



We'll always have Paris? Spatial inequalities and the rise of political discontent in the metropolitan region of Paris

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ABSTRACT

In recent decades, developed economies have experienced a strong concentration of economic activity around their main metropolises, generating economic and social fractures between these prosperous areas and the rest of the country. Several contributions in the literature on the 'geography of discontent' noted how the concentration of growth and prosperity in large metropolitan areas explains the rise of anti-system, anti-European political options. This paper focuses on the case of Paris and its surrounding region, Île-de-France, using the results of the last French presidential election in April 2022. Two candidates, one who embodied the Europeanist and pro-establishment option (Macron) and the populist option (Le Pen), faced each other in the second round of the election. This situation, combined with the high level of spatial disaggregation of socioeconomic information within the French statistical system, makes it possible to study the relationship between spatial inequalities and political discontent at the local level and analyse intra-metropolitan patterns. Inequalities at this scale explain a large part of the anti-establishment vote: the most prosperous areas tend to vote for the pro-establishment option, whereas populism becomes strong in the less favoured areas. Stagnating areas also have a greater propensity to support populist political parties.

1. Introduction

For more than a decade Europe has faced a growing wave of populist, anti-system and anti-European political options that are undermining its foundations from within. The exit of the United Kingdom (UK) from the European project can be considered the first major consequence of this anti-establishment and anti-European wave. However, these types of political options are at the forefront of several national governments or, in other cases, have a notable influence on them or the dominant political discourse. What explains the growth of these anti-European or anti-system options? What are the factors that can explain this dissatisfaction with the European Union (EU) or with the political and social status quo? Without a doubt, this phenomenon must be addressed from a multidimensional perspective; social, political, economic, and other contextual factors could have an impact. Among these various views on the phenomenon, a part of the literature, known as the 'geography of discontent', that focuses on the importance of territorial inequalities has emerged. Certain places have been 'left-behind', from the prosperity and growth of the integration process or globalisation of economies. These places tend to have systemic unemployment problems, which generate

emigration, and thus suffer from a lack of public services and transport accessibility. The population in these areas tends to age, and a climate of hopelessness is generated providing a fertile breeding ground for political discontent.

The Brexit referendum is the most studied case in Europe, both because of its relevance and because of how clear the options were: UK citizens had to choose between remaining in or leaving the EU without nuances or confusing messages. Therefore, it was ideal to identify the extent to which economic inequalities across space explain the propensity to vote against remaining in the EU. France is also a country that has experimented a notable growth of anti-European or anti-system options, with the steady rise of Marine Le Pen's *Rassemblement National* (formerly the *Front National*), a far-right populist party whose following has been growing with successive elections. Created in the 1980s by her father (Jean-Marie Le Pen) as a small fascist group, this party has evolved substantially and gained respectability over the last several decades. Thus, it came first in terms of the number of votes in the June 2024 European elections and third in terms of the number of parliament deputies in the recent legislative elections. Today, the *Rassemblement National* very clearly represents one of the three major

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electoral forces in France, along with Emmanuel Macron's presidential party and the *Nouveau Front Populaire* represented by Jean-Luc Mélenchon.

Although the situation is not as clear as that of Brexit, the case of the 2022 French presidential elections has generated the most similar situation to that of the UK referendum that we have been able to find in recent elections. In the second round, there were two options, represented by Macron and Le Pen, who presented themselves as pro- and anti-establishment, respectively. This makes the second round of the 2022 French presidential elections a good laboratory for testing and measuring the importance of spatial inequalities in voting behaviour and the emergence of an anti-European vote.

Another interesting feature of the voting movements is that the studies carried out for the UK and France show the existence of a greater propensity to vote pro-system in large cities, especially in London and Paris. On the contrary, the anti-system vote tends to be concentrated in rural areas or the remote peripheries of larger cities. However, an interesting increase in the anti-system vote is also observed in the less developed areas of the large metropolises.

Therefore, the objective of this work is to study the case of Paris, which is especially relevant because of its supremacy and symbolic significance in France. Using the results of the second round of the April 2022 French presidential elections, we propose analysing the propensity to vote for the anti-establishment in the city of Paris, the Parisian metropolitan area, and its regional environment (Île-de-France region, also known as the Greater Paris Region). We intend to contrast whether the relative economic position of each locality concerning its surrounding areas affects its propensity to vote for an anti-system option such as Le Pen. We seek to identify patterns in such a local context to understand the dynamics of this disaffected vote in metropolitan environments. The French statistics system provides valuable demographic, social, and economic information at the local level. Using this information, a model that considers spatial autocorrelation effects will be estimated.

With this objective in mind, the rest of the paper is structured as follows. First, an overview of the characteristics of the cases of France, Île-de-France, and Paris is presented to highlight both the relevance of the selected geographical area of analysis and the April 2022 French presidential election data. After this, the methodological proposal is made, first showing the data that are available and then explaining the proposed estimation strategy. Finally, the results are presented and discussed, concluding with a final summary section and economic policy proposals.

2. Why the case of Paris and Île-de-France is particularly important for the literature on the 'geography of discontent'

In recent decades, developed economies have experienced a strong process of concentration of economic activity around their main metropolises. Using the terminology proposed by Glaeser et al. (2020), it can be said that we live in the era of 'urban empires': large global metropolises dominate the economy and facilitate the process of extreme globalisation. The agglomeration economies that occur in these large urban areas encourage productivity, growth, and creativity (Glaeser, 2011). Nevertheless, the intensification of ultra-concentration of economic activity around the main metropolises does not occur without consequences. The economic and social fracture between these places and the rest of the country has grown enormously in the last three decades. Díaz et al. (2019) showed how, in Europe, there is a process of acceptable convergence at the national scale that actually obscures the intense divergence within each country. In some cases, such as France, the UK, or Spain, this divergence manifests as the capital (Paris, London, or Madrid) versus the rest of the nation. Sometimes, this social and economic fracture even occurs within the area of influence of the large metropolis, such as between its centre and its peri-urban environment (see Fernández et al., 2020).

