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Voting with Your Feet or Voting for Brexit: The Tale of Those Stuck Behind

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ABSTRACT
This paper promotes the idea of a culturally-sensitive Tiebout-Hirschman-Rothschild mechanism underpinning the UK's 2016 Brexit result. Our Culture-Based Development (CBD) model asserts a trade-off between two rival types of voting: voting with one's feet or voting in a radical way due to being unable to vote with one's feet, akin to a protest vote. We explore the effects on the Brexit vote of shares of public spending on culture and a particular type of migration dynamic that triggers social closure. Our findings reveal that strong support for the Leave campaign was encountered in areas with lower local government expenditure on culture and in areas with higher outflows of UK residents. Previous literature had found that left-behind places and places with concentrations of highly educated commuters are the pro-Brexit nests. Our CBD mechanism of perceived relative deprivation offers a reconciling explanation of these seemingly controversial findings.

1. INTRODUCTION

Underdeveloped localities that experienced higher levels of deprivation, sometimes referred to as places that are 'left behind', are believed to have experienced higher pro-Brexit vote shares but the mechanism for this voting result remains unclear and untested. Other research, such as Dorling (2018), suggests an alternative explanation for the Brexit vote, such that it was the 'middle class commuter county' that voted for the Leave campaign. This paper takes the left behind hypothesis one step further by exploring why using social capital to climb out of

deprivation (which happened in Italy, see Putnam, 2000) may not work in the UK and that the result is instead a radicalized, protest vote. We propose a mechanism that combines the migration aggregate sorting-related model of 'voting with their feet' (Tiebout, 1956) and the context-sensitive individual behavioural 'tunnel vision' model of relative inequality and radicalization (Hirschman and Rothschild, 1973).

Migrating away from localities with relatively poor public good provision and lower wages and towards areas that are more endowed with greater public provision and higher wages is the essence of Tiebout's (1956) 'voting with their feet' model. It appeared under the title of the 'theory of public expenditure' since its core idea revolves around people sorting themselves in space according to preferences for the handling of local public endowments. However, we note here that individuals who are able to 'vote with their feet' are the self-selecting ones, who are likely to have better skills, greater entrepreneurial spirit, higher chances to succeed, and are motivated and convinced that they have better prospects in an alternative, better-off area. Meanwhile, there is also the group of those who remain in the undesirable areas, and our model suggests that the attention should be focused on them. The reason for this attention becomes particularly clear, when the state of the people remaining in a locality in times of economic crisis and stagnation is considered from the perspective of Hirschman and Rothschild's (1973) destabilized 'tunnel vision' model. In their 'tunnel vision' model the perception of stagnation (being 'stuck') in a state of relative deprivation leads to riot behaviour. The aim of this paper is to investigate the hypothesis that those who were 'left-behind' voted for Brexit as a form of social riot-behaviour, with that behaviour being triggered by the perception of residing in a relatively deprived location due to the outflow of migrants. The microeconomic underpinnings of the proposed mechanism are that the outflows of other incumbent populations who take a chance on social mobility create a perception in the minds of those left behind that they reside in a location with greater relative deprivation so that they are not only 'left-behind' but also 'stuck behind'. The resulting psychological pain from the perception of relative deprivation triggered the pro-Brexit vote.

To test our hypothesis we compile a dataset at the Local Authority District level comprised of Brexit vote shares, local public expenditures related to culture, and in- and outflows of migrants. Application of a variety of methods, including three stage least square models and finite mixture models, reveals empirical support for a Culture-Based Development (CBD) behavioural mechanism, focused on the cultural local endowment and its impact on local economic development (see Tubadji, 2012, 2013). More precisely, we focus on the explanatory power of the interaction between cultural public spending and a particular

immobility-related local setting (triggering feelings of relative deprivation and social closure) which result in the pro-Brexit vote.

This paper has the following structure. Section 2 reviews the literature on the left behind Brexit hypothesis and its alternatives. Section 3 builds on the contributions of Tubadji (2012, 2013) and Tubadji and Nijkamp (2019) to generate our novel mechanism underpinning the left behind hypothesis based on the 'voting with their feet' and 'tunnel-vision' theoretical models. Section 4 describes the data and estimation strategy. Section 5 communicates the results and Section 6 concludes.

2. 'VOTING WITH THEIR FEET' AND OTHER BREXIT HYPOTHESES

The consequences of Brexit have been discussed fastidiously in the country- and regional-level academic literatures with particular foci on the stock market, FDI and trade flows (Corbett, 2016; Los *et al.*, 2017; Ramiah *et al.*, 2017; Dhingra *et al.*, 2018; Lankhuizen and Thissen, 2019; Perraton and Spreafico, 2019) and the resilience of localities (Martin and Gardiner, 2019). However, the cause of Brexit vote has remained a moot point. Although the literature offers several potential explanations, most of them build on an empirical association rather that a theoretical causal mechanism.

Causal explanations of the Brexit result can be grouped along two axes: an economic system vector and an individual (human) vector. The economic system vector encompasses (i) the left-behind hypothesis (economic development slack for some groups and/or places, i.e. relative deprivation), (ii) austerity and public spending cuts (i.e. absolute public impoverishment), and (iii) inequality and poverty (i.e. absolute individual impoverishment). In the context of economic deprivation and growing cultural diversity, the individual (human) vector includes (a) demography, (ii) skills and human capital, (iii) culture[1], attitudes and values, and (iv) immobility. Between the lines of these possible explanations is accumulating evidence for the well-known 'voting with their feet' hypothesis, but this scenario seems to be overlooked and underdeveloped as a possible explanation for the Brexit result.

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[1] Culture is defined in this study according to the definition used by the Culture-Based Development (CBD) paradigm, which suggests that culture is the local amalgamation of material and immaterial, inherited and contemporaneous (contemporaneous living-related) local attitudes. The greater the accumulation of cultural capital in a locality, the bigger the bias that it exerts on socio-economic choices in that locality. See Tubadji (2012, 2013) for a detailed elaboration of this definition and its conceptual underpinnings.

2.1 Economic system vector

Part of the literature seems to assume that Brexit is driven by a development of the economic system at the aggregate level. While evidence for the left behind (economic development) hypothesis exists at both the regional and individual levels, as a phenomenon it is mostly regional in nature. Rodríguez-Pose (2018) demonstrates the association between relative regional deprivation and local radicalization across different countries, which is consistent with the general theory and evidence on the geography of discontent in the UK and across European countries (McCann, 2019; Dijkstra *et al.*, 2019). This perspective has strong links with the political economy literature with deeper exploration into voting and discontent[2] for which there is now a wealth of evidence (see Los et al., 2017; McCann, 2018; Billing et al., 2019).

Austerity (which is a shock to economic development) was also documented by Fetzer (2019) as a factor associated with various measures of radicalization and pro-Brexit voting behaviour. Leveraging voting data since 2000, Fetzer demonstrates that facing austerity at individual or local levels always appears to be accompanied by the same type of voting result. These findings seem in line with more general findings about the effects of austerity on voting behaviour in other localities such as in the USA (Alesina *et al.*, 2011) and in Greece (Tubadji and Nijkamp, 2019).

Inequality, and especially perceived inequality, has been documented by Liberini *et al.* (2019) as a trigger for the Brexit vote. They illustrate the importance of perceived relative deprivation (as compared to the actual financial state of the individual) as a factor for voting for the Leave campaign in the Brexit referendum.

2.2 Individual (human) vector

The importance of the individual level (i.e. the human factor) has been considered to be a significant motivator to vote for Brexit both from its demographic aspects, rational practical constraints, culturally-biased perspectives, and international and domestic migration points of view. Sometimes this human/cultural factor in voting has been referred to as a second level (where the first level are economic considerations) in the analysis of voting in the USA and France (see Ogorzalek, 2019; Mulroy and Ogorzalek, 2019). While there are many extensions of this broader cultural/human category, such as ecology strategies, trade unionization and even

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[2] This starts with the notion of mutiny as suggested by Collier (1963) and Bernstein and Crosby (1980) and continued into more recent work by Benabou (1996), Rodriguez (1998), Barrow (1999), Stiglitz (2020) and Gibson (2003) among others.

psychological health and suicide (see Kiewiet, 2013; Coderre-LaPalme and Greer, 2018; Steeg, et al., 2020), these are derived aspects, endogenous to and related to the inequality between human demographic strata in a Polanyi tradition of opposition (Hopkin, 2017). There is even evidence that poverty obscures the concerns about the natural environment (Dasgupta et al., 2002; Hollander 2003), and thus cultural attitudes are endogenous to economics. Most importantly however, it seems that many of these concerns for voting are derived from inequality on the economic market. These issues have great complexity and there are accounts of individuals which suggest that inequality might be creating a partisan voting behaviour not among the poor but among the rich residents (Coles, 2016). Above all, these issues are context-sensitive and derived from the state of inequality. We avoid these economically endogenous derived aspects of the cultural-human factor and focus instead on purely demographic-related issues.

Demographic-related arguments prominently emphasise the importance of age in the Brexit vote, with the young strongly associated with the Remain vote (Clarke and Whittaker, 2016). A sizable portion of the literature engages with gender issues and the male dominance behind pro-Brexit nationalism (Haastrup et al., 2016; Abdou, 2017; Nicholas and Agius, 2017; MacLeavy, 2018). While this is a very relevant demographic aspect at the individual level, at the regional level the gender question gets confounded with the gender gap and inequality in the labour market, and disentangling the economic endogeneity that occurs if one attempts to account for gender as a source for voting at the regional level becomes very difficult to identify. Population, space and service capacity constraints on an island territory have also been proclaimed in politics and media as factors that strengthen the 'population bomb' view that immigration is a considerable and immediate problem in a similar way as has been voiced across the EU (Gietel-Basten, 2016).

The economic literature has interpreted these concerns from the human capital, internal migration, and culture and values towards diversity perspectives. An association between human capital and the pro-Remain vote has received wide empirical support (Becker *et al.*, 2017; Calvert Jump and Michell, 2019) and human capital is recognised widely as key for the policy transformation of the country and Europe (Bachtler and Begg, 2018).

