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EXTENDED ABSTRACT

Title: "The grass is greener on the other side of the hill": relationship between the Brexit referendum results and income inequality at the local level

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Abstract:

"The grass is greener on the other side of the hill": relationship between the Brexit referendum results and income inequality

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In June 22, 2016 the United Kingdom, the European Union and the rest of the world were surprised by the triumph of the pro-Leave option in the Brexit referendum, providing social researchers with an extraordinary case study. We have perfect information on the percentage of votes at a spatially disaggregated level, which allows to make precise studies about where and why the anti-European sentiment takes root. In this paper, a spatial analysis using a spatial dependence model is applied to understand and quantify the relevance of the different dimensions – demographic, cultural/educational as well as economic – that take place in the explanation of the pro-Leave stand rise. The analysis is made at local level thanks to the combination of official datasets with new data generated in the context of the EU H2020 project IMAJINE. A new indicator of relative inequality between each local area and its closer neighbours is proposed and included in the model. In general, we observe that most of the main conclusions obtained at regional or national level are supported when we work at local scale.

However, it is especially interesting to observe how the inequalities in the local contexts are clearly significant and had a relevant influence over the voters' decisions. These results provide with evidence of the existence of a kind of 'revenge' –using the Rodriguez-Pose terminology– of the places that does not mater, also and even more intensely, at the local scale.

1. Introduction

The success of the supporters of the exit of the United Kingdom from the European Union in the referendum of June 22, 2016 generated a shockwave not only throughout the United Kingdom but throughout Europe and the world. After seven decades of European construction, full of economic and social promise, the citizens of the United Kingdom and the rest of the world were taken by surprise by the triumph of the Brexit, after which an uncertain and complex future opened.

Given this uncertain and complex future of extricating the country from the EU and building up new forms of engagement, it is easy to suggest that voting was not an informed decision. There were campaigns on both sides with the Remain side mobilizing the establishment and the Leave side emphasizing its break with the Establishment and claiming a closer link with the ordinary people. Add to it Leave campaign tactics such as the "let's take back control" buses driving around parts of the country and barraging potential voters with claims that in many cases were not factually true, e.g. that the money saved from leaving the EU will result in the NHS getting £350m a week (website). The Remain campaign emphasized the negative effects of leaving the EU such as higher prices for imported goods, higher interest rates, loss of property values and hence has been dubbed as "project fear".

The question then is can we explain the vote taken in conditions of great informational uncertainty? What were the drivers of it? Was it perceived costs and benefits of leaving the EU? Did they react to feeling threatened by free movement of EU migrants? Were the voters reacting to being left behind by the structural changes in the economy?

Political science literature emphasizes attitudes towards the EU in relation to the outcome of the Brexit vote. Clarke, Goodwin and Whiteley (2017) use time series data and find that evaluation of political leadership, subjective economic judgement, attitudes towards immigration, partisanship (strong identification with a political party) and perception of economic sovereignty Granger-cause approval of EU membership. By the time of the referendum in June 2016 these attitudinal variables have shifted in a way that meant greater disapproval of EU membership. It follows that from such a historical perspective, Brexit can be considered as an expected event. After the severe international economic crises of 2007-2008, joined with the limited response given by the European institutions, a climate of dissatisfaction with the political system rapidly raises. This discontent has not stopped growing since then, with Brexit being one of the main materializations of this wave of discontent, but certainly not the only one and not the last. Consider the "Occupy" movement of 2011 and recent "yellow vests" protests in France as examples. As Gary Younge of the Guardian, points out "The broad narrative arc in most places is similar, and in some cases even more pronounced, then the one that brought us Brexit. The key difference is that Brexit comes complete with a timetable, a deadline, and an entity – the EU that has thus far escaped these trends because it is subject to diplomatic pressure of governments rather than to the popular pressure of voters. …" (Younge, 2019).

2. Among whose and where the anti-European vote takes root: a brief literature reappraisal

Seen in perspective, the Brexit can be considered as the chronicle of an expected event: after the outbreak of the severe international economic crisis in 2007-2008, the insufficient response

given by the European institutions generated a climate of general dissatisfaction with the political system that rapidly spread. This discomfort has not stopped growing ever since, being the Brexit a clear materialization of this wave of discontent, but not the only nor the last one.

Around the general idea of *discontent*, different related phenomena are gathering:

(i) A rise of populist parties and movements, with an anti-European stance in many EU countries (Algan et al., 2017; Vasilopoulou, 2018).
(ii) Reduced confidence in European as well as in national institutions, which has been referred to as a *Trust Crisis* (DG-Research and Innovation, 2017).
(iii) Decline in the support for the European Project in general, in line with falling levels of identification with the European Union (Flesher Fominaya, 2017).
(iv) Decreasing social engagement and participation among the citizens of EU countries (Magni, 2017).