This reality has been aggravated by the Great Recession that began in 2008, to which the EU responded with budget cuts and austerity measures. These measures were often followed by declining government revenues, which only exacerbated the situation by stoking social instability and unrest (Ponticelli and Voth, 2020). Perceived competition for reduced public services and declining economic opportunities spurred support for the anti-immigration sentiment and economic nationalism of far-right parties (Algan et al., 2017; Artelaris and Mavrommatis, 2021; Cremaschi et al., 2022; Steiner and Harms, 2021). This growing line of research, known as the 'geography of discontent' literature, connects economic disparities and inequalities across space with the emergence, growth, and consolidation of anti-system political options. McCann (2016), (2018) explains how the concentration of prosperity in large metropolises (London in the case of the UK) generates a climate of discontent in the periphery that reacts against the concentration of economic activity that he also identifies with globalisation and with the EU itself. Rodríguez-Pose (2018) formulated his hypothesis of 'the revenge of the places that do not matter.' The territories that are left behind, in which a climate of hopelessness takes root that leads to emigration and ageing, perpetuate a climate of discontent that is ultimately channelled through an anti-system vote. Multiple subsequent works have accumulated extensive empirical evidence for various cases within and outside Europe (Abreu and Öner, 2020; Abreu and Jones, 2021; Alabrese et al., 2019; Curtice, 2017; Lenzi and Perucca, 2021; Luukkonen et al., 2022 and, among others, Stein et al., 2022).

Billings et al. (2019) highlight the importance of analysing the phenomenon of political discontent at a highly disaggregated scale, i.e., at the local level. In line with that approach, Gutiérrez-Posada et al., (2021) studied how local spatial economic inequalities contribute to understanding the leaving vote in the Brexit referendum, and Fernández et al. (2024) used the same approach to study the rise of anti-system support in France during the 2022 French presidential elections. In both analyses, there was strong empirical evidence of the relevance of spatial inequalities at the local scale in understanding the formation of the dynamics of political discontent. Additionally, in both scenarios, the effect of the two large capitals, London and Paris, is identified: the pro-system vote in these areas is dominant over that of their metropolitan periphery, where, in some specific localities, there is a large concentration of anti-system support.

The case of the French presidential elections of April 2022 is very interesting because, in the second round, it put voters under two opposite options: the voters must decide between maintaining the status quo versus the anti-system proposal of populism. From the point of view of academic analysis, it is difficult to use ordinary electoral processes to test the idea of the 'geography of discontent' since such elections normally involve voting for complex options, including several alternatives that are close in the political spectrum, i.e., leaders with different charisma and the influence that local leaders can exert. However, the French presidential election system, being a two-round process if no candidate reaches a majority in the first round, incidentally, caused a situation comparable to that of the UK referendum. In fact, according to the French Constitution, the number of candidates in the second round is automatically reduced to the two winners of the first round. In the April 2022 French presidential election, the two candidates running for the seat in the second round represented two totally opposite alternatives: on the one hand, the far-right candidate from the *Rassemblement National* (RN) party, Marine Le Pen, presented herself with a markedly anti-establishment charisma, and on the other hand, Emmanuel Macron from the centre-right party, *La République En Marche* (LREM), embodied the pro-European and pro-system political values.

Furthermore, France has extraordinary economic and social statistical information at the local level. Specifically, the National Institute of Statistics and Economic Studies (INSEE) of France provides a wide variety of relevant economic, social, demographic, and political information at a granular scale of disaggregation. In particular, statistical data are obtained at the municipal level, which is the smallest administrative

subdivision of France. This level of spatial aggregation matches the so-called Local Administrative Unit (LAU) established in the Nomenclature of Territorial Units for Statistics (NUTS), which is the official system for dividing the EU economic territory. In being the most disaggregated administrative units with harmonized statistical information for EU member states, LAUs represent a subdivision of the NUTS3 regions. Currently, France has 34,966 LAUs.

Within this special relevance of the French case, both due to the situation that arose in the 2022 presidential election and due to the abundance and disaggregation of the data, the case of Paris is especially interesting. The city of Paris is located in the Île-de-France or Greater Paris region, which is the most populated region in France. It is made up of 1252 municipalities (i.e., LAUs). This region has some unusual characteristics, which makes it not only one of the most populated areas in Europe but also the centre of a large part of economic activity in France.

Île-de-France is by far the largest region in France in economic terms, as well as the most populous region in the country, with nearly 12.2 million inhabitants (approximately 18 % of the French population (INSEE, 2020) and 2 % of the European population). Its gross domestic product (GDP) represents 29 % of the national GDP. Workers are generally highly qualified, comprising 37 % of French managers and 40 % of the national workforce employed in research and development (R&D) activities. However, behind this large agglomeration are large hidden agricultural and rural regions, with many cultivation areas. In fact, 57 % of rural municipalities constitute 64 % of the region's territory. The regional territory accounts for 48 % of agricultural land (approximately 569,000 ha) and 24 % of wooded areas, the volume of which has declined rapidly due to very strong urban sprawl (approximately 480 ha per year since 2015) (Fonseca and Torre, 2023). In terms of population density, the most populous municipalities are located in the centre and west, whereas the sparsely populated or very sparsely populated municipalities are located on the outskirts, especially in the west, which has agricultural areas for field crops such as wheat or beetroot production (Fig. 1) (Observatoire régional de Santé d'Île-de-France, 2019).

Fig. 2 shows the map of the Île-de-France region with the distribution of the median income by municipalities (LAUs). It allows us to illustrate the second reason why the case of Paris and its surrounding region is so interesting: the marked differences in income observable therein. In fact, we can consider that Île-de-France represents the diversity of France within a single region, with very rich municipalities, such as the city of Paris itself and some of its surrounding municipalities, coexisting in a small regional space with others of relatively low level, middle income, located mainly in the Eastern periphery of the metropolitan area of Paris or the Île-de-France region.

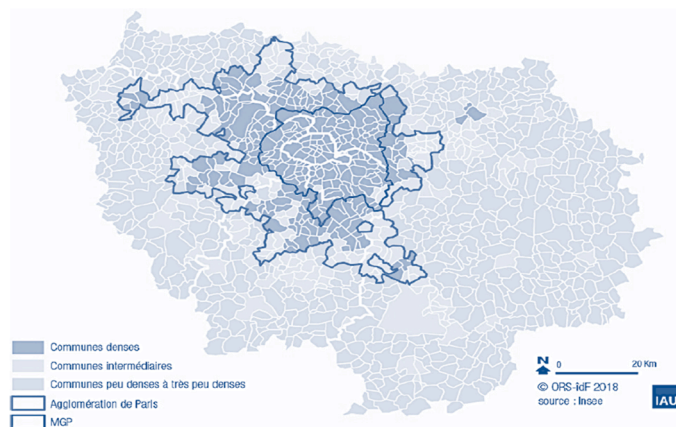


Fig. 1. Density of municipalities in the Île-de-France region (2018)¹¹

Source: Observatoire Régional de Santé d'Île-de-France, based on INSEE data.