Migration issues (in terms of the culture and values they embody) have primacy in the Brexit discourse. They are often cited to support anti-immigrant and xenophobic attitudes, nationalism or populism that are associated with the pro-Brexit vote (Inglehart and Norris, 2016; Rzepnikowska, 2019; Bulat, 2019). The migration question also interacts with different

migration patterns of female workers both in comparison with male and between high and low skilled female workers (Bailey and Mulder, 2017; Shutes and Walker, 2018).

The cultural narrative appears in the literature as a factor that operates at the local level. Using a case study of Liverpool and the Wirral, Nurse and Sykes (2019) elucidate that localities with similar economic conditions reacted differently to economic triggers for Brexit because their exposure to different narratives was interpreted from different location-specific and culturally-historic contexts. Consistent with this line of thought are studies of individual perceptions and subjective wellbeing that seem to have associations with Brexit (see Powdthavee *et al.*, 2019). Further, D'lotko *et al.* (2019) demonstrate that there were much greater cultural and socio-economic heterogeneities in the Remain vote than in the Leave vote.

A Culture-Based Development (CBD) approach (Tubadji, 2012, 2013) has been advanced by Lee *et al.* (2018) who advocates that Brexit can be explained by an interaction between personal characteristics and changes in local economic and cultural diversity due to migration. Lee *et al.* (2018) find strong association between immobility and the Brexit vote, mediated by economic decline and experienced cultural diversity changes (specifically a demographic change in non-white British migration). However, these interactions between local and personal characteristics, as well as their underlying mechanisms, remain largely undocumented and insufficiently clarified, and hence it is unclear whether they could be mediated by policy interventions.

2.3 Voting with their feet

Against the background set out above, it is somewhat surprising that Tiebout's (1956) 'voting with their feet' hypothesis has not been developed in the Brexit-related literature. Coined by Tiebout (1956) and later integrated into the creative class concept by Florida (Florida, 2002; 2005; Florida *et al.*, 2017), the 'voting with their feet' hypothesis assumes that people move away from places which they deem to provide insufficient amounts of public spending, but self-select to migrate to places that according to their preferences provide the preferred level of public spending. As immobility was associated with the Brexit vote (Lee *et al.*, 2018), it is plausible that this mechanism is operating across the UK.

Here we build on Tiebout's (1956) 'voting with their feet' hypothesis and do so with a theoretical twist. When people are able to vote with their feet due to a mismatch between their received and desired local public spending levels, it leaves behind in the locality a proportion of people who were unable to vote with their feet. Additionally, we underscore that Florida's

Creative Class take is predominantly focused on the cultural spending (and Bohemian occupations as he states it) related to the cultural endowment of a place, but this is done with the assumption that cultural spending signals to a migrant a culturally tolerant local milieu. In essence, the Creative Class assumes that the most creative human capital is most sensitive to culture-related amenities. It is also known that austerity policies lead to the closing down of many libraries and community centres throughout the UK. Therefore, we seek to identify whether there is empirical support for the 'voting with their feet' hypothesis around the Brexit vote and explicitly seek to identify if an association exists between cultural endowments and austerity measures, migration outflows from a locality, and its pro-Brexit vote. This mechanism is grounded on the assumption that lower migration outflows and higher cultural-spending austerity measures in a locality are associated with an inability of individuals to vote with their feet against austerity cuts. This hypothesis becomes even more pertinent given that poorer localities faced more severe cuts to local public spending (Innes and Tetlow, 2015).

3. THE CBD MECHANISM BEHIND THE LEFT-BEHIND VOTE

The Culture-Based Development (CBD) paradigm suggests that the cultural factor is a complex in composition proto-institution that activates all other institutional and economic factors in the economic system and is hierarchically superior to them (Tubadji, 2012, 2013). When applying this CBD paradigm to understand the reasons for the radical pro-Grexit vote in Greece, Tubadji and Nijkamp (2019) propose the so-called Dogville Effect. The Dogville Effect is the state whereby perceptions of deprivation due to economic austerity measures determine the speed and spread of radicalization of places. Akin to this Dogville Effect is the J-curve hypothesis in the sociology literature attributable to Davies (1962). The J-curve hypothesis suggests that short and sudden declines of previously stable and flourishing economic growth rates lead to social and economic revolutions/unrest. The J-curve was investigated empirically by Sivrikaya and Ongan (2019) and found to have strong compatibility with Brexit data, which implies that the Dogville Effect may as well exist as a phenomenon behind the Brexit vote too.

However, neither the Dogville Effect nor the J-curve hypotheses explicitly detail the mechanism that explains why and how the unrest occurs. This paper focuses on the human factor and its immobility as a potential underlying trigger for a psychological mechanism generating the unrest, and applies this to data on the pro-Brexit result. Specifically, our proposed mechanism does not highlight the respective roles of immobility and austerity (which is a temporary state), but rather emphasises the importance of immobility and inequality in

times of austerity. Below we amalgamate two seminal works on mobility and inequality into one model, which we call the Tiebout-Hirschman-Rothschild model, where migration-related behaviour reacts to public spending cuts to culture in times of austerity.

Hirschman and Rothschild (1973) offer an alternative to the J-curve hypothesis and employ what they coin a 'tunnel effect'. This tunnel effect relies on the concept of hopefulness in a state of inequality, which is expected due to being signalled as likely by personal socio-economic mobility. However, the authors' model implies that once the hope for inter-personal catch-up is replaced with a feeling of being left behind in a position of insurmountable inequality, then social unrest will occur. Davis (2019) formalizes this model and offers ideas for its empirical operationalization, but Moller's (2011) test of several hypotheses related to the tunnel effect revealed no strong corroborating evidence in Africa. A reason for a lack of supporting evidence in Moller's work may be due to their inability to capture effectively a key trigger behind the switch between a feeling of hopefulness and the feeling of being left-behind, which we suggest is articulated by Tiebout (1956), specifically the 'voting with their feet' mechanism.

Tiebout (1956) offers his famous model based on several assumptions, and a prominent one among them is that people are perfectly mobile and express their support for public good spending in a locality by choosing to move to live there. As put by Tiebout (1956, p.418), this is a model about the voter where "The consumer-voter may be viewed as picking that community which best satisfies his preference pattern for public goods". In the UK, a significant proportion of public expenditure was cut due to austerity measures after the 2008 global recession, and hence the Tiebout model could be highly applicable for the UK. Moreover, the Tiebout model suggests some intensification of mobility related to public good endowments. As is known from the Harris-Todaro model, however, the attractor of mobility is also wages, which are related to skills. Thus, certain individuals are not equipped with the right skills and education to be mobile according to their preferences for public good spending. The (relatively) lower skilled are then likely to be the ones who are unable to 'vote with their feet' against local austerity measures when they do not like the level of public spending in their locality, and hence they will feel stuck behind. Those stuck behind in localities that have inferior local public spending (in comparison to the individual's personal preference levels) will be triggered to switch from hopefulness for inter-personal catch-up to feeling left behind in a relatively deprived area. Thus, we suggest here that migration outflows from a locality with large public expenditure austerity cuts are likely to trigger higher shares of pro-Brexit votes by those stuck behind who cannot vote with their feet. We suggest that the protest vote

happens because higher intensities of outmigration signal higher degrees of relative deprivation for those stuck behind.

Finally, our proposed model builds on an element of Tiebout (1956) that has been adopted by Florida (2002a, b; 2005), specifically public investments in culture. People's preferences for public goods are suggested to be related to better socialization and high culture, which are traits related to Bohemian cultural production and consumption, and are also related to Veblenian goods that are important for socio-economically mobile individuals from poorer to richer localities[3]. Florida (2002a, b) reformulated this into the Creative Class hypothesis that highly educated people vote with their feet towards places with higher concentrations of Bohemian occupations that signal a more tolerant local milieu. While Moeller and Tubadji (2009), Fritsch and Stuetzer (2009), Alfken et al. (2015) and Brunow et al. (2018) as well as many others demonstrate that human capital follows wages and not the concentration of Bohemians in a causal manner, the second part of Florida's claim that the concentration of Bohemians signals a more tolerant milieu (see Florida et al., 2008) has not been contested empirically. Here we suggest that the provision of greater public good spending on culture might be a local signal for the creation of a more tolerant milieu that can attract human capital in places beyond the wage attractiveness of their profile, and can thus explain the heterogeneity of the protest vote in places where wage levels were attractive to stay, but the loss of tolerance-related public spending reached unacceptable levels[4].

Based on the above, we suggest an augmented Dogville-Effect CBD model of a human behavioural response to economic conditions and their changes in a locality. Specifically, we model the Brexit vote as a function of public spending on cultural goods and migration as stated in model (1):

$$BREXIT = \alpha + \beta_1 \, Public\_Good\_CULTURE_i + \beta_2 \, MIG_i + \beta_3 \, HC_i + \beta_4 \, X_i + e \qquad (1)$$

where α is the constant, *BREXIT* is the percentage of the protest vote supporting the Leave campaign in the Brexit referendum, *Public_Good_CULTURE* is the amount of austerity exercised on public good spending related to culture, and *MIG* is migration. The migration component has a compositional complexity, as **intra**-country **out**migration of individuals from one's own group may trigger the stuck behind feeling for those remaining in the locality and

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[3] Veblen and Harris-Todaro models originally made this distinctions between rural and urban areas.
[4] Here even some highly educated might feel 'stuck' if they could not migrate to a locality with an agreeable wage level.

inter-country *in*migration may exacerbate this feeling since the arriving individuals in the locality are of a different identity and are perceived as experiencing socio-economic mobility, while the locals themselves cannot partake in such a process and need to compete for the local opportunities with newcomers from a different cultural group; the latter is sometimes referred to by populist parties as the 'displacement' argument or is elsewhere called social closure (Weber 1922). Thus, net local outmigration is an alternative operationalization of this component of our model. *HC* is the local concentration of human capital and the *X* component represents economic characteristics of the locality related to wage levels and captures the desirability of the locality (such as physical capital, size of the labour market, etc.). Our model suggests that an interaction between a specific type of net migration, local human capital and public spending on culture is what ultimately identifies the triggers of the votes for the Leave campaign in the Brexit referendum.