Furthermore, as noted in the literature, these dimensions are *localized*, in the sense that they are more prevalent in some places than in others. More boldly speaking, there is a *geography of discontent* (Los et al., 2017; McCann, 2018; Rodriguez-Pose, 2018; Dijkstra et al., 2018), which means that the rise of populist movements, Euroscepticism, the loss of trust in European and national institutions, and the reduction of social engagement exhibit particular spatial patterns. A small but growing literature on this *geography of discontent* has focused mainly on the regional determinants of populist votes (Georgiadou et al., 2018), or the reasons behind the support for right-wing populist parties within particular social groups (Oesch, 2008). In the context of this growing literature concerned with understanding the drivers of the *discontent* in general, and its patterns across space in particular, Brexit has been a case-study of extraordinary relevance, attracting great academic attention and extensive analysis from the social sciences. Thanks to this literature, we are starting to understand which were the drivers behind Brexit, who are the 'brexiters' and where the Brexit had more support.

The percentage of voters in favour of Brexit increased monotonically with age, going from only 27% within the group aged 18-24, to 60% between those aged 65+. Conversely, it decreased monotonically with education (Crescenzi et al., 2017). In general, the academic studies confirm the 'age and education effects' on the probability of voting to leave the EU (see Arnosson and Zoega, 2016; Clarke and Whittaker, 2016; Harris and Charlton, 2017; and Manley et al., 2017; among others). However, in addition to those effects there was a clear relationship between the vote for leaving, migratory alarm and the slippery concept of identity. Though different approaches and techniques, authors such us Scruton (2016), Hobolt and Wratil (2016), Hobolt (2016), Arnosson and Zoega (2016), Clarke and Whittaker (2016), Langella and Manning (2016) or Goodwin and Heath (2016) agree that those voters who expressed concerns about immigration and multi-culturalism voted in favour of the leaving option.

What about the economic variables such as income, deprivation, or unemployment? Kaufmann (2016) summarizes the main conclusions of most of the previous related studies: "age, education, national identity and ethnicity are more important than income and occupation". However, as it is pointed out by Los et al. (2017), conceptual perspectives motivating Brexit exclusively on the basis of cultural issues (identity, national sovereignty, etc.) have been regarded by some as inadequate in describing the geography of the Brexit vote in an exhaustive way. This alternative view claims that variables accounting for the economic conditions of citizens and the economic geography of UK regions are, at least, as important as culture and identity to determine individual attitudes towards the EU and the voting patterns in the 2016 Referendum (Crescenzi et al., 2017). Indeed, empirical analyses on the Brexit vote that consider not only demographic and political variables but also proxy variables for local economic structure and 'economic exposure' to the rest of the European Union, all seem to suggest that economic factors have played a significant role (see Becker et al., 2016; Arnosson and Zoega, 2016; or Hobolt, 2016; among others). Adding to that, Bell and Machin (2016) and Darvas (2016) claimed that wage inequality and poverty are two crucial drivers of Brexit. Clarke, Goodwin, and Whiteley (2017) demonstrated that economic cost-benefit evaluations are at least

as influential as any sense of identity. On a similar strand, Curtice (2017) stated that the perceived impact on the economy of leaving the EU was the variable more strongly related to how people voted, while Clarke and Whittaker (2016) showed how labour market conditions are crucial in conditioning voters' choices: higher employment levels are associated with lower propensity towards Leave, suggestive that unemployed people were more prone towards Brexit than those with safe salaries and jobs (Ford and Goodwin, 2014: Clarke et al., 2016: Goodwin and Heath, 2016: Goodwin and Milazzo, 2015), Becker et al., 2017; or Alabrese et al., 2018).

Focusing on the geographical perspective it is clear that within the UK there were marked geographical differences in the voting patterns. Remain votes dominated in London and in many parts of the 'home counties' – western arc around London going from Cambridge to Oxford and down to Surrey– along with some of Britain's major cities such as Leeds, Manchester, Cardiff, Leicester, Bristol, Liverpool, Edinburgh and Glasgow. In addition, pro-remain voter preferences in both Scotland and Northern Ireland displayed markedly different outlines to those in localities that were perceived to have most benefited from globalization (Coyle, 2016; Field, 2016). As is pointed out by Goodwin and Heath (2016), the *geography of deprivation and prosperity* both interacted with, and also overlaid, each of the other individual-specific explanatory variables.

This previous literature regarding the spatial distribution of the leaving vote supports Rodriguez-Pose (2018) stance, explained in *the revenge of places that don't matter*: those areas specialised in declining activities and located in peripheral areas voted against a system they perceive has quelled their potential and driven them down a road in which the future offers no opportunities, no jobs and no hope (Gros, 2016; Rodrik, 2017). Rodríguez-Pose (2018) argues that territorial inequality is what matters. His contend is that although individual disparities play a role, the challenge to the system has come from a neglected source of inequality, territorial as opposed to interpersonal.