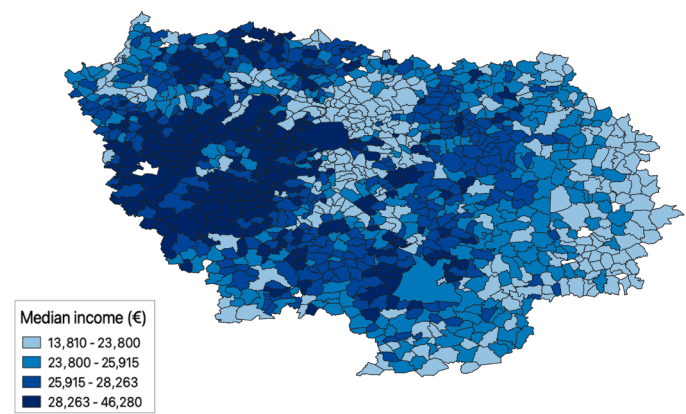


Fig. 2. Median income (€) of the municipalities (LAUs) of Île-de-France (2018). Source: Author's elaboration using data from the INSEE.

Finally, Paris and the Île-de-France region are cases with special relevance. In France's strongly centralized political/administrative model, Paris has always been the backdrop for protests and social transformations both in France and throughout Europe. This central role of Paris in French and European politics has continued in the last major protests and political movements. As an example, the revolt of the yellow vests in 2019, which occurred during Emmanuel Macron's first presidency, saw its most important violent events and opposition in the Parisian metropolitan area, with an invasion and partial destruction of the iconic Arc de Triomphe at the top of the Avenue of the Champs-Élysées. This revolt ensued following the government's environmental plan to limit the speed on motorways and impose taxes on fuel. It took the form of numerous violent demonstrations and occupations of roundabouts by protesters expressing their remoteness from central areas and the need to use their vehicles for work or personal trips. Their sensitivity to the spatial dimension and geographical isolation were very pertinent in this situation (Bourdin and Torre, 2022).

Fig. 3 presents the vote shares for the three main candidates in the first round of the 2022 French presidential elections. Fig. 4 shows the vote shares for the two candidates who advanced to the second round: Macron and Le Pen.

3. Empirical settings

3.1. Dependent variable: Percentage of votes for the various options and the interest of the extreme decision in the second round

Considering the objective proposed in the previous sections, we are interested in studying the relationship between the populist vote and spatial inequalities in the Île-de-France region. As the dependent variable of our empirical model, we use the vote in the French presidential elections held in April 2022, which comprised two rounds.

In the first round, there was a great plurality of candidates; however, the clear winners in the Île-de-France region were Emmanuel Macron (26.11 %²), the leader of the *Republique en Marche* party with a centrist political profile, Marine Le Pen (23.34 %), the leader of the *Rassemblement National* party with a far-right ideology, and Jean-Luc Mélenchon (20.82 %), the leader of the *France Insoumise* political party with a leftist ideology.³ The percentages of votes obtained by the three candidates with the most votes in the first round, which were Le Pen, Macron, and Mélenchon, are used as independent variables in this study. However,

² The values indicated in parenthesis indicate the percentage of votes received by each candidate with respect to the total number of voters.

³ These same candidates received the greatest support at the national level in the first round of the presidential elections.

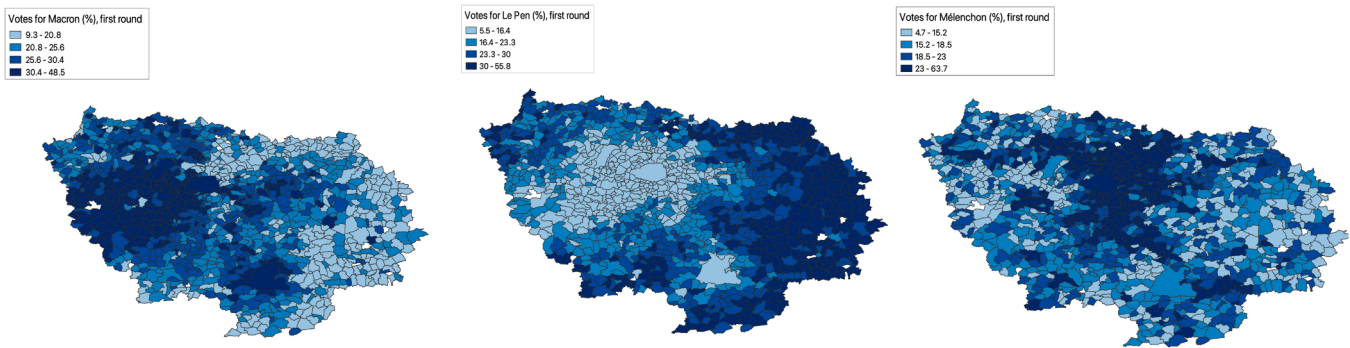


Fig. 3. Share of votes for Macron, Le Pen, and Mélenchon by municipality (LAU). First round of the French presidential elections, April 2022. Source: Author's elaboration using data from the French Ministry of the Interior.

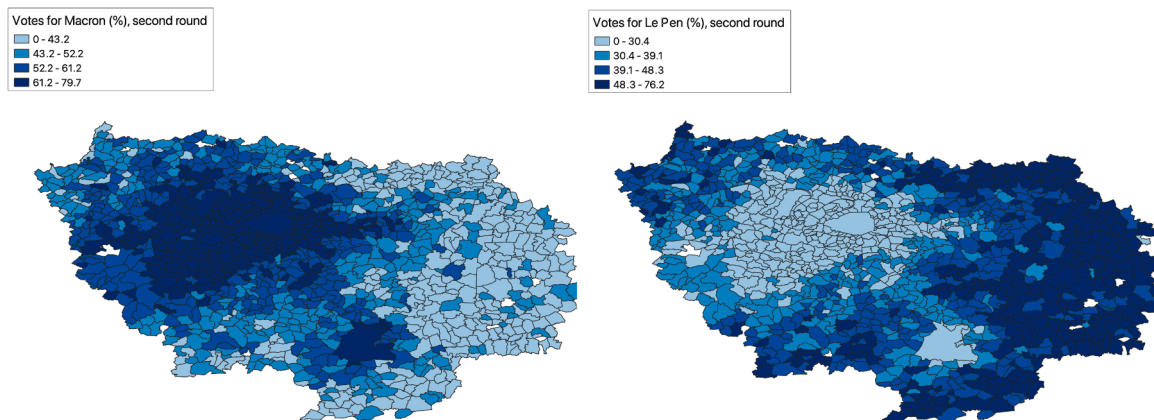


Fig. 4. Share of votes for Macron and Le Pen by LAU. Second round of presidential elections, April 2022. Source: Author's elaboration using data from the French Ministry of the Interior.

our work only focuses on the second round, where the two most-voted candidates in this first round, Macron and Le Pen, faced each other. Therefore, the percentage of votes received by Macron and Le Pen in the second round of the presidential elections are also taken as independent variables in this analysis. Although Macron, on average, achieved greater electoral support in the second round in the Île-de-France region, as occurred at the national level, support for Le Pen was also remarkable. Her support increased significantly in comparison to the first round, reaching over 76 % in various municipalities of the Île-de-France region.