The above CBD model sees voting as a behaviour and models the trade-off between two types of voting: voting with one's feet versus voting for the Leave campaign due to being unable to vote with one's feet. This model motivates the following testable hypothesis:

H01: The share of the Leave vote in the Brexit referendum is driven by the interaction between local austerity on culture, migration and human capital.

4. DATA AND ESTIMATION STRATEGY

To operationalize model (1) and its related working hypothesis, we compiled a dataset relating to Local Authority Districts (LAD) across England[5]. The main outcome variable is the vote share that supported the Leave campaign in the 2016 Brexit referendum. The main independent variables are: (i) culture-related public expenditure (labelled '*public spending: culture*') and (ii) three migration variables labelled '*total_inflow_foreign_immigrants*', '*total_outflow_uk_residents*' and '*net_mobile*', where the first and the second are the inflow of foreign immigrants and the outflow of UK residents in the respective locality over the period 2010-2016, and *net_mobile* is the difference between the aforementioned inflows and outflows thereby signifying the number of people that are visibly mobile to the people left behind in

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[5]   Omitted observations for specific variables meant that we had to drop the following LADs from our analyses: City of Bristol, City of London, East Hertfordshire, East Riding of Yorkshire, Eastleigh, Gateshead, Hartlepool, Country of Herefordshire, Kingston upon Hull, North West Derbyshire, North West Lincolnshire, South Derbyshire, Northumberland, South Derbyshire, South Ribble, Southampton, Southwark, Spelthorne, St. Albans, St Edmundsbury, Stevenage, Welwyn and Hatfield.

each LAD. We complement these variables with all the main variables of an endogenous growth model[6]. We also include the LAD's mean income (to approximate for the local wage effect) and its degree of rurality (in terms of percentage of territory in rural areas) in order to express the Tiebout voting in terms of the classical determinants of the Harris-Todaro (1970) model of mobility. Details of further control variables, including our two measures of the Index of Multiple Deprivation, are provided in the Appendix 1 along with their correlations in Appendix 2.

Figures 1 – 4 present two-way scatterplots between the pro-Brexit vote share and the natural logarithm of our variables of interest, thus considering the latter in relative terms (in order to distinguish the migration and cultural spending volumes from the size of the locality effect in this pairwise comparison). Maps in Figures 5 – 8 show the spatial distribution of these variables across the LADs. We notice that the LADs that recorded higher pro-Brexit vote shares also experienced relative low inflows (figure 1) and outflows (figure 2) of migrants between 2010 and 2016. Similarly, those LADs with higher pro-Brexit vote shares also experienced lower public spending on culture. Interestingly, the LADs that recorded high pro-Remain vote shares also experienced greater net migration of residents. We interpret the latter as a strong indication that perceived deprivation (and feelings of less upward mobility, i.e. feeling stuck behind) due to more intensive salient net outmigration (associated with relocation to more attractive localities) is a factor that was associated with the Brexit result. When relatively more people emigrated than immigrated in one's locality, this can be perceived as less upward mobility in one's locality, since more people desired to move out of it and fewer people desired to come in to it[7], plus the local competition includes newcomers from a different identity group.

Finally, our descriptive analysis considers the spatial autocorrelation of the main variables of interest according to our Tiebout-Hirschman-Rothschild model: upward net migration, public spending on culture, and the pro-Brexit vote share. We use a distance based spatial matrix and Anselin (1995) technique to look at a Moran's I scatter plot and a local spatial autocorrelation (LISA maps) in order to identify hot and cold spots (i.e. to identify spatial clusters of areas of higher or lower than the average value of a variable). This allows us to distinguish areas of positive and negative spatial correlation and areas surrounded with the reverse pattern to their

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[6] Labour and physical capital are measured in levels to reflect the size of the local economy while human capital is measure in percentages.

[7] This is a rationale for desirability associated with the literature and models on housing market and segregation, where people either substitute 1:1 in housing markets through migration or else some preferential sorting and segregation is considered to be taking place; see Boustan (2007, 2013).

own compared to the global average level. The results are presented in Figures 9 to 11 below. It becomes apparent that the centre of migration is around London and public spending on culture was much more spatially heterogeneous than migration. There are two main insights from this perspective on the data. While all variables seem to have certain degree of spatial correlation, both explanatory variables in our model seem to have a lot of outliers and these are opposite in pattern across the two variables (predominantly, high-high for culture and low-low for migration). This is consistent with our expectation that the two variables have an inverse relationship. Second, the local spatial effects between culture and the pro-Brexit vote share seem to be more closely associated than are the spatial patterns between the Brexit vote and migration data. While these are interesting insights, we should not forget that this is not related directly to the process described by the data, and we shall return to spatial econometrics in our robustness checks to identify autocorrelations and correlations in the error that remain invisible for other methods.

4.1 Estimation strategy

The estimation strategy is motivated by our theoretical expectations and the limitations of a cross-sectional dataset, although some variables, including the migration-related ones, reflect cumulatively the period preceding the Brexit vote and thus can be considered less directly dependent on the current cross-sectional measure of economic development.

The estimation strategy follows three steps: (i) a cross-checking for the presence of the main CBD mechanism behind the CBD model (1); (ii) an exploration of the main mechanism through interaction terms between the two main components of the mechanism, which are the migration and the culture-related public spending variables; and (iii) an investigation into the link between the cultural spending and migration mechanism on the one hand and the Brexit vote on the other hand, which disentangles as much as possible potential endogeneity issues using available data.

Our first step uses OLS estimations with robust standard errors to explore the responsiveness of the pro-Brexit vote to (i) public spending on culture, (ii) inflow and outflow of migrants, (iii) net mobility, and (iv) the percentage of highly educated people in addition to the migration, as the Tiebout and Creative Class models imply that the highly educated are highly sensitive to public spending on culture.

In our second step, we apply the OLS estimator with robust standard errors to test a model that includes all of the components of the CBD mechanism that were tested separately in step 1. We augment this model with an interaction term between the cultural public spending and the migration flow variables, and then further augment the model with a variable that interacts cultural public spending, migration flow and human capital variables. We use the physical capital and employment variables to account for local economic prosperity and controls for rurality and deprivation throughout this step.

We implement four robustness checks to the initial estimations of our Tiebout-Hirschman-Rothschild model. These are as follows. The first robustness check regards the endogeneity of culture and migration to the economic process. Although out-migration variables cover a cumulative period of 2010-16, Appendix 2 shows that there remains a high level of correlation across the variables which might introduce some bias in the estimation results including all of our theoretically justified determinants of the Brexit result. Therefore, we employ a third step in our estimation strategy in an attempt to disentangle the potential endogeneity issues by using a three stage least squares estimator, where in the first equation we model net migration over the preceding seven years explained by the Tiebout-relevant determinants of mean wage and rurality; then, in the second equation, we model the pro-Brexit vote share using as its determinants the net migration outcome variable of the first model together with the endogenous economic growth model related variables. Hence, we use a recursive framework that is statistically-justified given the historic nature of our migration variables covering the period 2010-2016.

The second robustness check regards the spatial autocorrelation of dependent and independent variables, which informs on the importance of historic lags of the dependent variable and omitted regional factors. To this effect, we employ a spatial lag and spatial error model for the first and second equation of our 3SLS model, considered separately. The spatial lag model can indicate whether our model is sensitive to autocorrelation that might occur due to our migration variable being an average of several years. The spatial error model instead can capture the presence of eventual additional spatial factors present in the error term that the standard model cannot detect. In case we detect any of these spatial effects, we will address them respectively using historical lags in the 3SLS setting or adding additional explanatory variables to better specify our Tiebout-Hirschman-Rothschild model.

The third robustness check decomposes the migration variable by years. It aims at capturing the importance of migration lags for the estimated effects in the model. This approach is also compatible with Robustness check 2, as described above.

The fourth robustness check compares alternative population change hypotheses that may shed further insight on the results about our Tiebout-Hirschman-Rothschild model and its social-closure based trigger. Our original hypothesis has its roots in the sociological notion of social closure (see Weber 1922; Tubadji 2020) , where one group compares itself to people in the same place with a different identity, who are perceived as a competing group and whose prosperity triggers feelings of relative deprivation with the first group. The prosperity of the competing group is approximated in our study through size of between-group-mobility differences which is hypothesized by our Tiebout-Hirschman-Rothschild model to be the trigger of pro-Brexit voting behaviour. We approximated this trigger of social closure through a specific population mobility profile and dynamics, as previously explained, but indeed this is a very specific population change definition. That is why, as a last robustness check, we use the same empirical model, but instead of our precisely calibrated measure for social closure, we use the crude measures of population change and population mobility including all migration flows. This serves to compare and contrast the insights about population change and mobility per se and the particular social-closure-based trigger of the Tiebout-Hirschman-Rothschild model.

5. EMPIRICAL RESULTS

The CBD mechanism outlined in model (1) is composed of two main elements, migration and public spending on culture; we initially explore their individual explanatory powers on the pro-Brexit vote. In our first specification in Table 1 we address the relationship between public spending on culture and the pro-Brexit vote while in the remaining three specifications we explore migration and the pro-Brexit vote.

We estimate three separate specifications because migration could be understood in three separate ways. We could explore migration by directly including in a specification the inflow of foreigners and the outflow of locals, but it is also possible to explore the same issue by taking the net amount of mobile people who remained in the locality as a result of these in- and out-flow processes. Given Tiebout's and Florida's take on human capital, we consider the entire number of people who are able to vote with their feet and self-select for migration and then include both the net flow of migrants and the concentrated human capital in the locality. These results are presented in Table 1.

