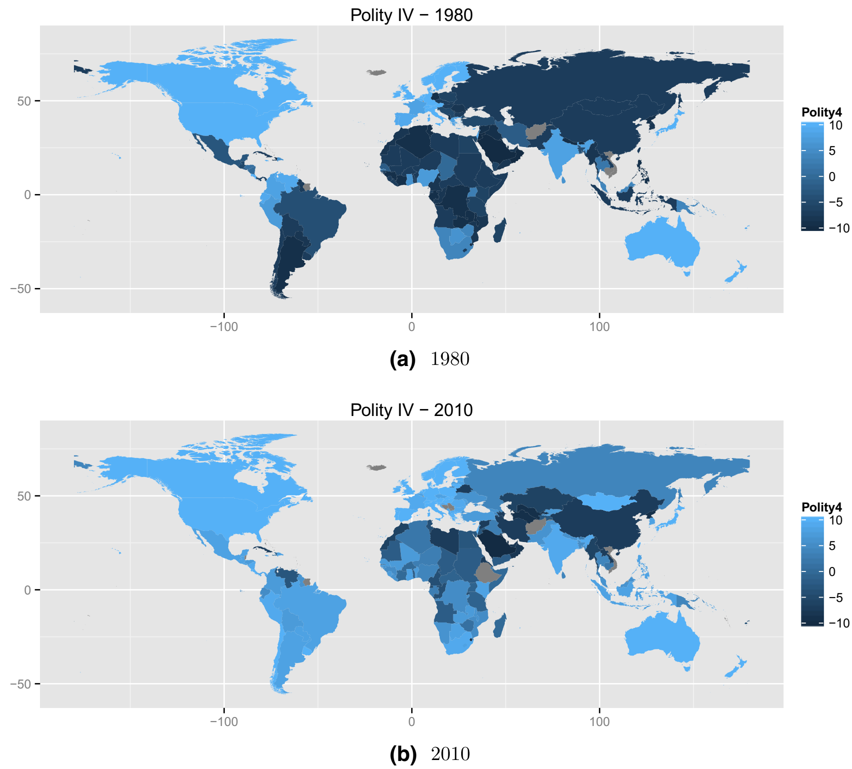

Figure 1. Regime classification (Polity IV), own illustration. [Colour figure can be viewed at wileyonlinelibrary.com]

with Crenshaw, 1995; Muller, 1995; Clague *et al*., 2001; Eichengreen and Leblang, 2008).

Similar to the findings of Kelejian *et al*. (2013), our results suggest that democracy levels are on average lower in countries with larger populations. A one standard deviation increase in trade is found to be connected to a 0.2 standard deviations lower level of democracy on average (in line with Li and Reuveny, 2003; Olsson, 2009). Furthermore, in line with Lutz *et al*. (2010), who suggest that a higher level of education of the older population is beneficial for democracy, we find that a decreasing gap in primary or higher education between the young and old population leads to higher democracy levels of 0.16 standard deviations. As in Gassebner *et al*. (2012), Helliwell (1994) and Ross (2001), we find that OECD member states have higher levels of democracy *ceteris paribus*, a result which is likely to be driven by the requirement of democratic institutions for OECD membership (Gassebner *et al*., 2012). Our results also provide evidence that countries in which more than 9% of the population speak English have a higher level of democracy by about 0.21 standard deviations, a result that may be linked to former colonial relationships with the United Kingdom (see Clague *et al*., 2001).

Table 2
Posterior results – no spatial spillovers

	PIP	Post. β	Post. σ	t stat.	Sig.
Muslim	0.869	−0.301	0.120	−2.514	***
Natural resources	0.754	−0.219	0.087	−2.503	**
GDP pc	0.730	0.269	0.118	2.282	**
Conflict (>1000)	0.651	−0.415	0.262	−1.582	**
MENA	0.557	−0.430	0.343	−1.252	*
Colony: UK, FR, PT, or ES	0.521	0.219	0.143	1.528	*
Population	0.475	−0.184	0.095	−1.933	**
Trade	0.441	−0.200	0.111	−1.803	**
Age difference: primary+	0.437	−0.155	0.095	−1.628	**
OECD	0.419	0.202	0.158	1.277	*
English language	0.406	0.207	0.157	1.322	*
Fertility	0.401	−0.196	0.160	−1.224	
Colony: FR	0.355	−0.188	0.185	−1.018	
South Asia	0.340	0.179	0.212	0.844	
Gini: Income	0.340	0.122	0.083	1.462	*
Age dependency <15	0.339	−0.151	0.148	−1.015	
Gender gap: primary+	0.331	−0.133	0.098	−1.357	*

Note: Variables for which PIP>0.33. Sig. *** (**) [*] indicates that in 99% (95%) [90%] of the models estimated the coefficient estimate was positive, or negative respectively. Calculation based on 300,000 iterations.