The panorama of the vote in Île-de-France in terms of the dependent variables considered is represented in Figs. 5 and 6, which jointly visualize the geographical areas where greater support for each candidate in the first and second rounds is concentrated. Fig. 5 shows the municipalities with the highest average vote for each of the three most-voted candidates in the first round. Municipalities in light blue represent places where the average vote for Le Pen was higher than that for the other candidates. The same is indicated in dark blue for Macron and in grey for Mélenchon. Fig. 6 shows the municipalities with the highest average number of votes for each candidate in the second round. Those municipalities that voted more for Macron on average are shown in dark blue, whereas those that voted more for Le Pen are shown in light blue. These maps visualise how an area in which the vote for Mélenchon predominated in the first round was dominated by Macron in the second round. These maps reinforce the need to carry out independent analyses

for each of the rounds.

3.2. Explanatory variables: The role of spatial inequalities controlling for other relevant factors

Our main variable is the median income of Île-de-France LAUs, which was obtained from INSEE. First, the links between the income level of the municipalities and the anti-system vote will be analysed. It will be possible to observe whether having a higher or lower level of income is associated with voting for a radical party. Second, and as will be detailed in the methodological section, some estimates will include the spatial lag of the LAUs median income as a regressor, a fundamental explanatory factor in this analysis. This variable will allow us to contrast whether the anti-system vote of a specific municipality could be motivated by having neighboring areas with a higher level of income, which in essence shows whether spatial income inequalities, in this case, between municipalities, could boost anti-system political parties support. A positive and significant coefficient of the mentioned variable indicates that a higher level of income in neighbouring areas promotes greater anti-system support in a considered municipality, or what is the same, it indicates that spatial income inequalities significantly promote anti-system voting. In summary, the median income spatial lag makes it possible to test whether greater support to anti-system parties in a certain municipality could be derived from being surrounded by neighbouring areas with a higher level of income, and thus, on spatial income inequalities.

Likewise, the literature that analyses the determinants of the anti-system vote also considers sociodemographic aspects as fundamental factors, as discussed in Sections 1 and 2. The age structure of the population, educational level, proportion of the immigrant population,

¹ In the typology of INSEE, dense municipalities have more than 330 inhabitants per squared kilometre (km²), and sparsely populated municipalities are those with a population density of at least 25 inhabitants per km² and a minimum of 300 inhabitants.

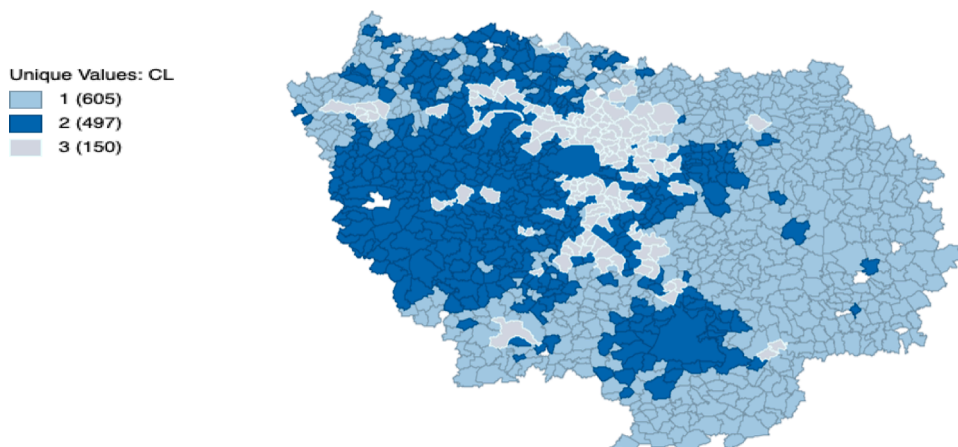


Fig. 5. Île-de-France LAUs with the highest average vote for Le Pen, Macron and Mélenchon in the first round of the presidential elections. Source: Author's elaboration using data from INSEE.

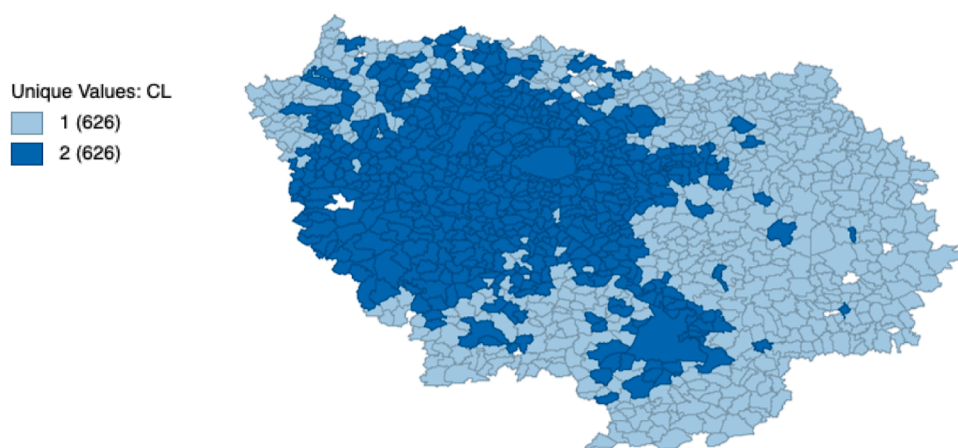


Fig. 6. Île-de-France LAUs with the highest average vote for Le Pen and Macron in the second round of the presidential elections. Source: Author's elaboration using data from INSEE.

professional profile, or the employment/ unemployment situation are factors typically used to explain the vote for radical parties; see for example, the proposed specification of the model of [Gutiérrez-Posada et al., \(2021\)](#) and [Abreu and Öner \(2020\)](#) taking the UK's referendum context. For this reason, the population over 65 years of age, the percentage of the immigrant population, the percentage of the unemployed population, and variables related to the professional profile and educational level of the individuals in each LAU are included as control variables (see [Table 1](#)).

The vote for Le Pen in both the first and second rounds of the French presidential election of April 2022 showed a clear spatial pattern (see [Figs. 3 and 4](#)); greater support for that candidate was mainly located in the Eastern part of the region, mostly in rural areas that are far from Paris, which is the most prosperous urban area of Île-de-France and the place that concentrates much of the economic activity of the region as well as of the whole country. The geographical distance of each municipality from Paris is included in this analysis as a control variable. Therefore, it will be possible to verify whether geographical proximity or distance to a highly crowded and dynamic area affects voting decisions in LAUs. To do this, a matrix of distances between the centroids of the municipalities of the Île-de-France region has been calculated using the EPSG:3857 coordinate system, which is typically employed to measure metric geographical distances. Once this matrix was obtained, the vector of Île-de-France municipalities' distance to Paris could be extracted.