Table 1 provides supporting evidence for the CBD mechanism that is consistent with previous findings. Specification one suggests that LADs that spend more public money on culture were also more likely to have lower vote shares in favour of Brexit.[8] The results in specification two strongly support the CBD 'voting with their feet' hypothesis: the LADs that experienced lower outflows and lower inflows of migrants recorded higher pro-Brexit vote shares, and hence those LADs that saw more people voting with their feet – both inflows of foreign migrants and outflows of UK residents – also saw higher vote shares for the Remain campaign because their residents did not need to vote to leave the EU as a protest vote against lower public good spending levels on culture. Put differently, as long as people manage to sort in and out of an LAD, there will be fewer resident people interested in protest voting.

Specification three supports our interpretation of the Hirschman and Rothschild (1973) 'tunnel effect' model. It illustrates that those LADs that had greater net outmigration also consequentially had more people whose hopes for inter-personal catch-up would be replaced with a feeling of being left behind and hence voted for Brexit. This result is expected by the CBD model as well. The higher the number of outwardly mobile individuals, the greater the recorded pro-Brexit vote share. Put differently, the higher net number of leaving individuals is evidence for, on average, a less attractive local milieu. Those incumbent persons unable to leave less attractive places are naturally more likely to feel more strongly stuck behind, which is then reflected in a higher protest (pro-Brexit) vote.

The final specification augments specification three with the LAD's percentage of human capital and we hereby corroborate existing evidence provided by Calvert Jump and Michell (2019) that the association between human capital and the pro-Brexit vote is significant and negative. A further interpretation of this result is that the LADs that were left behind in terms of outmigration but also more prosperous (where prosperity is approximated by the concentration of (often higher-waged) human capital) were less likely to vote for Brexit. The fact that high human capital areas may also vote for Brexit is explained by our CBD mechanism by the importance of relative perception of deprivation, which does not respond to actual

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8   Further, we explored the relationship between the pro-Brexit vote and public expenditure on culture using a finite mixture model, both alone and in the presence of controls for endogenous economic growth (i.e. human capital, physical capital and employment). The finite mixture model revealed the presence of three groups of localities with lower cultural public expenditures (first or second level of cultural expenditures) where cultural spending is associated with the pro-Brexit vote again in a statistically significant negative manner that was consistent with our OLS results. However, in localities with the highest cultural spending there was no association between the Brexit vote share and spending on culture. These finite mixture model results are not presented here for brevity but are available upon request from the authors.

poverty but is driven by the voter's relative perception of one's position in comparison to identical peers. More broadly, this is consistent with the UK's dual reality of rural life, which is notably different from the USA, as in the UK rural areas divide into left-behind areas that are situated exclusively far away from cities and prosperous rural areas in proximity to bigger cities (Curry and Webber, 2012; McCann, 2019, 2020). In spite of their internal differences, both types of rural areas apparently suffer a relative deprivation syndrome when compared with the wealthiest urban areas.

All our post-estimation tests show that the specifications considered have good explanatory power and do not suffer multi-collinearity problems. The average VIF tests (presented in tables) are below the critical value of 10, as are the VIFs for all individual variables (omitted in tables for brevity but available from authors upon request).

Although these results are consistent with our underlying theoretical position, it is essential that the results survive a full test of the CBD hypothesis and specifically the inclusion of i) interaction between cultural public expenditures and migration, and ii) the presence of relevant control variables.

5.1 Inclusion of interaction terms

Table 2 presents four specifications. The first specification combines the main variables of the CBD mechanism – cultural expenditure and the specific in- and out-flows of migration – plus a bunch of relevant controls. The second specification expresses the same model, but instead of the in- and out-flows of migration we use the net difference between the net in- and out-flow as a quantification of the migration mechanism. The third specification adds interactions between the migration flow component and the cultural public expenditure in order to express fully the CBD mechanism. Specification four follows the Tiebout and Florida theoretical motivation to include further an interaction term between the cultural public expenditure and the percentage of human capital in the locality. The main components of the CBD mechanism survive the joint test of significance, but the sign of the effect of public expenditure on culture changes, which we expect is due to association between the two elements, as the migration flows are strongly correlated with the cultural public spending (this may reflect an endogeneity issue[9] that we will explore in subsequent robustness checks). Even with the inclusion of the control variables, the model behaves as expected with higher income LADs having lower pro-

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[9]   This endogeneity issue however is likely to be smaller here as the migration flows are for the period 2010 – 2016, while the cultural spending is for 2016.

Brexit vote shares and those LADs with higher unemployment rates also recording higher pro-Brexit vote shares, and both results are consistent with previous findings.

When we substitute the in- and out-flows of migration with their net difference in Specification two then we observe that the mobility and income variables become the only variables with statistical explanatory power. This corroborates our CBD model because it suggests that socio-economically mobile people, who can concentrate in richer LADs, are the ones that report greater Remain vote shares. This finding is consistent with the findings that some well-educated people might as well have voted pro-Brexit if they find themselves in poorer LADS that they cannot leave and are thus perceiving themselves relatively worse off than the educated in richer LADs. This is how the CBD mechanism brings together and explains the seemingly contradictory separate but robust singular finding existing in the literature that (i) human capital is negatively associated with the pro-Brexit vote, and that (ii) some higher-profile relatively wealthier areas also voted pro-Brexit. While the latter were wealthier than the entirely left behind, these areas were seen by their incumbents as worse off than the forerunners of the economy. This relative positioning creates similar stuck behind feelings as that of the inhabitants of lagging left-behind areas.

We should also note here that while the explanatory powers of specifications one and two are close, specification one has a higher R-square. This leads us to extend specification one with relevant interaction terms as in specifications three and four.

Specification three includes interactions between the migration flow and cultural public expenditure components, in order to express more fully the CBD mechanism. Specification four follows Tiebout and Florida theoretical motivations and further augments the model to include an interaction term between the cultural public expenditure and the percentage of human capital in the locality. From these two specifications, it emerges that the main driver in the CBD mechanism is the interaction between the outward mobility of local residents and the public investment in cultural goods. This finding is in line with Lee *et al.* (2018) and strongly supports our CBD mechanism which explains the findings in Lee *et al.* (2018) through a mechanism based on a culturally-sensitive Tiebout-Hirschman-Rothschild model. Neither the inflow of migrants, nor the concentration of human capital variables remain statistically significant after the inclusion of these interaction terms, which is consistent with previous findings that claim that foreign migration is not an essential cause of high Brexit vote shares. Nevertheless, our findings corroborate Möller and Tubadji (2009) assertions by countering Florida's claims that human capital migration follows culture rather than wages. This is also in

line with many leading creative class studies (see Marlet and Van Woerkens, 2007; Fritsch and Stuetzer, 2009; Alfken et al., 2015; Brunow et al., 2018).

While our results carry a strong economic meaning, public investment in cultural goods is endogenous to local economic development. Migration is also strongly associated with local economic development. Our VIF tests show that considering directly their interaction creates multi-collinearity in the OLS regression, and therefore we need to separate the cultural and migration effects and account for the local development (or under-development through deprivation indices) in order to disentangle this statistical ambiguity. For this purpose, we implement the following robustness checks for the economic meaning of the OLS results: employing a 3SLS technique, spatial econometric approaches and historic lags.

5.2 Robustness check 1

To address the potential endogeneity problem between the migration and cultural spending components in our model, we implement a three-stage-least-square empirical approach. We first model separately the dependence of the migration flows on the public spending on culture, and then we explain the pro-Brexit vote share with net migration. This is a particularly suitable strategy for our conceptual and empirical setting because the presence of socially mobile people transforms a positive 'tunnel effect' (Hirschman and Rothschild, 1973) into a trigger for a high pro-Brexit vote share when the LAD experiences economic stress as reflected in the austerity-related public spending. It is not problematic to include our migration flow variables in the second part of the equation, as they represent the period 2010-2016, and cultural spending is excluded from the second equation because it might be closely related to the local growth variables in 2016. Hence, accounting for the relationship between migration and cultural spending in the first stage but not including the cultural expenditure variable in the second stage of the 3SLS model allows us to avoid the endogeneity problem of expressing quantitatively our CBD mechanism.

The five specifications in table 3 differ only in the second part of the model and the differences are as follows. Specification one includes the economic growth-related variables of employment, physical capital and human capital. Specification two and three replace the economic growth-related variables with alternative indicators of multiple deprivation[10].

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[10] It is worthwhile to note there that the ranking of deprivation goes from one to infinity, where one represents the highest level of deprivation. Thus, in essence, the ranking of the Index Multiple Deprivation (IMD) shows lower deprivation when the number of the ranking is higher.

Specifications four and five amass the growth and deprivation indexes together, albeit including alternative indicators of multiple deprivation.

The results across all specifications in table 3 show a consistent message. The concentration of mobile people in a LAD during the period 2010-2016 is negatively associated with the area's cultural spending and mean income. This is a consistent finding because net migration, as seen from Appendix 1, is always a negative number, thus higher numbers represent fewer people to out-migrate from the locality in comparison to the numbers who in-migrate. Moreover, because the pro-Brexit vote is greater in LADs with lower productivity and greater deprivation, which both distribute unevenly across the UK, both factors explain the pro-Brexit vote without creating collinearity problems. Once again, our CBD mechanism manages to explain simultaneously why the less-educated and relatively less well-off places voted pro-Brexit, where the mechanism explaining consistently both findings is rooted in our version of the Tiebout-Hirschman-Rothschild model. This mechanism is based on perceptions of relative deprivation and it seems to successfully explain the Brexit vote and its related seemingly controversial findings. Perceived relative deprivation is understood here as feelings of being stuck behind in a place that is not a desired location for the incumbents to voluntarily sort into and which they cannot leave. Our CBD model shows that perceived relative deprivation and not the level of deprivation alone seems to be the most consistent explanation of protest voting.