Comparing our results to those of Gassebner *et al.* (2012), out of the variables identified by the authors as being robustly related to democracy only the share of Muslims, *per capita* GDP and OECD membership are identified as robust determinants in our setup. Other covariates that were identified as robust by Gassebner *et al.* (2012) (past transitions, fuel exports, former military leader and relationship to other democratic countries) have a relatively low inclusion probability and tend to be insignificant upon inclusion according to our results. Additionally to the factors described above, also income inequality, the gender gap in education, arable land, and population density are found to be important in terms of the precision parameter reported in the last column of Table 2. These factors are however less likely to play a major role as determinants of democracy once specification uncertainty is accounted for, as shown by their lower PIP. The identification of more than 50 robust driving factors of democracy by Hegre *et al.* (2012) also lacks this additional evaluation of the importance of variables, as in the EBA framework the inclusion probabilities of regressors cannot be explicitly evaluated. This shows the usefulness of allowing for greater flexibility in a fully Bayesian framework, which furthermore makes the quantification of the relative importance of explanatory factors possible.

Accounting for spatial structures in democracy

Next, we explicitly control for spatial spillovers between geographically or culturally close countries. We first investigate for which spatial relationships statistically significant spillovers can be detected after controlling for the large set of explanatory factors described. For measuring spatial structures, we include a common border matrix (CB), whose elements w_{ij} (prior to standardisation) are equal to one if countries i and j share a common border and zero otherwise, two matrices based on nearest neighbour definitions (NN5 and NN25), whose elements w_{ij} are equal to one if country i is one of the (5 or 25) nearest neighbours of country j and zero otherwise,[21] two matrices based on distance bands (DB1500, DB3000), whose elements w_{ij} are equal to one if the distance between the capital cities of countries i and j is smaller than a given distance (1500 or 3000 km, respectively) and zero otherwise, and an inverse distance matrix, whose elements w_{ij} are equal to 1 divided by the distance between the capital cities of country i and j, in the set of weights matrices. Additionally, we include a religious proximity matrix, whose elements w_{ij} are equal to the Euclidean distance between religious adherence fractions of the population of country pairs for 10 religion groups.

Table 3 reports some descriptive statistics on each of the spatial matrices used. The table shows the average, minimal, and maximal number of links between countries as well as the proportions of zero elements for each spatial matrix. It also reports the degree of spatial autocorrelation in a model which does not include any additional control variables. We perform BMA using spatially filtered data based on the eigenvectors of the corresponding (transformed) weight matrix.

Before we report the posterior results for this analysis, we evaluate the existence of spatial spillovers for each spatial structure in order to find out whether controlling for spillovers in democracy appears indeed important. The large number of models entertained in our analysis and the additional burden implied by the computation of the marginal likelihood of SAR models implies that a direct application of BMA to SAR specifications that would allow us to retrieve the posterior over the spatial autoregressive parameter is not feasible. This justifies the use of spatial filtering in our BMA application as a shortcut to explore the model space efficiently. As we cannot retrieve the posterior over the degree of spatial autocorrelation ρ using the spatial filtering framework, we additionally estimate fully specified SAR models for the top 10 models for each spatial matrix, identified through the BMA procedure over

Table 3
Descriptive statistics of spatial matrices

	CB	NN5	NN25	DB1500	DB3000	Dist	Relig
Average links	3.02	5.00	25.00	9.80	22.98	130.00	130.00
Minimal links	0.00	5.00	25.00	0.00	1.00	130.00	130.00
Maximal links	13.00	5.00	25.00	30.00	47.00	130.00	130.00
Proportion of 0	0.98	0.96	0.81	0.93	0.82	0.01	0.01
ρ_{SAR}	0.40	0.42	0.70	0.32	0.53	0.69	0.82

[21] Nearest neighbours are identified according to the distance between the capital cities of two countries.