[Table 1](#) summarises the dependent and independent variables included in this analysis. Basic information, such as definitions and sources regarding all variables as well as main descriptive statistics, is included. The data on the independent variables refer to the period 2018, the last year for which information on these variables is available.

3.3. Spatial unit of analysis

The 'geography of discontent' literature highlights that the existence of spatial income inequalities within countries and regions drives support for anti-system political parties ([Gutiérrez-Posada et al., 2021](#)). Consequently, the most disaggregated spatial unit of analysis in this study is used to capture how spatial economic differences at the local level can motivate the vote for anti-system options such as Le Pen within the Île-de-France region.

Fortunately, French statistics provide a wealth of socioeconomic information at a highly disaggregated spatial level. Specifically, the statistical information considered in this analysis, i.e., the variables reflected in [Table 1](#), is obtained at the Local Administrative Unit level of spatial aggregation, which is a subdivision of the NUTS3 areas. The LAU is the most disaggregated level for which information for all variables included in the analysis is available. We refer to these units as LAUs or municipalities interchangeably. In particular, the Île-de-France region has a total of 1252 LAUs, as was previously mentioned.

Table 1

Database description: Variable definitions, sources, and main descriptive statistics.

| Variable | Definition | Source | Mean | St. Desv. | Min. | Max. |
|---|---|--|-----------|-----------|--------|--------|
| <i>Dependent variables</i> | | | | | | |
| Votes for Macron 1st round (%) | % of votes for Macron in the first round over the total votes of each municipality | French Ministry of the Interior | 26.11 | 7.10 | 9.30 | 48.55 |
| Votes for Macron 2nd round (%) | % of votes for Macron in the second round over the total votes of each municipality | | 52.33 | 12.20 | 0 | 79.68 |
| Votes for Le Pen 1st round (%) | % of votes for Le Pen in the first round over the total votes of each municipality | | 23.34 | 9.06 | 5.46 | 55.81 |
| Votes for Le Pen 2nd round (%) | % of votes for Le Pen in the second round over the total votes of each municipality | | 39.21 | 11.82 | 0 | 76.19 |
| Votes for Mélenchon 1st round (%) | % of votes for Mélenchon in the first round over the total votes of each municipality | | 20.82 | 9.45 | 4.67 | 63.71 |
| <i>Independent variables</i> | | | | | | |
| Median income (€) | Median income of each municipality measured in € | French National Institute of Statistics and Economic Studies (INSEE) | 26,155.06 | 4235.69 | 13,810 | 46,280 |
| Unemployment rate (%) | % of unemployed individuals over the total active population of each municipality | | 9.58 | 3.50 | 1.18 | 25.22 |
| Agriculture (%) | % of individuals employed in the agriculture over the total active population in each municipality | | 1.78 | 4.62 | 0 | 42.86 |
| Artisans, merchants and entrepreneurs (%) | % of individuals employed in the agriculture over the total active population in each municipality | | 11.22 | 6.32 | 0 | 43.52 |
| High skill occupations (%) | % of individuals employed in high skilled occupations over the total active population in each municipality | | 34.72 | 13.75 | 0 | 87.50 |
| Immigrants (%) | % of immigrants over the total of population in each municipality | | 9.84 | 7.00 | 0 | 45.97 |
| People over 60 (%) | % of population over 60 years over the total population in each municipality | | 21.91 | 5.25 | 6.04 | 55.55 |
| High education (%) | % of individuals with tertiary education over the total of population in each municipality | | 53.35 | 10.75 | 24.99 | 85.06 |
| <i>Observations</i> | | | 1252 | | | |

Source: Author's elaboration.

3.4. Exploratory data analysis, econometric strategy, and empirical model definition

As explained in the previous sections, the candidates' vote share does not seem to be randomly distributed across space. Table 2 shows the values of the statistics and the significance of the Global Moran I and Geary C tests, which are typically used to detect whether there is an autocorrelation process between the observations of our dependent variables. The null hypothesis of both tests, which denotes the existence of no spatial autocorrelation between the observations, is rejected in each case, meaning that there is a positive and significant spatial correlation between the dependent variables' observations in the first and second rounds of the French presidential elections of April 2022.

In addition, the so-called Exploratory Spatial Data Analysis (ESDA) allowed us to visualise and better comprehend the existing spatial autocorrelation process between the observations of the candidates' vote shares. Fig. 7 reflects the ESDA for Le Pen's share of the vote in the second round of the presidential election. First, Moran's I scatter plot shows a positive spatial correlation, meaning that those places supporting Le Pen were surrounded by municipalities supporting that candidate. In contrast, areas not supporting Le Pen were surrounded by municipalities with low support for that candidate. Second, the Local

Table 2

Global Moran I and Geary's C tests for detecting spatial autocorrelation in voting patterns in LAUs in the Île-de-France region.

| Dependent variables | Global Moran's I | | Geary's C | |
|-------------------------|------------------|---------|-----------|---------|
| | Statistic | p value | Statistic | p value |
| <i>First round</i> | | | | |
| Votes for Macron (%) | 0.601 | 0.000 | 0.389 | 0.000 |
| Votes for Le Pen (%) | 0.734 | 0.000 | 0.259 | 0.000 |
| Votes for Mélenchon (%) | 0.490 | 0.000 | 0.515 | 0.000 |
| <i>Second round</i> | | | | |
| Votes for Macron (%) | 0.759 | 0.000 | 0.232 | 0.000 |
| Votes for Le Pen (%) | 0.745 | 0.000 | 0.246 | 0.000 |

Source: Author's elaboration.

Indicator of Spatial Association (LISA) Cluster Map complements the last conclusions, allowing us to visualise which groupings of municipalities show a significant spatial correlation with the vote for Le Pen. In dark red, those municipalities that voted highly in favour of Le Pen and were surrounded by others that also voted highly for that candidate are shown in the High-High cluster. This cluster is formed by municipalities far from Paris, mostly located in the Eastern half of the region. In dark blue, those municipalities that, on the contrary, voted to a lesser extent for Le Pen and were surrounded by other municipalities with low support for that candidate are reflected by the Low-Low cluster. This cluster comprises municipalities such as Paris and all its adjacent areas, as well as the LAUs located in the central-west area of Île-de-France. Few municipalities strongly supported Le Pen and were surrounded by municipalities that did not support her (see the High-Low clusters) or vice versa (see the Low-High clusters), which suggests that all neighbouring municipalities had very similar voting patterns.