Estimating a VIF test for the separate specification in our 3SLS model shows that we do not encounter any longer multi-collinearity in our model. Meanwhile, we manage to express the interaction assumed by the CBD model through using a recursive structure, where our measure for net flow of migrants is explained a priori by public investment in local cultural goods. Thus, using the variables' temporal specificities in a recursive system enables us to (i) account for endogeneity issues in cultural spending and migration, and (ii) account for the interaction effect from the former to the latter, avoiding the multi-collinearity from the simple OLS with interaction terms.

5.3 Robustness check 2

To address the potential spatial correlation aspects in the estimated model, we employ a spatial lag and spatial error model for the first equation of our 3SLS model, explaining the clustering of upward migration across the UK. Next, we estimate a spatial lag and spatial error models for explaining the spatial clustering of the pro-Brexit vote, or the second equation of our 3SLS

model. We always compare and contrast these results against an OLS estimation, in order to detect the differences between using a standard econometric technique versus the insight from the spatial regression. Results are presented in table 4.

As seen from table 4, while the concentration of upward mobility has evidence for both spatial error and spatial lag effects, the pro-Brexit vote exhibits only a spatial lag effect. We interpret this as a sign that both processes are clustered in space. However, while migration has many additional factors that affect it, the pro-Brexit vote does not seem to exhibit interference of further correlations in the error term. This means that we could consider our 3SLS model well-specified with regard to explaining the pro-Brexit vote with this set of explanatory variables. The modelling of the migration component however might benefit from further quantification effort. We therefore do one more additional quantification check with regard to this explanatory variable. Most notably however, while there seems to exist evidence for spatial effects, and the use of the different models affects the magnitude of the effects, still the general economic meaning of the results across the OLS and spatial estimations remains consistent.

5.4 Robustness check 3

Next, we give a further consideration to the upward mobility variable with regard to decomposing our initial aggregate measure (which summarizes the net migration in a five year period before the Brexit) into historic migration lags. The original and lagged estimations are compared in table 5.

As seen in table 5, our original 3SLS model (specification 1) can be transformed into similar models (across Specification 2 to 7) by breaking down the average upward migration (net move) variable into an identically defined variable but only for 2016, explained by several historic lags of the same variable. This historic-lags-approach helps to reveal the sources of autoregression that the spatial lag model highlighted. But meanwhile, using the historic lags spoils the recursiveness of the estimated 3SLS model as now both outcome variables are recorded in the year 2016. Thus, ultimately, we need to augment the model by including the public spending on culture in the second equation of our 3SLS model, where migration is handled separately in equation one and the historic lags serve as instruments for cleaning the endogeneity interferences with the cultural spending in equation two.

The results show that using a variable that captures the average level of migration over 2011-2016 allows to identify the local effect of culture on migration. If we quantify migration

through a variable informed only about a single year (namely 2016), then this affects the sign of the cultural variable which otherwise still remains significant. This is a clear sign of the interconnectedness between culture and migration levels within the same year. Involving historic lags for migration enables the demonstration that migration is strongly autoregressive not only across space (as we see in table 4) but also across time. This highlights that we need to estimate a panel data model in order to capture fully the endogeneity of culture and migration, if the data were available for the voting component of the model to enable this estimation. Finally, Specification 8 shows that the cultural component cannot be omitted from the model because it is significant for explaining the pro-Brexit vote. Considered altogether, these estimation results show that we have identified an optimal solution by using a variable that captures average level of migration over 2011-2016 as this variable is less directly dependent on the level of migration in 2016. This creates a temporal distance between our migration and cultural values as statistically the time of occurrence between spending on culture and migration variation are now different. Finally, the results seem to suggest that we have good reasons to believe that both migration and culture affect the pro-Brexit vote as suggested by our Tiebout-Hirschman-Rothschild model.

5.5 Robustness check 4

Finally, we check the explanatory power of alternative populational-change-related hypotheses that may seem similar to our original Tiebout-Hirschman-Rothschild model. Our check entails two alternative procedures.

First, we re-estimate our results from Table 1, 2 and 3 by adding as an additional control variable the overall population change due to migration. The results show that the overall change of population has a very limited explanatory power with regard to the pro-Brexit vote. It manages to register significance only after a substantial amount of other control variables are accounted for in Table 2. Meanwhile, across all specifications, the crude measure of population changes never affects significantly the performance of our main social-closure variables of interest and even strengthens the performance of the cultural variable.

Second, we re-estimate Table 1, 2 and 3 by entirely substituting our social-closure measure with all the available in and out-flows of migration, of both international migrants and UK home migrants. The new results depict a somewhat consistent economic take, where it seems that the different flows and their net values have certain significant association with the pro-

Brexit vote but a consistent story is difficult to emerge when all these more crude measures of the migration flow are accounted together as the signs of impact change across specification. Cultural spending however retains significance. We consider that these findings demonstrate that culture, international and internal migration flows do matter for Brexit, but only our filigree net migration measure that finely captures the social closure effect manages to elicit a consistent mechanism on regional level. Result tables for Robustness check 4 are not presented in the paper for brevity but are available from the authors upon request.

6. CONCLUSION

This article suggests a culturally-motivated CBD model of protest voting driven by perceived relative deprivation. Our operationalization of this CBD model follows a Tiebout-Hirschman-Rothschild rationale and defines 'perceived relative deprivation' as an interaction between local public spending on culture and relative net-outward-mobility attractiveness. Put differently, this is a feeling of being stuck behind or unable to move out from a place that is less endowed with the public provision of cultural goods and appears relatively undesirable for more mobile incumbent people.

The study explored whether the 2016 Brexit referendum result had its theoretical roots in Tiebout's (1956) theory of 'voting with their feet', which suggests that those who cannot vote with their feet experience a behavioural trigger to protest vote (i.e. pro-Brexit voting) due to salient disruption of their positive 'tunnel effect' (Hirschman and Rothschild, 1973) caused by immobility in times of austerity on culture-related public expenditures. We operationalized the CBD mechanism through an interaction between cultural public spending and specially selected migration flows modelling the trigger of social closure, and we use this interaction as an explanatory factor for high local pro-Brexit vote shares.

Using Local Authority District-level data and econometric techniques to account for endogeneity issues, we obtained results that are supportive for previous findings and revealed in a novel way the mechanism behind these findings. The results corroborate the findings of Lee *et al.* (2018) which documented a positive association between immobility and pro-Brexit voting, and we corroborate findings presented by Calvert Jump and Michell (2019) that education and human capital were able to explain part of the Brexit vote share.

Our results further demonstrate a mechanism that explains why places with relatively immobile people recorded higher pro-Brexit vote shares. Our CBD model is based on a mechanism that is a hybrid between Tiebout's (1956) 'voting with their feet' model and

Hirschman and Rothschild's (1973) model that links inequality with perceptions of being 'stuck' behind in relatively poorer economic conditions. Our results suggest that higher local pro-Brexit vote shares may reflect a protest vote associated with the higher presence of net outmigration. The reason for this is that net outmigration numbers signal upward socio-economic mobility of others from our group and people from groups different than our own which intensifies the feeling of being stuck behind in a locality that is unsatisfactory as conditions and opportunities for us. Additionally, we reveal that the dissatisfaction is strongly related to relatively low levels of public expenditures on culture, since culture and identity are strongly related. Thus, our CBD mechanism explained the seemingly contradictory findings from previous research maintaining a positive association of the pro-Brexit vote with both left-behind and wealthier commuting zones. This highlights the importance of the essence of the CBD model that suggests that perceived relative deprivation and not absolute poverty levels underpin protest voting behaviour.

Our findings highlight also that some major inequalities that exist in the country related to the housing market (Adler and Ansell, 2020) or gender and migration (Bailey and Mulder, 2017; Shutes and Walker, 2018) need to be taken seriously by policy-makers in a post-Brexit reality. This is important because any source of inequality can create a feeling of perceived deprivation. Leaving the conditions of any relative inequalities unattended is likely to create further pockets of perceived deprivation and socio-economic and political instability. Similarly, it is very important to consider how reduced migration opportunities after Brexit (Portes and Forte, 2017) and educational mobility (Mayhew, 2017) will influence the stuck-behind mechanism of socio-economic disruption.

Spatial clustering of the pro-Brexit vote, migration and austerity related to public spending on culture seem to depict an even more complex dynamic as suggested by the key explanatory factors in our Tiebout-Hirschman-Rothschild model. The importance of these variables is confirmed in both standard and spatial econometric modelling setting.

One limitation of the current study may be that it uses aggregate rather than individual-level data and is in a cross-sectional rather than panel format, which is in contrast to the micro-level data used in Lee *et al.* (2018), but nevertheless our results should be of interest and relevant to policymakers faced with aggregate indicators and focused on LAD-level issues. Also, while the actual personal vote is not known, when the share of pro-Brexit vote grows proportionally to the share of a certain category of voters across space, this identifies the individual vote preference of this type of voters. Future research could gain more precision in

this identification by employing a multi-level model that incorporates both area-level and individual-level data to formulate a more detailed analysis of the CBD mechanism.

Further considerations of these data limitations are related to two insurmountable hurdles with voting data: (i) the use of aggregate data is always endangered by the ecological fallacy of assuming a mechanism behind the observed voting behaviour on aggregate level and its unrelated correlations with aggregate variables (as potentially possible in the case of our analysis), and (ii) the self-reporting bias in individual data, where the reported voting preference is not guaranteed to be the one actually cast as a vote in real voting behaviour. As none of these cases is superior to the other, we look forward to testing of our hypothesis with individual level data as well, which, in spite of it self-reported nature, will allow us to triangulate the validity of the mechanism implied in our analysis, through an alternative data availability with its own advantages. Meanwhile, we remind the reader that individual data and findings about it cannot be readily aggregated on regional level either, if we want to avoid the fallacy of composition by assuming that micro behaviour leads by simple aggregation to regional behaviour. Therefore, our regional economic analysis here serves to clearly demonstrate the existence of the association between enacted voting behaviour and regional social closure and stuck behind feelings – what we call here the Tiebout-Hirschman-Rothschild mechanism. Now that its presence is explicitly documented on regional level, this justifies that our hypothesized mechanism merits further analysis potentially with micro data as well.