spatially filtered data. The results of this analysis are reported in Table 4. The table provides information on the extent of spatial autocorrelation as measured by the maximum likelihood estimate of the parameter ρ and its significance (reported in the cells) for the top 10 models and for each of the seven spatial linkage matrices (in columns). The results reported in Table 4 give strong evidence concerning the existence of spatial spillovers, whose strength depends strongly on the form of the weighting matrix used. Spatial autocorrelation is particularly strong when the spatial linkage matrix with 25 nearest neighbours or religious proximity linkages are used. In the main part of the analysis, we follow Kelejian *et al.* (2013) and Leeson and Dean (2009) in basing our inference on the CB matrix and compare the results to the findings when we allow for spillovers based on religious proximity.[22]

Table 5 summarises the results of the BMA analysis using spatially filtered data based on the CB weighting matrix. While the (posterior mean) coefficient estimates of all variables are close to those obtained when we did not control for spatial spillovers, the relative importance of variables as measured by their PIP is affected by the assessment of spatial spillovers in the model space considered. In contrast to the results obtained with standard linear regression models, after controlling for spillovers in democracy levels a smaller number of variables appears robust in terms of their PIP, indicating that spatial relations capture the effect that is otherwise attributed to other explanatory variables.

All indicators that appeared highly important as determinants of democracy according to the results of the BMA analysis without spatial spillovers (with a PIP of over 0.5) still have a PIP of over 0.4 in the CB setup. The same is true for population size, trade volumes, and the English language variable, which turn even more important in explaining differences in democracy levels after accounting for spatial autocorrelation. In contrast to the exercise based on

Table 4
Spatial autocorrelation of democracy for the 10 models with the highest posterior model probability

Model	CB	NN5	NN25	DB1500	DB3000	Dist	Relig
#1	0.28***	0.28**	0.74***	0.03	0.2	−0.09	0.75***
#2	0.21**	0.26**	0.73***	0.05	0.58***	−0.08	0.75***
#3	0.15	0.31***	0.69***	0.12	0.51***	−0.11	0.76***
#4	0.24***	0.17	0.53***	0.08	0.51***	−0.1	0.7***
#5	0.18**	0.13	0.4**	0.02	0.23	0.41	0.7***
#6	0.22**	0.16	0.37**	0.08	0.23	−0.08	0.67***
#7	0.15*	0.21*	0.71***	0.05	0.55***	−0.07	0.66***
#8	0.23**	0.13	0.7***	0.03	0.56***	0.15	0.7***
#9	0.14	0.29***	0.74***	−0.04	0.53***	0.38	0.68***
#10	0.16*	0.27**	0.41**	−0.02	0.25	−0.01	0.7***

Note: *** (**) [*] indicates statistical significance at the 99% (95%) [90%] confidence level.

[22] Detailed results for the other spatial linkage matrices are available from the authors upon request.

Table 5
Posterior results – spatial spillovers: common border

	PIP	Post. β	Post. σ	t stat.	Sig.
Muslim	0.880	−0.291	0.108	−2.687	***
Population	0.752	−0.228	0.086	−2.654	***
Trade	0.716	−0.271	0.110	−2.470	***
English language	0.669	0.313	0.165	1.898	**
Natural resources	0.660	−0.173	0.074	−2.349	**
GDP pc	0.621	0.232	0.114	2.033	**
MENA	0.521	−0.438	0.381	−1.151	*
Conflict (>1000)	0.447	−0.293	0.240	−1.218	*
Legal Origin Scandinavian	0.400	−0.259	0.234	−1.108	
Population density	0.379	0.116	0.067	1.723	**
Fuel exports	0.343	−0.129	0.101	−1.276	
OPEC	0.336	0.193	0.246	0.782	

Note: Variables for which PIP>0.33. Sig. *** (**) [*] indicates that in 99% (95%) [90%] of the models estimated the coefficient estimate was positive, or negative respectively. Calculation based on 300,000 iterations.

models without spatial spillovers, also Scandinavian legal origin gains importance in contributing to lower democracy levels when controlling for spillovers between contiguous countries, although its effect is not significant at the 90% credibility interval. Interestingly, the age distribution of educated individuals and OECD membership are not among the set of robust determinants of democracy once spatial spillovers are included in the specifications that compose the model space. Spatial spillover effects in democracy seem to capture at least some part of the effects of these variables.