The ESDA analysis of Macron's second-round presidential election vote share shown in Fig. 8 is essentially the opposite of that observed for Le Pen, which suggests that places with low support for Le Pen were dominated by municipalities with high support for Macron. This is logical in the second round since individuals had only the alternative of voting for Le Pen or Macron or abstaining from voting. However, as seen in Annex I, the ESDA analyses of Le Pen's and Macron's vote shares in the first round are very similar to those in the second round. This suggests that, in both rounds, there were similar well-defined geographical clusters that supported the mentioned candidates. However, it should be considered that these clusters are not the same in the first and second rounds due to the redistribution of the vote, mainly due to the disappearance of Mélenchon from the panorama of political alternatives. Mélenchon, as initially argued, was the third candidate with the highest support in the first round. The High-High cluster for this candidate was in the centre of Île-de-France, right in the agglomeration area; consequently, when this candidate disappeared, this part of the region began to be a cluster of strong support for Macron in the second round (Mélenchon had instructed his supporters to not vote for Le Pen in the second round). In conclusion, Macron managed to capitalise on votes

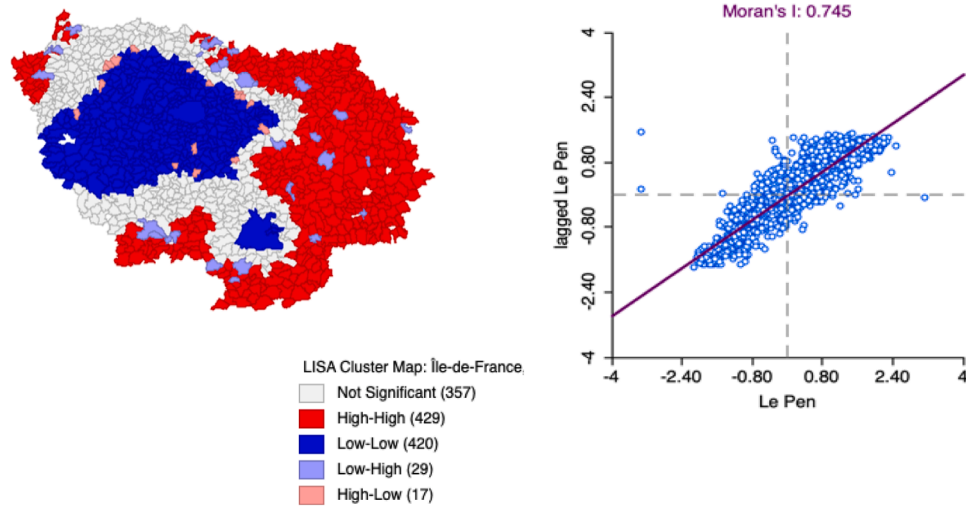


Fig. 7. LISA cluster map and Moran's I of Le Pen second-round presidential election vote shares. Source: Author's elaboration using data from the French Ministry of the Interior.

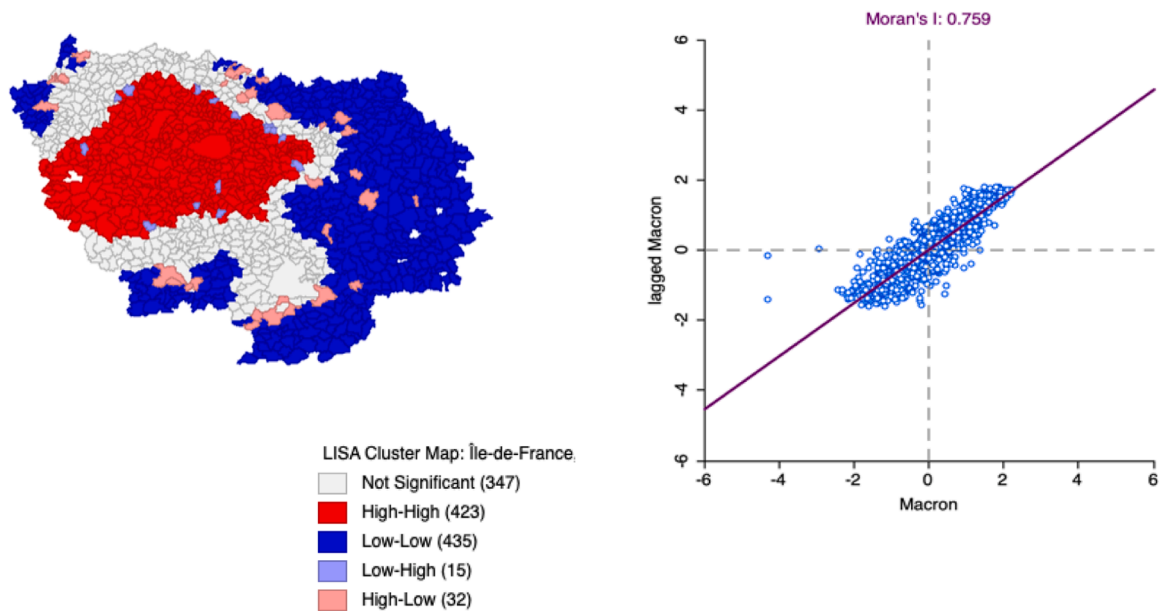


Fig. 8. LISA cluster map and Moran's I of Macron second-round presidential election vote shares. Source: Author's elaboration using data from the French Ministry of the Interior.

from Paris and the entire Eastern area of Paris in the second round, an area in which Mélenchon dominated in the first round.

The results of the exploratory analysis reinforce the need to control for possible spatial dependence as the location of each municipality and its spatial environment could determine voting behaviour. Consequently, the methodological strategy that better adapts to this context is spatial econometrics because it allows capturing the influence of space in the configuration of voting patterns. Carrying out spatial econometrics requires determining the neighbourhood matrix; in other words, it is necessary to establish *a priori* the neighbours of each Île-de-France LAU. Various neighbourhood matrices have been used, such as a fifty-kilometre distance matrix, which is usually considered an optimal distance to establish the neighbourhood criterion. Additionally, a twenty-nearest neighbours matrix was used. The number of twenty neighbours was used given that it is the median number of neighbours within a fifty-kilometre radius in Île-de-France LAUs.