In accordance with the idea of a *feeling of spatial revenge*, Los et al. (2017) pioneered the evidence on how people in less prosperous regions who felt that they had suffered under modern globalization were much more likely to vote for leaving than people in more prosperous regions, and this was true even after controlling for personal characteristics. The irony is that the regions that voted to leave also tended to be more dependent on Europe for their prosperity than the regions that voted to remain (Los et al., 2017). These leave-voting regions were more dependent on EU markets for their trade and prosperity, and many of them had benefited significantly from regional development funding from EU Cohesion Policy over many years. Additionally, as McCann (2016) emphasizes, while many of these weaker regions has suffered under globalization, they have actually benefited under Europeanization, with the latter process partially mitigating the effects of the former, a fact that was not at all understood by the general public. According to McCann (2018) "In the UK an important pro-Leave narrative was that the 'metropolitan elites' of London were the only real beneficiaries of EU membership while other regions had not enjoyed the benefits of European economic integration. In contrast, empirically, it is now clear that this 'metropolitan elite' argument was completely incorrect, and that the regions which most benefited from the EU markets for their viability were largely the non-core weaker regions of the UK".

Most of the previous literature on the *geography of discontent* present analyses for regions, although none of these analyses deals specifically with the spatial patterns of the leave vote using a local scale, disregarding the importance of spatial disparities at that level of spatial disaggregation. The contrasting image of the voting dynamics in large cities and rural areas, or in the centre and periphery of regions, stresses the relevance of the local level in the study of the results of the referendum. The reason behind this research void is the scarcity of data on income or poverty for more disaggregated geographies. In this paper we propose an analysis of how socioeconomic variables and spatial disparities explain the Brexit vote based on the development of a database of socioeconomic variables at local scale created in the frame of the

H2020 European project IMAJINE, which allows us to test empirically the idea of the *revenge of places that do not matter* at higher level of spatial disaggregation.

3. Empirical settings: spatial unit of analysis, estimation of local income and dataset

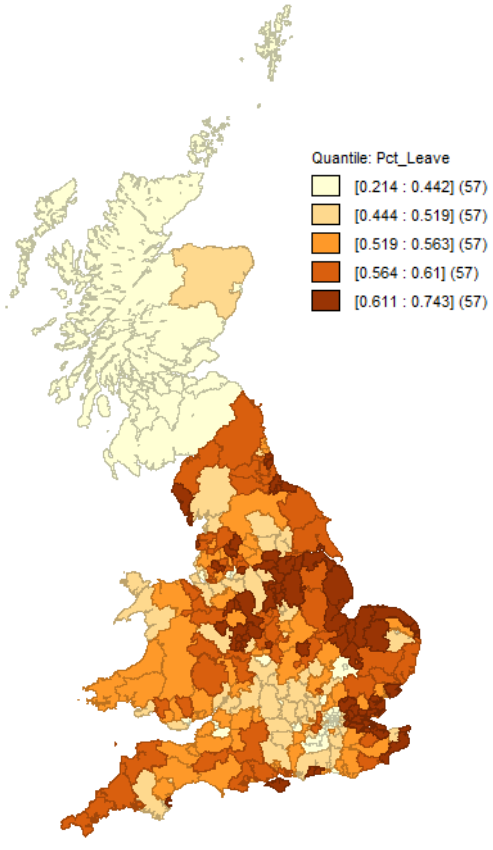
3.1. Spatial unit of analysis: the Local Authorities

Given the objectives set out in this paper, we have to work considering the local dimension. Nevertheless, the existing data at different spatial levels should be taken into account to ensure that the information on the main socioeconomic variables of an area is available. As shown in previous analyses, different (particularly finer) spatial scale may yield different results: taking the politically contentious issue of in-migration, Colantone and Stanig (2016) as cited in Lee, Morris and Kemeny (2018), find that stocks and flows of immigrants in NUTS 3 regions are unrelated to voting intention, "a finding that stands in direct contrast to that found by Goodwin and Milazzo (2017), who use more disaggregated parliamentary constituencies". For that reason we are going to use Local Authorities (LAs hereinafter), the lower geographical level identifiable in the Population Census microdata.

3.2. Independent variable: leave votes share in the Brexit referendum

Our dependent variable is the leave-vote share by LA. The electoral commission of the UK provided this information. A representation of its spatial distribution by LAs is plotted in Fig. 1. It shows a heterogeneous landscape where some areas exhibit a lower share of leave votes, like London and its neighbouring areas in the west (Oxfordshire and Hampshire) and the south (Surrey, West Sussex and East Sussex). On the other side, some localities in western Britain, namely the coasts of Lincolnshire and Norfolk, show the higher support to the leave option.