Figure 2 provides a visual overview of the differences in findings between the BMA exercise based on linear regression models and the BMA results using spatially filtered data. We depict not only a summary statistic but also the whole posterior distribution of the parameters associated to the most robust variables under each one of the two settings in the form of a bean plot, together with the PIP of each variable.

When taking into account spatial democracy spillovers based on first-degree contiguity (CB), population size, trade volumes, English language, and to some extent Scandinavian legal origin, population density, and fuel exports become more important in terms of their PIP (indicated by the size of the bars on the left side in Figure 2). The PIP of Muslim religion and OPEC membership remains very similar to that obtained in the setting without spatial autocorrelation. All other variables tend to lose some of their importance as measured by their PIP. Despite these changes, the posterior distribution of the parameters for all covariates conditional on inclusion changes only slightly across settings. Although posterior means (indicated by the spikes in the distributions) differ between the two approaches, these differences are small in most cases. In general, the mean of the posterior distribution tends to be higher in absolute value in the scenario in which the PIP of the corresponding

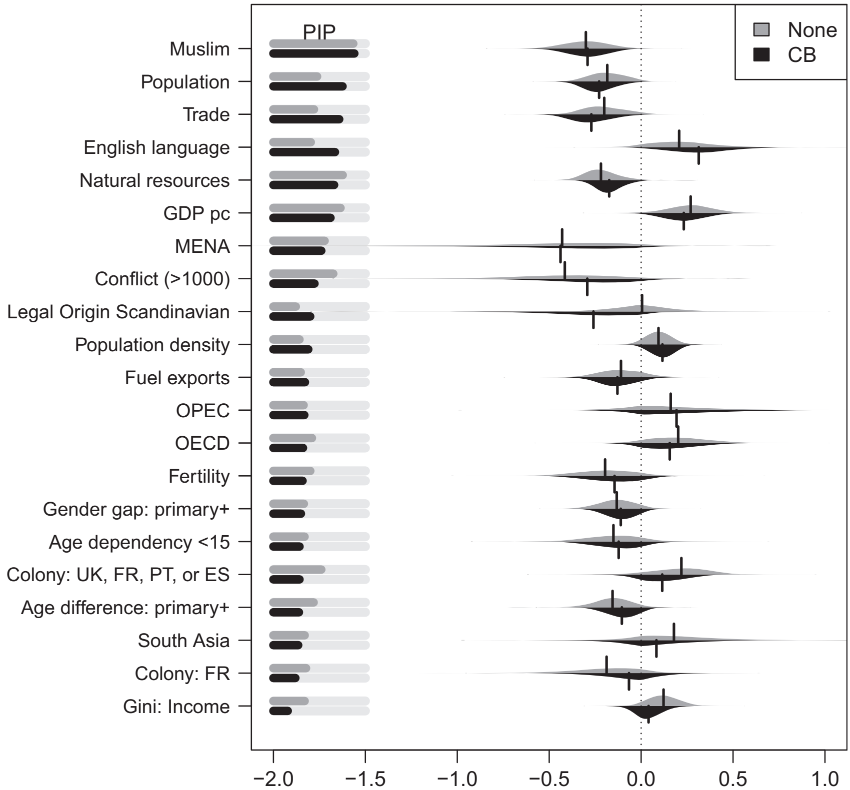

Figure 2. Posterior distributions and posterior inclusion probabilities (>0.33 in at least one specification) for different spatial weight matrices.

variable is higher. The only cases with a larger change in the posterior mean include English language, armed conflict and Scandinavian legal origin, and to a lesser extent population size, trade volumes, the dummies for colonies and income inequality, which are also the variables whose PIP was stronger affected by allowing for spatial spillovers in democracy levels. Thus, not accounting for such spillovers appears to leads to some bias in the estimates of their effect on democracy.