Our analysis starts with simple estimates, such as Ordinary Least

Squares (OLS), and ends with more sophisticated estimates in which spatial dependence problems are controlled. In particular, three models of spatial econometrics are developed. First, the spatial autoregressive (SAR) model introduces a spatial component through the dependent variable. This approach allows us to capture how the voting pattern of neighbouring municipalities can affect the voting behaviour of a certain municipality. The typical specification of the model is reflected through expression [1]. Second, the Spatial Error Model (SEM) captures spatial autocorrelation through the error term. The equation of an SEM is presented through expression [2]. Third, the Spatial Durbin Model (SDM) is used. On the one hand, with the inclusion of a spatial component through the dependent variable, SDM allows us to control for the possible influence of neighbours' ideology on the voting decisions of the municipalities, like the SAR model. On the other hand, the SDM also permits the inclusion of spatial components through the independent variables, which allows us to control for the possible effects that the socioeconomic or demographic conditions of the neighbours

have on the determination of the vote in a specific municipality. The typical expression of an SDM is reflected by equation [3].

$$y = \rho W y + \beta X + u \quad (1)$$

$$y = \beta X + u \quad u = \lambda W u + \varepsilon \quad (2)$$

$$y = \rho W y + \beta X + \gamma W X + u \quad (3)$$

4. Main results

Tables 3 and 4 reflect the main estimates when employing the share of votes for Le Pen and Macron in the second round, respectively, as dependent variables. Annex II includes the estimates derived from taking the share of votes for Le Pen, Macron, and Mélenchon in the first round as the dependent variables. The Global Moran I test over OLS regression residuals shows a positive and significant statistical value in all carried-out estimates; see Tables 3, 4, II.1, II.2, and II.3 presented in Annex II. The abovementioned results suggest that spatial correlation between the OLS residuals is a problem for every model. The basic assumption of independence between observations is not met; therefore, it is inappropriate to proceed with the OLS estimates. Relying on spatial econometrics, such as by employing SAR, SEM, and SDM estimates, resolves this spatial autocorrelation issue. Additionally, Annex 3 includes estimates of the direct, indirect and total impacts linked to the SDM estimates, considering the percentage of votes for Le Pen in the second round as a dependent variable.

All the spatial components estimated in the SAR, SEM, and SDM regressions are significant and positive, indicating that there is a problem of spatial dependence, which in this case is captured through the spatial components included in each estimate. On the one hand, rho (ρ) is the spatial component that is included in both the SAR and SDM estimation. In all the SAR and SDM specifications for each round and candidate, this parameter takes a significant and positive value, which confirms, first, that there is a spatial dependence problem that is captured through these models and, second, and consequently, that the vote in one place is not independent of the vote made by adjacent municipalities. Lambda (λ), the spatial component included in the SEM estimates, is also significant and positive, meaning that the estimated error associated with each observation is consistently related to those of

neighbouring areas. The SEM, through the lambda (λ) parameter, allows for the capture and control of this spatial correlation between the errors.

The Akaike Information criterion (AIC) is a statistic typically used for model selection. The lower the value of this statistic is, the better the model is in terms of its goodness of fit and non-complexity of specification (Akaike, 1998). As shown in Tables 3 and 4, the estimates that consistently have a lower AIC value are those associated with the SDM. For this reason, the SDM estimates are taken as a reference for the interpretation of the results. They also provide greater explanatory capacity by allowing the inclusion of the independent variables' spatial lags, which is particularly interesting in line with the objectives of this study.

5. Discussion: Behind the spatial distribution of votes, spatial income inequalities

This section discusses the main results obtained from the estimates associated with the first (see Annex II) and second rounds (see Tables 3 and 4 presented in Section 4) of the French presidential elections of April 2022. The roles of sociodemographic factors and economic factors in the appeal of Macron and Le Pen are discussed. As justified, the interpretation of the results is based on SDM regressions. Special attention is given to analysing how spatial income inequalities could be linked with each candidate's support, especially with the radical option. Additionally, we discuss whether the socioeconomic and demographic determinants of the anti-system vote differ from one round to another.

5.1. The role of sociodemographic and spatial variables

The results presented in Tables 3 and 4 show that the sociodemographic profile of the municipalities of Île-de-France that support the pro-system and anti-system political options is practically the opposite in the second turn of the election. On average, individuals who have a higher level of education or who work in highly qualified jobs vote to a greater extent for Macron, the pro-system option. In other words, variables such as the percentage of the population with a high level of education, as well as the percentage of high-skilled occupations, showed a significant and positive association with the vote for that candidate in both electoral rounds (see Table 4 and Table II.2 presented in Annex II). The opposite is observed in the case of Le Pen: the mentioned variables

Table 3

Summary estimates. Dependent variable: Votes for Le Pen (%) in the second round of the presidential elections.

| | OLS | | SAR | | SEM | | SDM | |
|---|--------|----|---------|----|--------|----|----------|----|
| Intercept | 53.850 | ** | -29.462 | | 9.923 | | -157.550 | ** |
| Median income | 4.332 | * | 9.019 | ** | 6.890 | ** | 8.243 | ** |
| Unemployment rate (%) | -0.179 | ** | -0.183 | ** | -0.212 | ** | -0.201 | ** |
| Agriculture (%) | 0.013 | | -0.023 | | -0.017 | | -0.020 | |
| Artisans, merchants and entrepreneurs (%) | 0.009 | | 0.005 | | 0.012 | | 0.004 | |
| High skill occupations (%) | -0.115 | ** | -0.073 | ** | -0.070 | ** | -0.066 | ** |
| Immigrants (%) | -0.884 | ** | -0.455 | ** | -0.604 | ** | -0.558 | ** |
| People over 60 (%) | -0.383 | ** | -0.309 | ** | -0.335 | ** | -0.320 | ** |
| Highly qualified (%) | -0.683 | ** | -0.491 | ** | -0.497 | ** | -0.482 | ** |
| Distance to Paris | 0.001 | * | 0.001 | | 0.001 | ** | 0.001 | |
| Lag Median income | | | | | | | 14.102 | * |
| Lag Unemployment rate (%) | | | | | | | 0.130 | |
| Lag Agriculture (%) | | | | | | | -0.047 | |
| Lag Artisans, merchants and entrepreneurs (%) | | | | | | | -0.122 | |
| Lag High skill occupations (%) | | | | | | | -0.046 | |
| Lag Immigrants (%) | | | | | | | 0.312 | ** |
| Lag People over 60 (%) | | | | | | | 0.073 | |
| Lag Highly qualified (%) | | | | | | | -0.179 | |
| Observations | 1252 | | 1252 | | 1252 | | 1252 | |
| AIC | 7711.4 | | 7464.4 | | 7513 | | 7454.8 | |
| Rho (ρ) | - | | 0.476 | ** | - | | 0.482 | ** |
| Lambda (λ) | - | | - | | 0.825 | ** | - | |
| Moran's I over residuals | 0.129 | ** | - | | - | | - | |

Note: *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration.