In summary, the findings in this paper represent evidence for the potential existence of an important tool for preventing protest political behaviour of voters, by identifying the perceived relative deprivation mechanism that leads to a protest vote. As both components of the CBD mechanism are identified – culture-related public expenditure and migration – increases in public expenditure related to culture and greater opportunities for mobility (enabling them to leave a locality) should both be crucial tools of interest for decreasing chances of a protest vote.

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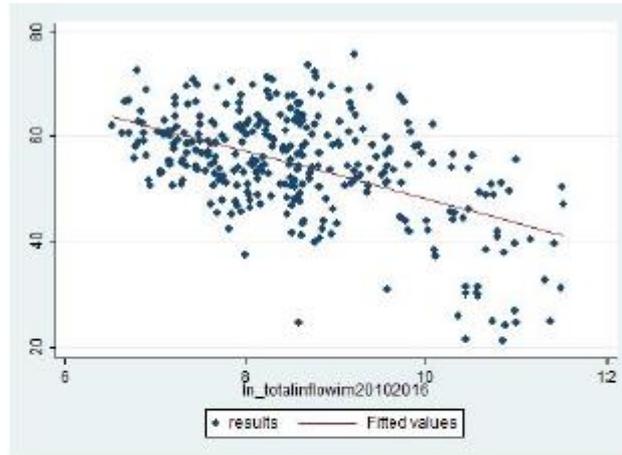
Figure 1: Relative inflow of immigrants 2010-2016 and the pro-Brexit vote

Note: *The figure presents a two-way scatter plot.*
Source: Authors' calculations.
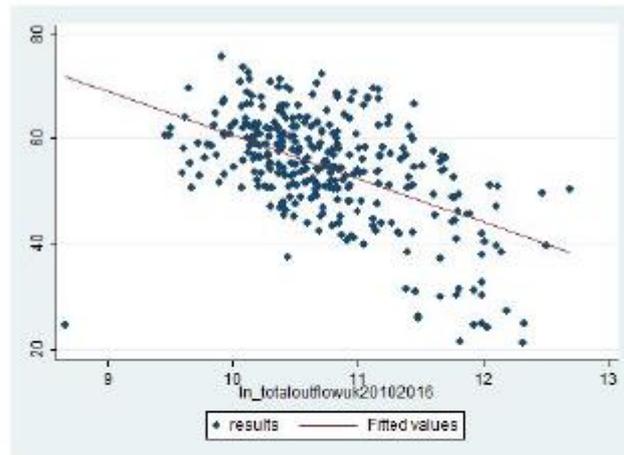
Figure 2: Relative outflow of UK residents 2010-2016 and the pro-Brexit vote

Note: *The figure presents a two-way scatter plot.*
Source: Authors' calculations
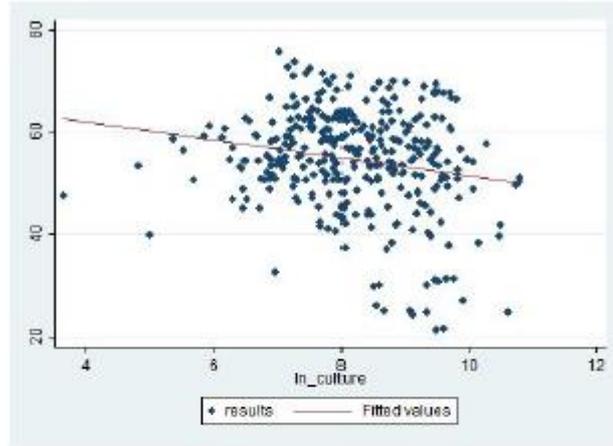
Figure 3: Relative public spending on culture and the pro-Brexit vote

Note: *The figure presents a two-way scatter plot.*
Source: Authors' calculations.
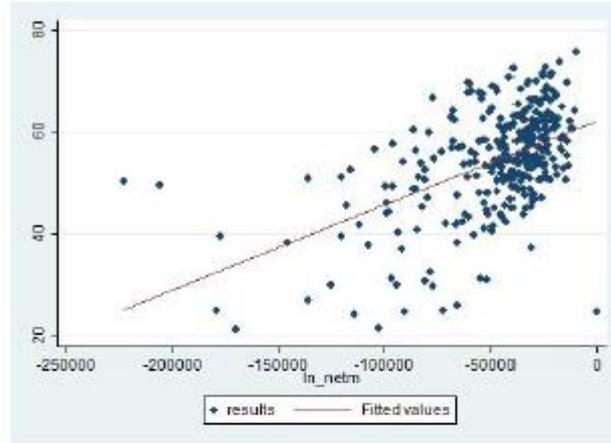
Figure 4: Relative salient upward mobile 2010-2016 and the pro-Brexit vote

Note: *The figure presents a two-way scatter plot.*
Source: Authors' calculations.
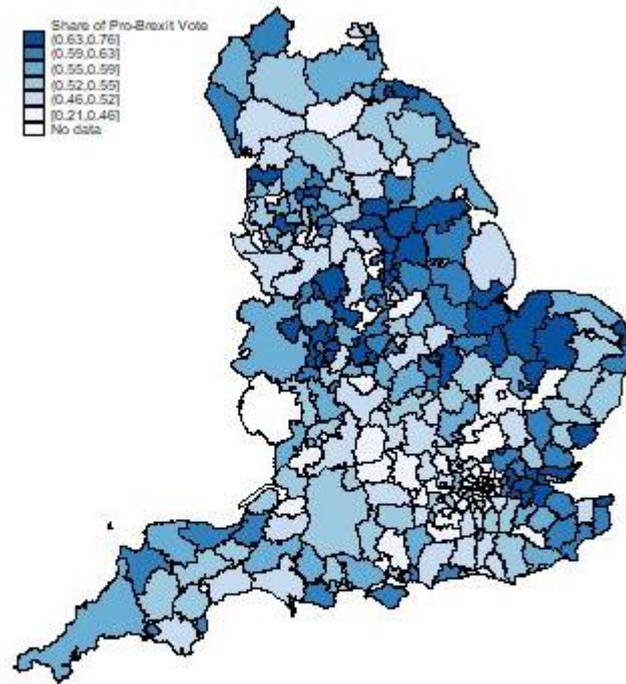
Figure 5: Pro-Brexit vote

Note: *The map presents the spatial distribution.*
Source: Authors' calculations.
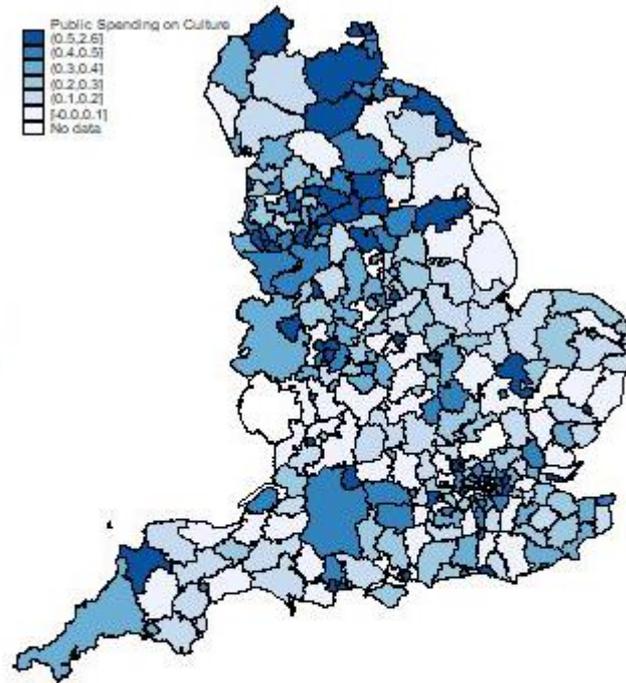
Figure 6: Public spending on culture

Note: *The map presents the spatial distribution.*
Authors' calculations.
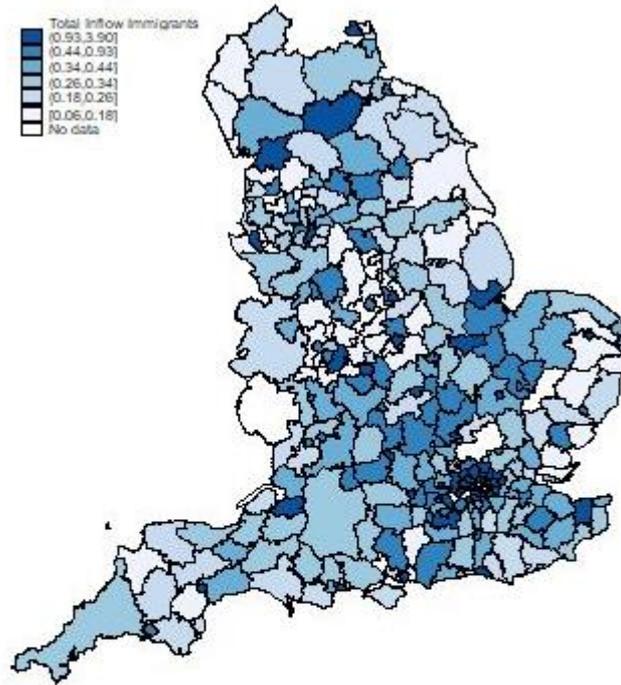
Figure 7: Total In-Migrants

Note: *The map presents the spatial distribution.*
Source: Authors' calculations.
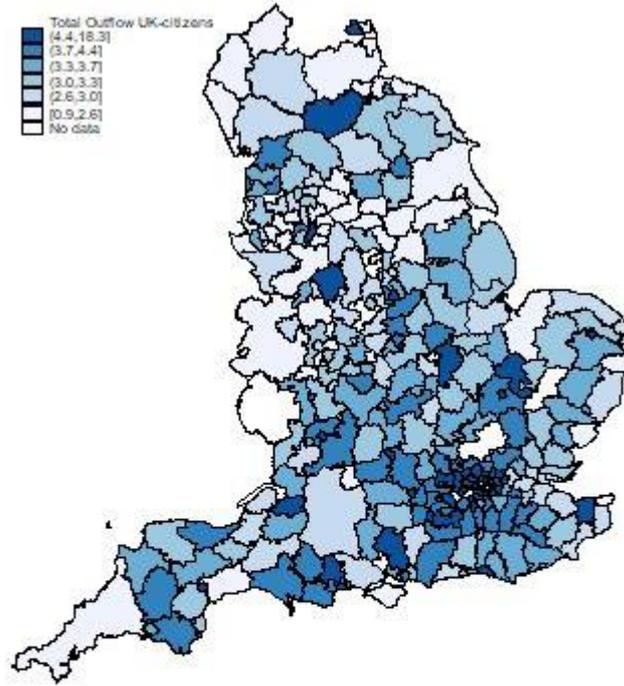
Figure 8: Total Out-Migrants

Note: *The map presents the spatial distribution.*
Source: Authors' calculations.