Fig. 1. Leave-vote share in the Brexit referendum by Local Authority



Source: Own elaboration using data from the Electoral Commission of the UK.

3.3. Our main explanatory variable: a measure of local spatial inequality

The main objective of this paper is to evaluate the relevance that spatial inequality had in the Brexit outcome in particular, as well as in the rise of Euroscepticism more generally. Apart from the demographic or educational features that have been considered in previous studies along with the economic circumstances and expectatives, we are interested in the concrete aspect of spatial economic inequality at the local scale. This objective, however, goes hand in hand with the absence of income or production data at a local level. The estimation of this kind of data has been one of the ambitions of the European Project IMAJINE (Horizon 2020), as an attempt to generate reliable information at the local level that is coherent with the official sources at more aggregated stances (regional and national). This projects aims to study spatial differences of various natures across the EU territories, using several socio-economic pointers, and explicitly considering the role played by the spatial scale. More specifically, one part of the project consists on disaggregating the income and wellbeing indicators that are available for several EU countries at an aggregated regional level (NUTS1 or NUTS2 regions) in order to produce analogous measures at the sub-regional or local scale (NUTS3 or lower). The result of this disaggregation will enable the quantification of potential inequalities between territories that could be masked as a consequence of data aggregation (e.g. urban rural gaps within regions).[1]

The procedure followed to produce the data mentioned has two stages, as explained in Fernández-Vázquez et al. (2018). In the first stage, the imputation technique proposed in Elbers et al. (2003) and Tarozzi and Deaton (2009) is applied. Although extensive explanations can be found in the mentioned paper, in summary the procedure combines the information from the European Union Social Indicators and Living Conditions survey (EU SILC), and from the Population Census (PC) for a given economy. The EU SILC contains detailed socio-economic information about the households surveyed, but no details about their geographical location further than NUTS1. Estimates based on EU SILC typically do not allow, consequently, inferring consumption figures for sub-regional units as municipalities or cities. On the other hand, microdata from the PCs contains geographical information of the individuals surveyed at a disaggregated scale, but economic indicators -and more specifically consumption figures- are not generally available. The strategy suggested in Elbers et al. (2003), and in Tarozzi and Deaton (2009) consists on estimating regression models of the indicator of interest (y) on a set of regressors (Z) that are both observable in the EU SILC and the PC. Once these models are estimated at an aggregated spatial scale, the results for the parameters are projected over the households surveyed in the PC. Since the PC has the detailed geographical location of the households, this technique enables the estimation of y at the same disaggregated spatial scale presented in the PC.

The second stage seeks to guarantee the consistency between the estimates for the sub-regional units and the regional aggregates from the official dataset (i.e. EU SILC), since it could happen that the sum of the estimates $\hat{y}_i$ for the households ($i = 1, \dots, D$) in a region is larger or smaller than the regional figure. Fernández-Vázquez et al. (2018) propose an alternative approach based on Generalized Maximum Entropy (GME) to adjust the estimates and make them consistent them with the official aggregates. The point of departure is considering each estimate obtained through the procedure proposed in Tarozzi and Deaton (2009) as the realization of a random variable that can take M values, contained in the vector $b'_i = [b_{i1}, \dots, b_i^*, \dots, b_{iM}]$. Each support vector b_i is different for every small area i and contains an odd number of values that are centered on point b_i^* symmetrically. Each direct estimate in the realization of the sample $\hat{y}_i$ is assumed to be this particular point of its corresponding vector ($\hat{y}_i = b_i^*$). However, any of the other points contained in b_i could have been observed instead.

[1] See http://imajine-project.eu/ for more details about the project.

Let us illustrate this idea by considering the simplest case where $M = 3$ values, being $\hat{y}_i$ one of them. The other two values are specified depending on an assumed possible deviation from $\hat{y}_i$. A natural way to set these values would be to consider that deviations from the sample mean that are larger than three standard deviations are highly unlikely. In such a case, the support vector could be defined as:

$$b'_i = \left[\hat{y}_i^d - 3S_i^2 \ , \hat{y}_i^d \ , \hat{y}_i^d + 3S_i^2\right] \quad [1]$$

where S_i is the standard deviation for the predicted value for household *i*. Once the possible realizations for each direct estimate have been specified, a probability distribution $p'_i = [p_{i1}, p_{i2}, \dots, p_{iM}]$ should be assigned to produce the estimation. The GME direct estimator of y_i will be given by the expression:

$$\tilde{y}_i = \sum_{m=1}^{M} p_{im} b_{im} \quad [2]$$

An interesting feature of the GME approach is that it allows the inclusion of some additional out-of-sample information, if it is available. In most cases, even when our target is the estimation of the y_i local indicator, some aggregated information for the whole group of areas exists. For instance, the means of y_i for the set of small areas forming a region must be estimated, but an (out-of-sample) estimate of the mean for the whole region $\bar{y}$ could be available.