Table 6 reports the results based on democratic spillovers between countries with a similar religious composition. The findings are comparable to those of the analyses before. GDP per capita, natural resource rents, English language and armed conflict remain important for explaining democracy levels, with a PIP of over 0.4. The age distribution of education and fuel exports gain in terms of their PIP, while the importance of trade flows and population size decreases; yet, the effect of these variables remains well estimated. On the contrary, Muslim religion, the MENA region and OECD membership are not among the robust determinants of democracy in this specification. The

Table 6
Posterior results – spatial spillovers: religious composition

	PIP	Post. β	Post. σ	t stat.	Sig.
GDP pc	0.521	0.199	0.106	1.875	**
Age difference: primary+	0.487	−0.172	0.101	−1.706	**
Natural resources	0.447	−0.130	0.072	−1.811	**
English language	0.431	0.219	0.150	1.455	*
Conflict (>1000)	0.408	−0.276	0.232	−1.193	*
Fuel exports	0.403	−0.138	0.089	−1.553	*
Colony: UK, FR, PT, or ES	0.365	0.161	0.125	1.286	*
Fertility	0.361	−0.170	0.136	−1.255	
MENA	0.355	−0.263	0.266	−0.990	
Trade	0.340	−0.162	0.104	−1.550	*
Population	0.334	−0.148	0.093	−1.587	**

Note: Variables for which PIP > 0.33. Sig. *** (**) [*] indicates that in 99% (95%) [90%] of the models estimated the coefficient estimate was positive, or negative respectively. Calculation based on 300,000 iterations.

religious proximity matrix is likely to capture a large part of the effect of these variables once it is included in the model.

In order to evaluate the robustness of the findings obtained with spatial spillovers based on the CB and the religious weighting matrix matrices to different specifications of geographic linkages across countries, Figure 3 summarises the results of the BMA analysis in addition for a nearest neighbour (NN25) and a distance band (DB3000) specification of spatial spillovers. The figure comprises all variables with a PIP above 0.33 for the CB matrix and adds variables whose PIP is above 0.33 in any of the alternative specifications tested.

Although Figure 3 shows that the PIPs of some variables vary quite strongly with the specification of the spatial weighting matrix used, there is a set of variables whose PIP consistently lies above the 0.33 threshold. For the weights matrices analysed (CB, NN25, DB3000, religion), this set consists of the population size, trade volumes, natural resource rents and being in the MENA region. These variables are also among the most important ones for model specifications without spatial spillovers. Furthermore, English language, GDP per capita and armed conflicts have a PIP exceeding this threshold for all specifications but those based on the DB3000 matrix.[23] Our analysis suggests that these variable are robustly related to democracy levels after taking into account model uncertainty and the likely existence of spatial spillovers in democracy. The results are robust to different specifications of spatial spillovers and the inclusion of different sets of control variables.

[23] The DB3000 matrix allows for geographical spillovers to a larger range of countries than the other matrices, which might thus have an effect on the estimate of the effect of some of the covariates. Apart from that, the share of Muslims in the population has a consistently high PIP except for specifications allowing for spillovers to closer countries in terms of religion, which might take up this effect.