Figure 9: LISA – Public spending on culture

Moran's I Scatter Plot – Public spending on culture
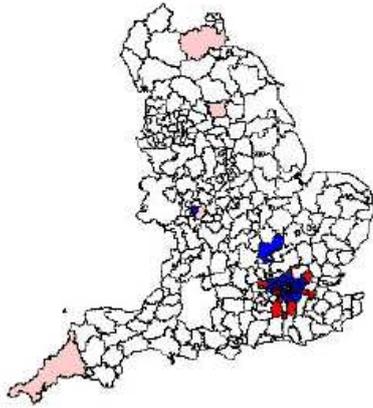
Figure 10: LISA Map – Net Migration
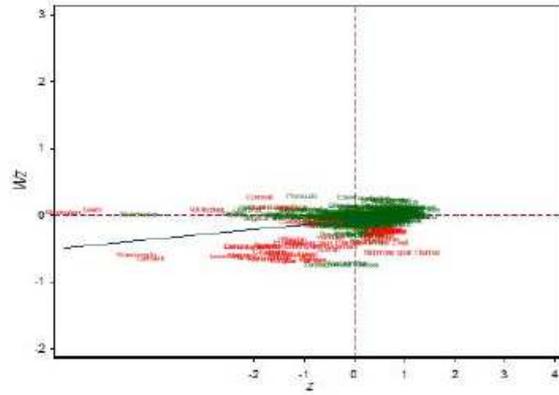
Moran's I Scatter Plot – Net Migration
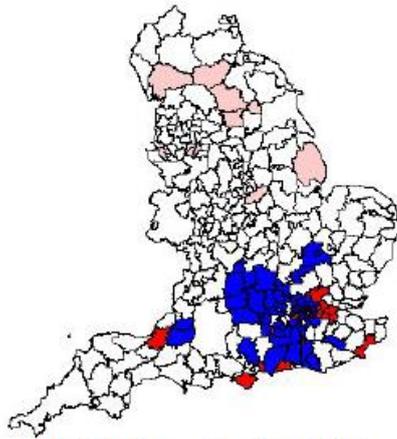
Figure 11: LISA Map – Pro-Brexit Vote
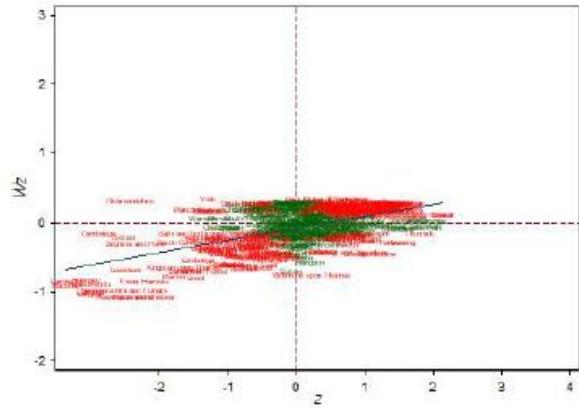
Moran's I Scatter Plot – Pro-Brexit Vote

Table 1: Basic CBD Mechanism - Cultural – Migration – Pro-Brexit Vote

dep.var.	Spec. 1			Spec. 2			Spec. 3			Spec. 4		
					pro-Brexit vote							
	coef.	t-value		coef.	t-value		coef.	t-value		coef.	t-value	
public spending: culture	-0.0003	-4.14	***	0.00042	1.51							
total_inflow_foreign_immigrants (1)				-1E-04	-1.15							
total_outflow_uk_residents (2)				-0.0001	-2.31	**						
net upward-mobile (1 – 2)							0.00017	6.86	***	0.00015	5.53	***
perc_edu_high										-100.32	-2.61	***
_cons	56.64	87.99	***	60.91	45.53	***	62.31	56.77	***	65.81	47.74	***
N	325			325			325			304		
Prob > F	0.0000			0.0000			0.0000			0.0000		
VIF	1.00			4.75			1.00			1.22		
R-squared	0.06			0.36			0.26			0.30		

Note: *The table represents OLS estimations with robust standard errors.*
Source: Authors' calculations.

Table 2: Interaction of Cultural Public Expense, Migration and Human Capital as Determinants of the Pro-Brexit Vote

	Spec. 1			Spec. 2			Spec. 3			Spec. 4		
dep.var.					pro-Brexit vote							
	coef.	t-value		coef.	t-value		coef.	t-value		coef.	t-value	
public spending: culture	0.0003	2.72	**	0.0002	1.31		-0.0004	-3.56	***	-0.0005	-2.01	*
total_inflow_foreign_immigrants (1)	-0.0001	-2.25	*				-0.0002	-1.92		-0.0002	-1.80	
total_outflow_uk_residents (2)	-0.0001	-3.90	***				-0.0002	-5.27	***	-0.0002	-5.12	***
net upward-mobile (1 – 2)				0.0002	5.98	***						
inter_cult_inflow (1)							-1.98E-10	-0.05		-1.2E-09	-0.24	
inter_cult_outflow (2)							4.58E-09	3.47	***	4.88E-09	2.97	**
inter_cult_perc_edu_high										0.0013	0.29	
mean_income	-0.0381	-7.00	***	-0.0447	-6.92	***	-0.0302	-5.54	***	-0.0303	-5.48	***
perc_unemployed	240.0504	2.60	**	179.9023	1.80		226.6855	2.56	**	225.5842	2.57	**
perc_edu_high	61.7880	1.92		-51.7439	-1.50		113.8603	3.75	***	104.7326	2.38	*
physical_capital	-2.1072	-1.34		-1.7813	-1.03		-1.3442	-0.87		-1.3704	-0.89	
employment	0.9966	0.76		1.5869	1.26		5.7178	4.51	***	5.7671	4.55	***
rural	0.0021	0.15		-0.0082	-0.55		-0.0063	-0.48		-0.0069	-0.53	
rank_of_deprivation_IMD	0.0001	0.82		0.0002	0.97		-0.0001	-0.54		-0.0001	-0.55	
_cons	112.7892	2.97	**	113.6733	2.77	**	81.3918	2.18	*	82.3845	2.23	*
N	303			303			303			303		
Prob > F	0.0000			0.0000			0.0000			0.0000		
VIF	5.01			3.67			16.51			22.56		
R-squared	0.63			0.58			0.68			0.68		

Note: *The table presents OLS estimations with robust standard errors.*
Source: Authors' calculations.

Table 3: Cultural Public Expense and Upward-mobile Migration behind pro-Brexit Vote

	Spec. 1			Spec. 2			Spec. 3			Spec. 4			Spec. 5		
dep.var.1	net upward-mobile (1 − 2)														
	coef.	z-value		coef.	z-value		coef.	z-value		coef.	z-value		coef.	z-value	
public spending: culture	-3.283	-20.33	***	-3.279	-20.31	***	-3.283	-20.33	***	-3.279	-20.31	***	-3.285	-20.34	***
mean_income	-89.489	-8.07	***	-89.429	-8.06	***	-88.713	-8.00	***	-91.461	-8.25	***	-88.661	-7.99	***
rural	54.506	1.72		55.666	1.76		55.968	1.77		53.851	1.70		55.625	1.76	
_cons1	16989.710	2.72	**	16894.460	2.71	**	16536.590	2.65	**	17997.680	2.89	**	16533.030	2.65	**
N	303			303			303			303			303		
pseudo R-squared	0.66			0.66			0.66			0.66			0.66		
chi2	584.14			584.76			584.14			584.87			584.36		
VIF	1.14			1.14			1.14			1.14			1.14		
P	0.0000			0.0000			0.0000			0.0000			0.0000		
dep.var.2	pro-Brexit vote														
	coef.	z-value		coef.	z-value		coef.	z-value		coef.	z-value		coef.	z-value	
net upward-mobile (1 − 2)	0.0002	3.69	***	0.0002	10.58	***	0.0002	11.49	***	0.0002	4.21	***	0.0001	3.48	***
employment	4.200	1.89								3.068	1.49		0.602	0.36	
physical_capital	-9.030	-6.34	***							-7.328	-5.43	***	-3.586	-3.28	***
perc_edu_high	6.888	0.21								-77.941	-2.41	*	-75.197	-2.97	**
rank_of_deprivation_IMD				-0.001	-6.22	***				-0.001	-7.04	***			
rank_of_deprivation_edu							-0.001	-17.00	***				-0.001	-15.10	***
_cons2	253.329	7.23	***	74.235	33.97	***	82.855	59.25	***	233.565	7.13	***	163.424	6.28	***
N	303			303			303			303			303		
pseudo R-squared	0.42			0.36			0.63			0.50			0.68		
chi2	180.22			116.51			444.85			264.81			592.54		
VIF	2.32			1.12			0.99			2.20			2.19		
P	0.0000			0.0000			0.0000			0.0000			0.0000		

Note: *The table presents three stage least squared estimations (3SLS) and post-estimation tests.*
Source: Authors' calculations.