This information can be easily included in the GME estimation as follows:

$$\underset{p,w}{Max}\, Ent(P,W) = -\sum_{i=1}^{D}\sum_{m=1}^{M} p_{im} ln(p_{im}) \quad [3]$$

subject to:

$$\sum_{m=1}^{M} p_{im} = 1;\ i = 1, \dots, D \quad [4]$$

$$\sum_{i=1}^{D}\left[\sum_{m=1}^{M} p_{im} b_{im} + \sum_{l=1}^{L} w_{il} v_{il}\right][N_i] = \bar{y} \quad [5]$$

where N_i is the sampling weight of household i in the PC. Note that Eq. 4 represent just the standardization constraints, and that Eq. 5 contains the additional aggregated information.

In the case of the UK, the EU-SILC contains approximately 8,058 households, for which the information on a set of demographic characteristics (age, labour status, education level, occupation, etc.) is gathered in matrix Z. The variables on this matrix have been selected following a double criterion:

- They should be appropriate explanatory factors used in regression models that predict household consumption levels.
- They should be observable in the UK PC 2011 as well.

Table 1 summarize the final set of variables used.

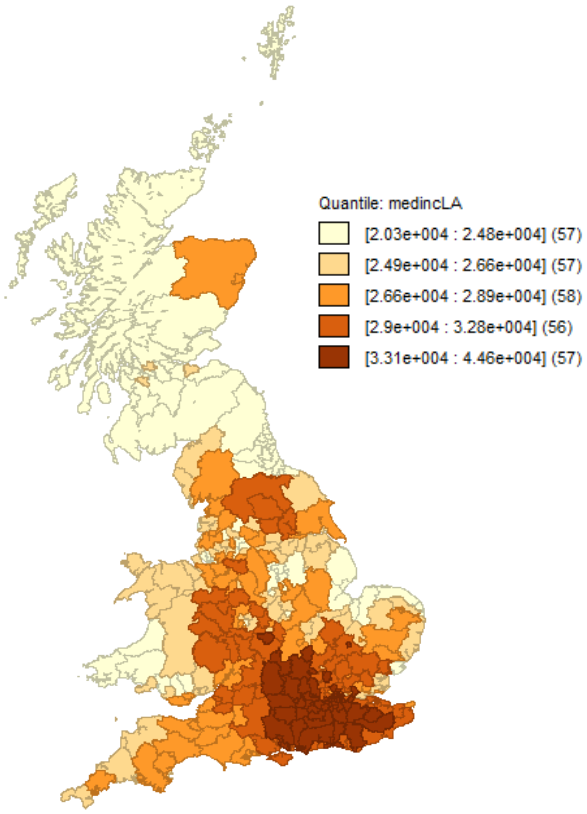
Table 1. Variables used as predictors – EU-SILC and census microdata (2011)

Head of household age and age2
Head of household gender
Head of household is foreigner from an EU/ foreigner from non-EU country
Head of household marital Status: Married/Separated/Widow/ Divorced
Head of household education: Post-mandatory/non-college education/college education
Head of household activity status: Worker/Retired or disable/other activity
Head of household is in a part-time employment
Head of household occupation: Manager/Technician or professional/Support worker or sales/Craft, machine operators or skilled agricultural worker
Head of household economic sector: CNAE (1 digit)
Tenure of the dwelling
Number of rooms in the dwelling
Number of workers in the dwelling
Number of members (by age) in the household
Household structure: single parent/couple with children/couple without children /other with family/other without family

Once the variables in Z are chosen, regression models that predict household consumption (monetary expenditure) for each household i in the EU SILC are estimated. These regression equations are estimated individually for each one of the 37 areas or locations to allow for regional heterogeneity in the parameters. The vector with the estimates of each equation ($\hat{\beta}$) are then assigned to the households in the sample of the PC, which consists of approximately 1.5 million observations, and the consumption predicted for each household i is calculated as $\hat{y}_i = \hat{\beta} z_i$. Afterwards, the GME adjustment described in equations 3, 4 and 5 is applied to make these estimates consistent with the regional figure available in the EU SILC for the UK in 2011 (NUTS2 level).

Thanks to the estimation process described, we can have income information at the local level (LA), making it possible to plot the map of the spatial distribution of income in the UK depicted in Fig. 2.

Fig. 2. Median income by Local Authority (2011)



Source: Own elaboration using data from IMAJINE (Fernández-Vázquez et al., 2018).