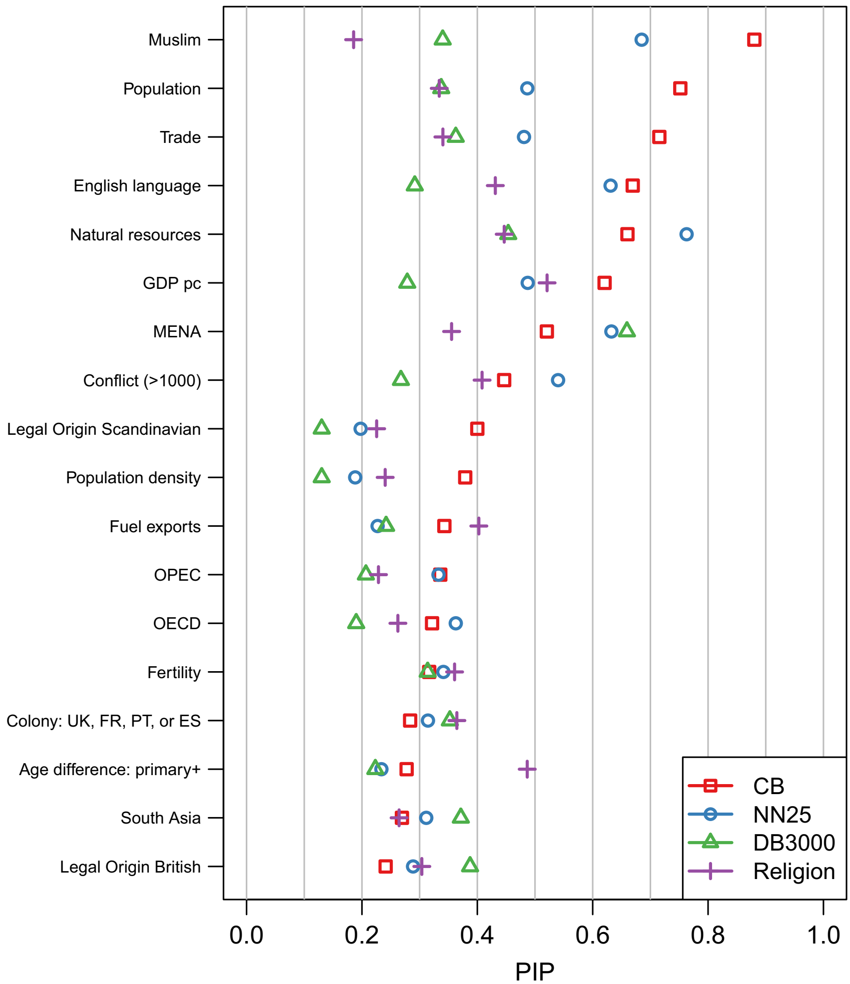

Figure 3. Posterior inclusion probabilities (>0.33 in at least one specification) for different spatial weight matrices. [Colour figure can be viewed at wileyonlinelibrary.com]

Robustness

Changes in democracy

An alternative specification to the models estimated so far is to consider changes in democracy as dependent variable, rather than democracy levels.[24] The set of models focusing on democracy levels nests specifications on changes in democracy to the extent that we included the initial level of democracy among the list of covariates. In this case, the model in levels can be rewritten as a specification in first differences in a straightforward manner by

[24] See also the online appendix S2 for alternative settings based on different indicators of democracy.

subtracting the initial level of democracy from both sides of the specification. The variable measuring the initial level of democracy achieves consistently a rather low PIP in our BMA exercises (around 0.15). We perform an alternative BMA exercise including the same set of covariates as in the main analysis but requiring the initial level of democracy to be always included among the regressors, as to ensure that our model space is only composed by models that can be rewritten as specifications for the change in our democracy variable and include potential conditional convergence dynamics. Table 7 shows the results for the estimation based on the common border matrix.[25]

As compared to before, a smaller set of covariates is included in at least one third of the models visited by the Markov chain (and thus have a PIP of over 0.33). As expected, the initial level of democracy has a negative effect on the change in democracy, indicating a pattern of conditional convergence in democracy dynamics. The set of control variables that are robustly related to changes in democracy is similar to that for explaining democracy levels. All variables that had a PIP of over 0.5 for democracy levels also now turn out to have a PIP of over 0.4 for democracy changes, with their effects being quantitatively comparable to before. The only exception is GDP per capita, whose PIP decreases to 0.3. Similarly, armed conflicts and Scandinavian legal origin remain important with a slightly lower PIP of 0.39 and 0.34 respectively.[26]

Heteroscedasticity adjustment

The BMA exercises performed hitherto are based on the assumption that the model-specific error terms follow a Student *t*-distribution with two degrees of freedom ($v = 2$), in order to account for heteroscedasticity and/or outlying observations. We assess the robustness of our results to this assumption by repeating the exercise for $v = 6$, as well as for normally distributed errors. Figure 4 summarises the BMA posterior results and the PIP of the most important variables for these settings. These changes in the specification of the error term do not affect the posterior distribution of the parameters strongly.[27]

Allowing for different degrees of freedom for the t-distribution, or for a normally distributed error term, the share of Muslims, population size, trade volumes, English language, natural resource rents, the dummy for the MENA region and armed conflict remain among the variables that have a PIP higher than 0.33 for all specifications of the error distribution considered. The PIPs of GDP per capita, Scandinavian legal origin, population density and OPEC membership decrease below the threshold of 0.33 once we allow for thinner tails of the error distribution. These results have to be interpreted with caution, however, as they might to some extent be driven by the presence of heteroscedasticity and outliers.

[25] Results for settings without spatial spillovers and with other spatial linkages are available from the authors upon request.

[26] In this specification, Scandinavian legal origin has a negative effect on democratic changes at the 90% credibility interval.

[27] Figure S.1 in online appendix S2 summaries the PIPs resulting from error tdistributions with 2, and 6 degrees of freedom, and a Normal distribution.