Table 4: Spatial Lag versus Spatial Error Models for Upward-mobile Migration and pro-Brexit Vote

			*				.			
method	OLS				Spatial Error Model			Spatial Lag Model		
dep. var.					*netmove*					
	coef.	t-value			coef.	z-value		coef.	z-value	
culture	-3.3	-10.65	***		-3.4	-21.48	***	-3.3	-20.99	***
meanincome	-88.5	-3.85	***		-59.1	-4.39	***	-58.0	-4.66	***
rural	55.4	1.93			37.8	1.18		12.3	0.38	
_cons	16441.8	1.41			8275.6	0.73		40064.2	5.16	***
N	303				303			303		
lambda					0.9	9.13	***			
rho								0.8	4.86	***
Moran's I					10.7	0.0000		10.7	0.0000	

method	OLS				Spatial Error Model			Spatial Lag Model		
dep. var.					*results*					
	coef.	t-value			coef.	z-value		coef.	z-value	
netmove	0.0	5.39	***		0.0	7.69	***	0.0	7.34	***
employment	1.2	1.20			1.6	1.59		1.1	1.05	
physicalcapital	-3.5	-2.30	*		-4.5	-3.56	***	-2.8	-2.32	*
perc_edu_high	-71.0	-2.35	*		-81.1	-3.25	***	-60.1	-2.37	*
rankofeducations~g	0.0	-14.16	***		0.0	-15.13	***	0.0	-13.70	***
_cons	158.6	4.64	***		179.4	6.34	***	132.8	4.03	***
N	303				303			303		
lambda					0.9	12.72	***			
rho								0.2	1.13	
Moran's I					11.0	0.0000		11.0	0.0000	

Note: *The table presents Spatial Lag and Spatial Error Models with post estimation tests for the respective spatial effects and a global Moran's I.*
Source: Authors' calculations.

Table 5: Autoregressive Historic Lags of Upward-mobile Migration and its Effect on pro-Brexit Vote

	Spec. 1		Spec. 2		Spec. 3		Spec. 4		Spec. 5		Spec. 6		Spec. 7		Spec. 8	
	coef.	z-value	coef.	z-value	coef.	z-value	coef.	z-value	coef.	z-value	coef.	z-value	coef.	z-value	coef.	z-value
dep. var. 1	netmove								net2_2016							
culture	-3.3	-20.31 ***	2.02E-07	2.44 *	-1.31E-08	-0.73	-3.99E-09	-0.23	1.53E-09	0.09	6.17E-10	0.04	-3.20E-09	-0.18	-3.58E-09	-0.20
net2_2015					0.9807	87.27 ***	0.7500	14.51 ***	0.7252	14.10 ***	0.7213	13.89 ***	0.7035	13.40 ***	0.7052	13.43 ***
net2_2014							0.2353	4.55 ***	0.1047	1.57	0.0971	1.42	0.0944	1.38	0.0942	1.38
net2_2013									0.1651	3.07 ***	0.1500	2.42 *	0.1408	2.27 *	0.1403	2.26 *
net2_2012											0.0280	0.49	-0.0076	-0.13	-0.0079	-0.13
net2_2011													0.0696	1.69	0.0689	1.67
meanincome	-91.5	-8.25 ***	-0.0000654	-10.92 ***	-6.62E-06	-4.95 ***	-7.43E-06	-5.72 ***	-7.30E-06	-5.69 ***	-7.27E-06	-5.66 ***	-7.48E-06	-5.84 ***	-7.43E-06	-5.80 ***
rural	53.9	1.70	-6.44E-06	-0.40	1.77E-06	0.52	1.17E-06	0.35	-9.52E-07	-0.29	-9.91E-07	-0.30	-1.66E-07	-0.05	-1.08E-07	-0.03
_cons	17997.7	2.89 ***	-0.0089	-2.71 **	0.0033	4.65 ***	0.0041	5.89 ***	0.0043	6.29 ***	0.0044	6.29 ***	0.0045	6.38 ***	0.0044	6.36 ***
R-squared		0.66		0.27		0.97		0.97		0.98		0.98		0.98		0.98
dep. var. 2								results								
netmove	0.0002	4.21 ***	712.8395	5.20 ***	423.1	11.02 ***	427.1	11.13 ***	428.08	11.16 ***	428.3270	11.17 ***	430.10	11.22 ***	427.17	11.24 ***
employment	3.1	1.49	-6.4	-6.65 ***	-6.5	-8.67 ***	-6.4	-8.64 ***	-6.4	-8.63 ***	-6.4	-8.64 ***	-6.4	-8.64 ***	-4.7	-4.46 ***
physicalcapital	-7.3	-5.43 ***	-3.5	-2.18 *	-5.7	-4.81 *	-5.7	-4.75 ***	-5.7	-4.72 ***	-5.7	-4.72 ***	-5.6	-4.70 ***	-6.0	-5.01 ***
perc_edu_high	-77.9	-2.41 *	-41.8	-1.20	-49.8	-1.74	-52.2	-1.82	-53.5	-1.86	-53.5	-1.86	-53.6	-1.87	-52.0	-1.83
rankofimdscorewh	-0.0006	-7.04 ***	-0.000039	-0.31	-0.0002	-2.95	-0.0002	-2.89 **	-0.0002	-2.86 **	-0.0002	-2.86 **	-0.0002	-2.84 **	-0.0003	-3.50 **
culture															-0.0002	-2.42 *
_cons	233.6	7.13 ***	193.3	5.87 ***	236.5	9.09 ***	235.2	9.02 ***	234.7	9.00 ***	234.6	8.99 ***	234.2	8.97 ***	237.7	9.18 ***
R-squared		0.50		0.49		0.57		0.57		0.57		0.57		0.57		0.58
N		303		303		303		303		303		303		303		303

Note: *The table presents 3SLS including historic lags for upward-mobile migration and post estimation tests.*
Source: Authors' calculations.

Appendix 1: Definitions of Variables and Descriptive Statistics

Variable	Definition	Source	Obs	Mean	Std. Dev.	Min	Max
pro-Brexit vote	percentage of voters who supported Brexit	Electoral Comission	325	54.5	10.01	21.4	75.6
public spending: culture	public investment as part of overall local investment in culture and related activities in a LAD area, including spending on cultural services such as: Archives; Arts development and support; Heritage; Museums and galleries; Theatres and public entertainment; Community centres and public halls; Foreshore; Sports development and community recreation ; Sports and recreation facilities, including golf courses; Open spaces; Tourism; Library services.	British Government: Ministry of Housing, Communities & Local Government	325	6231.6	7230.78	-142	49288
total_inflow_foreign_immigrants (1)	total number of international immigrants	ONS Local area migration indicators	325	11148.8	17298.06	684	101284
total_outflow_uk_residents (2)	total number of emigrants with British origin	ONS Local area migration indicators	325	57910.8	45487.49	5811	323253
net upward-mobile (1 – 2)	difference between the two above – accounting for the total number of people lost from the locality and not substituted by an inflow	ONS Local area migration indicators	325	-46762	30889.35	-222909	-403
mean_income	mean income in the LAD in GBP	ONS Earnings and working hours	324	514.8	95.23	354.6	1046.6
perc_unemployed	percentage of unemployment in the LAD area	ONS Census 2011	304	0.034	0.01	0.015	0.069
perc_edu_high	percentage of population with educational degree higher than the Census category 16 - Level 4+: Degree (BA, BSc), Higher Degree (MA, PhD, PGCE),perc_high_edu NVQ Level 4-5, HNC, HND, RSA Higher Diploma, BTEC Higher level, Foundation degree (NI), Professional Qualifications (Teaching, Nursing, Accountancy) (England & Wales & Northern Ireland) ;	ONS Census 2011	304	0.044	0.02	0.025	0.124
physical_capital	Log of capital investment by region in England	ONS Developing new statistics for infrastructure	325	22.9	0.41	22.0	23.9
employment	Log of number of employed people in local authority in the thousands	ONS Local labour market indicators	325	4.0	0.56	1.8	5.8
rural	Rural% (including Large Market Town population, where people living in the Large Market Towns are defined as Urban in the Rural Definition. For the purposes of classifying Local Authorities these towns are considered to be Rural.	ONS Local Authority Rural–Urban Classification	304	35.3	35.62	0	100
rank_of_deprivation_IMD	Highest level of deprivation is 1. The Index of Multiple Deprivation (IMD) is an overall relative measure of deprivation constructed by combining seven domains of deprivation according to their respective weights, namely: Employment Deprivation Domain; Income Deprivation Domain; Education, Skills and Training Deprivation; Health Deprivation and Disability; Crime; Barriers to Housing and Services; Living Environment Deprivation.	British Government: Ministry of Housing, Communities & Local Government	304	17674.6	5525.95	4231.6	29833.6
rank_of_deprivation_edu	Highest level of deprivation is 1. Education, Skills and Training Deprivation (13.5%) charts the skills and career training gap in the local population. The government divides this into two sub-domains: one relating to children and another relating to adults potentially gainfully employed.	British Government: Ministry of Housing, Communities & Local Government	304	16777.4	4717.11	6772.7	28077.2

Note: *The table presents descriptive definitions, sources and statistics the main variables of interest.*
Source: Authors' calculations

Appendix 2: Correlation between Main Variables of Interest

	pro-Brexit vote	public spending: culture	total_inflow_foreign_immigrants (1)	total_outflow_uk_residents (2)	net upward-mobile (1 – 2)	perc_edu_high
pro-Brexit vote	1					
public spending: culture	-0.20	1				
total_inflow_foreign_immigrants (1)	-0.55	0.63	1			
total_outflow_uk_residents (2)	-0.57	0.76	0.90	1		
net upward-mobile (1 – 2)	0.53	-0.76	-0.76	-0.97	1	
perc_edu_high	-0.37	0.26	0.71	0.56	-0.42	1

Note: *The table presents correlation coefficients between the main variables of interest.*
Source: Authors' calculations.