Once we have the income level by LA, we use it to calculate a new measure of spatial inequality. In this work, we decided to build an indicator that represents the relative average difference in the local median income between a LA and its nearest fifteen neighbours. Particularly, this indicator ($Diff_i$) is defined as:

$$Diff_i = 1/n \sum_{i,j}^{n} \left(\frac{Minc_i - Minc_j}{Minc_i} \right) \quad [6]$$
$$i \neq j \; ; n = 15$$

The absolute value of this index shows how near or far is a LA to its neighbours in terms of median income, being positive if the region is above the average within its defined vicinity, and negative if it sits below. The latter case is especially interesting, as some sociological studies claim that perceived economic deprivation with respect to the surrounding areas might be one of the reasons that motivated certain segments of the population to vote for leaving the EU. These claims are in line with the economic studies of Los et al. (2017) and Rodríguez-Pose (2018) that show how the referendum gave an opportunity to those discontent with their lagging-behind situation to take "revenge" on the "metropolitan elites". According to this, we expect a negative and significant relationship between the leave-votes share and the spatial relative inequality indicator introduced earlier: the lower the value of the indicator (meaning more negative, and

subsequently, a worst relative economic performance of the area regarded in comparison to their neighbours), the higher the share of leave votes.

3.4. Sources and definition of the control variables

To complete the model we need to add the set of other variables identified in the literature as relevant variables in order to properly explain the Brexit voting. According with the literature revised in section 2 previous papers on this matter considers, apart of economic inequality, demographic, educational and cultural variables as drivers of the vote result, along with the labour market conditions, the ideological position regarding the international economic integration (euroscepticism) (Arnosson and Zoega, 2016; Becker et al., 2017; Clarke et al., 2017, Crescenzi et al., 2018 among others).

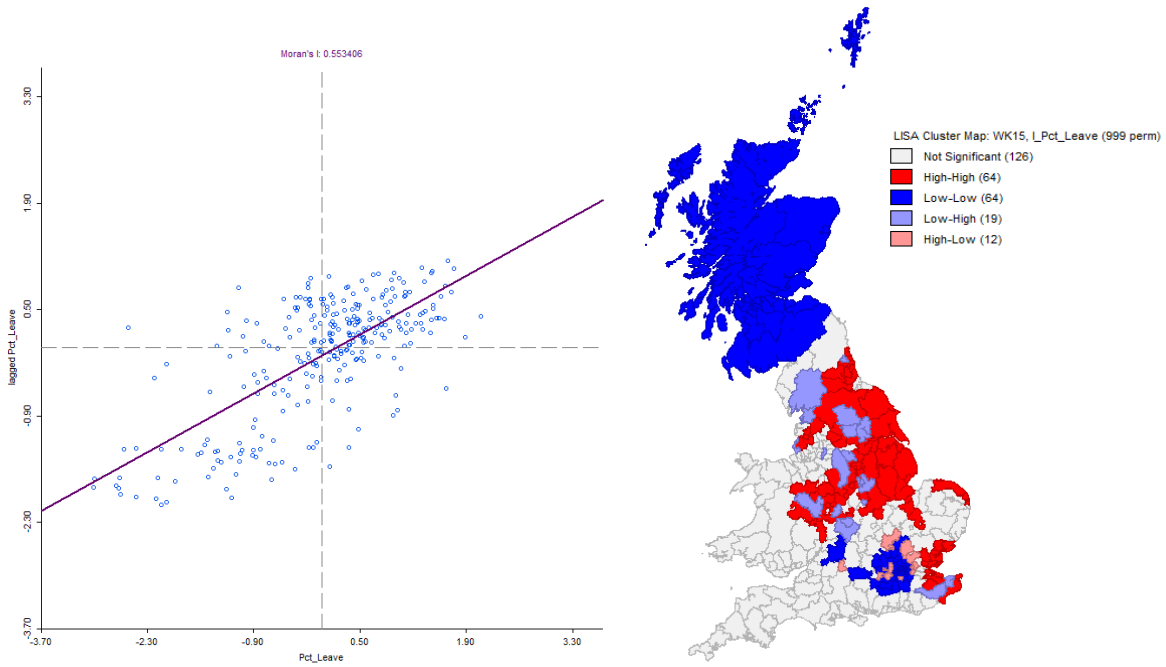
Following the line set in previous empirical exercises, is this paper we will include a variety of the already reviewed possible divers to explain the share of leave votes in LAs across the UK.

4. Empirical model specification: implementation of the spatial dimension of the analysis

Although the study of the effect of the economic inequality on the result of the Brexit referendum is not new, to our knowledge this is the first study to use local income data to assess the spatial effect of relative income differences. From the methodological point of view, the indicator included is also a novelty, although its use is complemented by the several options available to deal with spatial dependence (autocorrelation in the error term induced by the spatial structure of the data), as reviewed extensively in Anselin (1988 and 2006), Anselin and Bera (2004), Arbia (2006), LeSage and Pace (2009) or Elhorst (2014).