Table 7
Posterior results (changes in democracy) – spatial spillovers: common border

	PIP	Post. β	Post. σ	t stat.	Sig.
Past regime index	1.000	−1.033	0.072	−14.403	***
English language	0.673	0.354	0.143	2.477	***
MENA	0.648	−0.723	0.371	−1.945	**
Population	0.634	−0.212	0.070	−3.038	***
Trade	0.605	−0.254	0.085	−2.996	***
Muslim	0.550	−0.234	0.104	−2.250	***
Natural resources	0.471	−0.150	0.060	−2.484	**
Conflict (>1000)	0.392	−0.399	0.253	−1.574	**
Legal Origin Scandinavian	0.338	−0.366	0.252	−1.451	*

Note: Variables for which PIP>0.33. Sig. *** (**) [*] indicates that in 99% (95%) [90%] of the models estimated the coefficient estimate was positive, or negative respectively. Calculation based on 300,000 iterations.

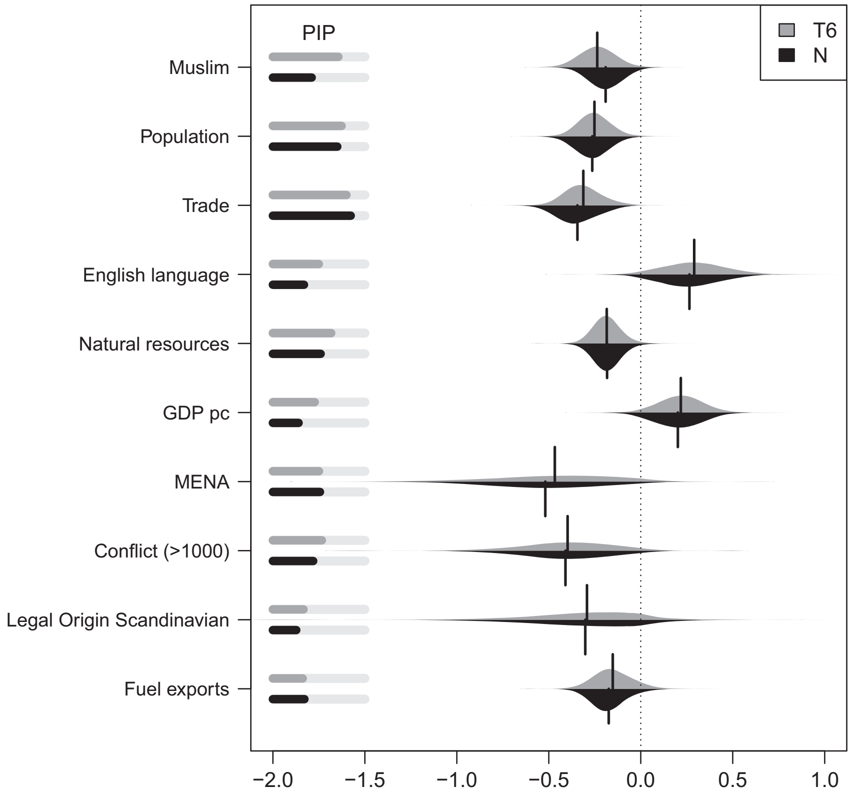

Figure 4. Posterior distributions and posterior inclusion probabilities (>0.33 in at least one specification) for different error distributions (Spatial weight matrix: CB).

Summarising the insights obtained from the large number of settings entertained in the analysis, our estimates support the existence of spatial spillovers of democracy across countries that cannot be assessed using exclusively linear covariates and require models that explicitly account for a spatially autocorrelated dependent variable. Our results indicate that prior studies that did not include population size, trade volumes, natural resource endowment, and the MENA region, as well as English language, GDP per capita, armed conflicts, and Muslim religion, OECD membership, and colonial history variables among their regressors might suffer from an important omitted variable bias as those factors turn out to be the most robust determinants of democracy levels. Furthermore, inference based on methods that do not address spatial linkages might have led to biased conclusions, especially for variables whose influence on democracy disappears once democratic spillovers are controlled for.

Our approach highlights the importance of evaluating not only the significance of variables upon inclusion in a particular model but also their relevance in terms of their probability of inclusion once specification uncertainty is explicitly assessed. Merely focusing on model-specific statistical significance levels might overstate or underestimate the importance of covariates in terms of being important explanatory factors of democracy levels. Not accounting for spatial spillovers might mistakenly attribute the effect of such spillovers to other variables, leading to an overestimation of their importance and biasing the estimates of their effects on democracy levels.