The estimation of a usual index of spatial dependence over the leave vote in the Brexit referendum clearly shows how relevant is the spatial dimension. As can be seen in Fig. 3 there are a clear spatial pattern of concentration of the vote.

Fig. 3. Exploratory analysis: LISA cluster map on the independent variable



Provided that in the first part of this study we will focus on the potential role played by the spatial spillovers, as shown by the clustering of LAs with a high and low share of leave votes that can be seen in Fig. 3, and that the Moran's I test confirms the existence of spatial autocorrelation, the specification chosen to deal with it is the Spatial Durbin Error Model (SDEM):

$$Pct\_Leave_i = \alpha + \rho W Pct\_Leave_i + \beta_1 Diff_i + \beta_2 Theil_i + \sum_{j=3}^{6} \beta_j Dem\ Struc_i + \sum_{j=7}^{9} \beta_j Ed\ Struc_i + \sum_{j=10}^{12} \beta_j Tenure\ reg_i + \sum_{j=13}^{16} \beta_j HH\ size_i + \sum_{j=17}^{20} \beta_j Occupation_i + \sum_{j=21}^{32} \beta_j Sector_i + \sum_{j=33}^{34} \beta_j Labourmkt_i + \varepsilon_i \quad [7]$$

In order to assess the influence of the neighbouring localities from a global perspective, in this analysis we will rely on a definition of neighbourhood as the fifteen nearest municipalities (the same used in the construction of the relative income difference indicator), contained in matrix W, using centroids as reference points. The proposed spatial scheme reflects properly the distribution of the percentage of leave votes, as indicated by a preliminary examination of the data through an Exploratory Spatial Data Analysis (ESDA) (Anselin 1999).

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5. Main results

The results of the estimation proposed in the equation [7] (see section 4), applied to data at local level (LAs, see section 3.1), are presented in Table 3. Working at the local level limits the availability of data and, therefore, reduces the potentialities of all the empirical analysis. However, it has been possible to incorporate the main variables, or proper proxies, to measure the relevance of the demographic and educational/cultural dimensions (see section 3.4) as well as, thanks to the estimations of the IMAJINE project (see section 3.3), the socio-economic dimension.

A first idea that stands out in the estimation is the significance of the *Rho* component of the SLM, which clearly indicates the existence of spatial dependence. It, as well as the LISA analysis presented in Fig. 3 (previous section 4), is an evidence of the existence of local processes of concentration of the leaving vote in the Brexit referendum. In other words, as was indicated by Rodriguez-Pose (2018) or Dijkstra et al. (2018) at more aggregated spatial levels, there are geographical patters in the raise of the populist movements, Euroscepticism or in the loss of trust in European and national institutions. In this paper we try to shed light about this geographical patters of the *discontent* by means of the interpretation of our *DIFF* variable, see equation [6], combined with the intra-local disparities measured thought the Theil index. But, before entering in the analysis of these two main variables of our approach, a brief review of the rest of the variables will be presented.

The previous literature remarks the relevance of the demographic and cultural/educational dimensions as well as socioeconomic conditions. Our results working with information at local level (LA) totally confirms most of the previous conclusions, normally obtained at regional level. Regarding the demographic structure, the average age of the LA is significant with

positive sign indicating that the older is the territory, the greater the vote in favour of the Brexit. We also identified that a higher share of native population in the LA corresponds to a higher taste for leaving. The educational structure is also significant and with a negative sign witch means that the lower the average level of education of a LA the larger is its support for the Brexit. In general all these results are coherent with the conclusions of previous works such as Crescenzi et al. (2017), Arnosson and Zoega (2016), Clarke and Whittaker (2016), Harris and Charlton (2017), Manley et al. (2017) and Scruton (2016), among others.

Regarding the socioeconomic dimension what our results indicates is that the decision to vote in favour of leaving the EU has been as influenced by economic factors as much as by the cultural and demographic factors, in line with the main conclusions of the previous works of Arnosson and Zoega (2016), Becker et al., (2016), Crescenzi et al. (2017), Hobolt (2016) or, among others, Los et al. (2017). For example, the percentage of families with house ownership, which can be used as a proxy for the household welfare, is significant and with a negative sign showing that those families with favourable conditions at home are less prone for voting in favour of Brexit.

Likewise, the occupation level of the territory affects significantly and with a negative sign the percentage of votes in favour of Brexit. Additionally, we observe that the general conditions of the labour market also have a relevant effect. The results with these two variables clearly indicates that the areas with labour markets more affected by crises, specially the long-run crises, tend to reveal their discontent by voting against staying in the EU. This result is plenary consistent with the conclusions obtained by Clarke and Whittaker (2016): higher employment levels are associated with lower propensity towards leave, suggestive that unemployed people were more prone towards Brexit than those with safe salaries and jobs.

It is particularly interesting to observe how the structure by economic sector of the local areas affects electoral decisions. What is identified in our approach is that in the LAs with higher presence of industries more exposed to the immigrant workforce, especially the construction sector, there are a raise of the pro-Brexit vote. However, many of these sectors are, at the same time, the ones that benefit most from belonging to the European single market. This result is particular coincident with the thesis defended by McCann (2016): the general public did not understand the profits derived from the Europeanization but the magnified the impacts of globalization or immigration over their economies.

In summary, our analysis allows us to conclude that when we descend to the local scale (LA) the main conclusions obtained in previous works developed in a regional dimension are maintained and, in some cases, more evident.

However, the most important contribution of this work is to identify the influence that spatial inequalities in this local scale have had on the decision of the pro-Brexit vote. It was possible thanks to the use of the new dataset generated in the framework of the H2020 IMAJINE project (see section 3.3). To date, given the absence of income data in this local scale, it was not possible to carry out an analysis of this type. We can incorporate the spatial inequalities in our analysis by means of two ways: first using a Theil index which allows us to measure the intensity of inequality within each local unit (LA) and second using a new index, called *DIFF*, that we have proposed in this paper, see section 3.2 and equation [6], that allows us to measure the level of inequality of a LA with those of its surroundings.

The inequality within each local unit, inside each LA, is significant and has a positive effect over the percentage of leaving vote. Its means, the greater the internal inequality (measured through a Theil index) is, the greater the vote in favour of Brexit. However, this variable is only significant at 10%, one of the lowest levels of significance in all the estimation. This is an understandable result because when we descend to the highest possible level of spatial disaggregation (LA) in many cases the spatial units are very homogeneous internally, which makes the variability of the Theil index reduced and, therefore, it generates a lower explanatory capacity of this variable. Taking this into account the occlusion should not be that the

differences within the territory are not relevant but if we use very disaggregated and homogeneous units these differences are smaller and, therefore, less explanatory.

On the other hand, the variable that we have called *DIFF*, which has been defined as the relative average difference in the local average income between LA and its nearest fifteen neighbours (equation [6], section 3.2), is highly significant and negative. This means the relative position of each LA in relation to its closest neighbours has had a clear influence on the referendum voters. According with our results, when the average income of their LA is above the average income of the LAs in their surroundings, the percentage of votes in favour of remaining in the EU tends to rise. However, when the average income of their LA is below the average income of the LAs in their surroundings, there is an increase in the percentage of votes in favour of leaving the EU. When we talk about the comparison of the income of a LA with those of its surroundings in the context of a country like the United Kingdom, with a strong metropolization along several large cities, mainly around greater London area, we mainly are referring to the comparison between the peripheral places and the central ones of these metropolitan areas. Therefore, what are basically indicating our results is the discontent that tends to be generated among the peripheral local areas in front of the great development and hoarding of activity of the great metropolitan centres.

From our point of view, this result serves as empirical evidence on a local scale of two of the most important theses aimed at the general causes of the success of Brexit proposed from the *geography of discontent* literature, that are very related among them.

On the one hand the thesis of McCann and others, presented in several previously quoted works, see McCann (2018) for a summary. Phil McCann agues that an important part of the Brexit's success was due to what we can called as the 'pro-leave narrative': the EU benefits the 'metropolitan elites' while the other areas have not benefited from belonging to the single market. As McCann himself points out, this discourse is not real, but the existence of inequalities in very close metropolitan spaces, which would have occurred independently of belonging to the EU, gives an apparent evidence in favour of this 'narrative'. The results founded with our *DIFF* variable gives empirical support to this thesis.

On the other hand, in an even more evident way, we believe that this result clearly supports the thesis of Rodríguez-Pose and others, see Rodríguez-Pose (2018) for a summary, of a kind of 'revenge of the places that does not matter'. The idea of Adrés Rodriguez-Pose was formulated in a national level, in the comparison between economically successful regions again the places specialized in activities in crisis and decline. However our results show that this dynamic occurs in an equal or more intense way in the local scale among LAs. Using the argumentation of Rodriguez-Pose, the persistence of inequalities in the local environment, many times lower than those that occur at the national level but more easily observable, generate a climate of *discontent* with the institutions that ends up in a punishment vote against projects such as of the EU. This happen despite the clear emphasis of the European institutions on correcting such inequalities.

It is interesting to note that the EU is not responsible for the spatial inequalities generated at the local scale. This is something associated with the concentration processes around large cities, a macro global trend. Even more, the institutions of the EU, as it tries to articulate policies of economic, social and territorial cohesion, tend to reduce these processes of concentration. Again, it is clear that it has generated a climate of magnification of the negative effects of globalization/integration without appreciating the positive effects of the policies of territorial cohesion of the EU.

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