V Conclusions and Discussion

The literature dealing with empirical assessments of the determinants of democratic regimes has recently developed an interest in providing robust inference with respect to model uncertainty (Gassebner *et al.*, 2012; Hegre *et al.*, 2012). In this contribution, we improve the existing methods used in this branch of empirical political economy by applying Bayesian methods that account for model uncertainty in the presence of a spatially correlated dependent variable. The evidence provided by Kelejian *et al.* (2013), Leeson and Dean (2009), and Seldadyo *et al.* (2010) concerning spatial spillovers in institutions and democracy indices justifies the need for methods that address these two issues simultaneously.

Our results indicate that some of the existing evidence concerning the robustness of widely used variables as determinants of democratisation is driven by the lack of explicitly accounting for model uncertainty. Additionally, neglecting spatial spillovers might lead to erroneous conclusions on the importance of geographic factors and other variables that can be captured by spatial correlation structures. Once these issues are accounted for, population size, trade volumes, the proportion of Muslim population, natural resource rents, being a MENA country, English language, GDP per capita and the incidence of armed conflicts appear as the most important variables explaining differences in the degree of democracy across countries over long periods of time (about 30 years in our analysis). The share of Muslims, population size, trade volumes, natural resource rents, being a MENA country and armed conflicts have a negative robust partial correlation with democracy. We find that countries in which more than 9% of the population speak English and countries with higher GDP per capita tend to present systematically higher levels of democracy after accounting for a large number of other factors that may affect the political regime, including spatial spillovers. In line with the results of Kelejian *et al.* (2013), Leeson and Dean (2009), and Seldadyo *et al.* (2010), the analysis carried out emphasises the importance of exploring geographical linkages when approaching research questions related to the development of political regimes. Our findings suggest that the strength of spillovers in democracy depends on the form of the spatial link matrix used and on the specific model specification.

Thus, our results put forward four main conclusions concerning democratisation processes. First, the importance of the share of Muslims, natural resource rents, the MENA region, and English language, which is likely connected to British colonial history, point towards the central role played by institutions that are conducive to political freedom and democracy. Institutions that aim at protecting property rights and investment and limit the risk of expropriation are likely to go hand in hand with more democratic forms of political organisation. By contrast, a strong connection between the state and religion, or institutions that prevail in areas which rely on high resource rents are arguably less conducive to democratisation and can help maintain existing authoritarian structures.

Second, our results provide support for Lipset's theory on the social prerequisites for democracy. Our findings indicate that higher levels of wealth can be conducive to democratisation and, once high levels of democracy have been reached, contribute to regime stability. As higher income levels are connected to lower fertility and a lower proportion of young people in the population also the youth bulge theory could play an important role in this respect. On the other hand, social unrest and armed conflict can reduce regime stability and make democratic regimes less tenable.

Third, some factors whose effect on democratisation is ambiguous from a theoretical point of view and for which empirical research has led to conflicting results are found to be robustly related to higher levels of democracy after accounting for model uncertainty and spatial spillovers in democratisation. Our study identifies population size and trade volumes to be negatively related to democracy levels, after accounting for these issues (see Dahl and Tufte, 1973 for arguments concerning the effect of population size on democracy and Li and Reuveny, 2003 for a discussion of the effect of globalisation).

Finally, our findings strongly confirm theoretical arguments and empirical evidence on the existence of democratic spillovers between geographically or culturally close countries. These contagion effects, which can arise based on political, economic, and cultural reasons (see Leeson and Dean, 2009, for a discussion), might be able to explain waves of democratisation that have been observed in the past (see Bonhomme and Manresa, 2015) and might be important in the future.

The aim of this study was to provide a first analysis that takes into account issues of model uncertainty in combination with spatial spillovers in identifying robust determinants of democracy. Open issues remain that could not be addressed entirely in the current study and are left for future research. While we aimed to address the often neglected issue of potential reverse causality by following Clague *et al.* (2001) in using cross-sectional data with long time lags of explanatory variables, taking endogeneity into account explicitly over shorter periods of time was beyond the scope of this article. Future work on the determinants of democracy would benefit from fully accounting for endogeneity by using an instrumental variable framework, while accounting for model uncertainty and spatial dependence.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Data appendix.

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