Table 4

Summary estimates. Dependent variable: Votes for Macron (%) in the second round of the presidential elections.

| | OLS | | SAR | | SEM | | SDM | |
|---|---------|-----|--------|-----|--------|-----|---------|-----|
| Intercept | -47.870 | * | 4.707 | | 9.923 | | 119.680 | |
| Median income | 4.455 | * | -1.541 | | 6.890 | *** | -0.903 | |
| Unemployment rate (%) | 0.228 | *** | 0.223 | *** | -0.212 | *** | 0.232 | *** |
| Agriculture (%) | -0.020 | | 0.010 | | -0.017 | | 0.005 | |
| Artisans, merchants and entrepreneurs (%) | -0.032 | | -0.028 | | 0.012 | | -0.028 | |
| High skill occupations (%) | 0.114 | *** | 0.069 | *** | -0.070 | *** | 0.062 | *** |
| Immigrants (%) | 0.943 | *** | 0.495 | *** | -0.604 | *** | 0.593 | *** |
| People over 60 (%) | 0.341 | *** | 0.268 | *** | -0.335 | *** | 0.274 | *** |
| Highly qualified (%) | 0.625 | *** | 0.427 | *** | -0.497 | *** | 0.417 | *** |
| Distance to Paris | -0.001 | *** | -0.000 | | -0.001 | *** | -0.001 | |
| Lag Median income | | | | | | | -12.885 | * |
| Lag Unemployment rate (%) | | | | | | | -0.054 | |
| Lag Agriculture (%) | | | | | | | 0.060 | |
| Lag Artisans, merchants and entrepreneurs (%) | | | | | | | 0.162 | * |
| Lag High skill occupations (%) | | | | | | | 0.055 | |
| Lag Immigrants (%) | | | | | | | -0.276 | ** |
| Lag People over 60 (%) | | | | | | | -0.054 | |
| Lag Highly qualified (%) | | | | | | | 0.206 | * |
| Observations | 1252 | | 1252 | | 1252 | | 1252 | |
| AIC | 7758.4 | | 7492 | | 7550.1 | | 7483.7 | |
| Rho (ρ) | - | | 0.49 | *** | - | | 0.462 | *** |
| Lambda (λ) | - | | - | | 0.843 | *** | - | |
| Moran's I over residuals | 0.129 | *** | - | | - | | - | |

Note: *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration.

display a negative correlation with support for that candidate (see Table 3 and Table II.1 presented in Annex II). These results are in line with the conclusions of Abreu and Öner (2020), Gidron and Hall (2020), and Goodwin and Heath (2016), among others, who reported that low levels of education were associated with greater support for radical political options.

The results suggest that when there is a plurality of political alternatives, such as in the first round, the closest municipalities to Paris tend to vote for non-extreme right parties. Specifically, Tables II.2 and II.3 presented in Annex II show that there is a negative relationship between the distance to Paris and the vote for Macron and Mélenchon, which suggests that the vote coming from the most educated categories of the population tends to concentrate near this large city. This is logical and consistent with Fig. 3, where the vote for Macron was located in western Paris, but especially notable in the case of Mélenchon, which had the highest percentages of votes in Paris and the surroundings of the city. In the second electoral round, this distance to the Paris variable does not seem to be significant in explaining voting patterns. This result is consistent with the observation that Mélenchon's voters at the national level often have a high level of education (Bourdin and Torre, 2022) and, in turn, tend to concentrate close to Paris. When this candidate disappears, the concentration of the pro-establishment vote in Paris is no longer so evident, although Macron captures part of the area dominated by said candidate. However, it could be concluded that the significance of the distance to Paris dissipated in the second round by the redistribution of the vote caused by the reduction in the number of political alternatives.

Regarding to the demographic factors, the age of the individual is a variable that contributes significantly to determining electoral support for each candidate. Specifically, the results reveal that municipalities with a greater percentage of the population over 60 years of age present a positive association with support for Macron, whereas that variable has a negative association with support for Le Pen. This result could also be associated with municipalities' level of income. Surely, the municipalities that present a larger population over 60 years of age have higher average income levels, especially since retired people usually have larger incomes than younger workers do. In summary, a lower concentration of immigrants in the municipality, a lower proportion of the highly qualified population or those employed in high-skilled occupations, and a low concentration of individuals over 60 years of age are

variables that significantly contribute to determining support for anti-system political options such as Le Pen in the Île-de-France region.

The immigrants effect deserves a particular attention. Tables 3 and 4 show that, first, a higher percentage of the immigrant population in a municipality is positively associated with the vote for Macron, whereas it is inversely related to the vote for the radical option, Le Pen. Anti-system parties do not usually support immigration in their electoral programs and usually propose restrictive immigration policies; it is the case of Le Pen, therefore, it is logical to observe that the municipalities that have higher percentages of immigrants vote for a candidate who defends the inclusion and integration of the immigrant population, such as Macron. However, it is interesting to observe the effect of the spatially lagged variable in the SDM. Municipalities around a town with a strong immigrant presence tend to vote more for Le Pen and less for Macron. Therefore, it cannot be ruled out that the presence of immigrants boosts the anti-system vote among national residents.

5.2. The role of economic factors

In the first round, support for Macron, the most-voted candidate, was partially determined by economic factors. As seen in Table II.2 (presented in Annex II), first, median income presents a significant and positive association with the vote for that candidate; this was as expected, given that in the first round, support for Macron was mainly concentrated in the western area of Île-de-France, the richest part of the region (see Fig. 3). Second, spatial income inequalities do not increase support for Macron: the spatial lag of median income is nonsignificant, in other words, being surrounded by neighbouring areas with a higher level of income did not significantly favour the support for that candidate. However, in the second round, support for Macron was no longer motivated by economic factors. As seen in Table 4, median income is nonsignificant, as is the spatial lag of median income. These results are logical according to Fig. 4 and 6, where it was observed that in the second round, Macron managed to capture votes from the western part of the region but also from a significant part of eastern Paris, which are low-income LAUs that strongly supported Mélenchon in the first round. According to the literature on discontent, eastern Paris could have been considered an area with great potential for cultivating an anti-system vote, given that, in addition to presenting a lower income level, it is geographically close to high-income municipalities such as Paris, which

could have awakened a vote of revenge given its disadvantaged position. However, ultimately, an anti-system vote was not cultivated in those places. This is one reason to consider that political discontent does not only appear and rise in extremely disadvantaged municipalities. The typical Macron voter changed from voters from high-income municipalities in the first round to individuals who live both in advantaged and depressed economic LAUs in the second round.

Economic factors are particularly important for explaining support for the radical option. As expected, spatial income inequalities contributed notably to the rise of Le Pen in both electoral rounds. This is observed through the spatial lag of the median income; see Table II.1 presented in Annex II and Table 3. This variable has a positive sign, which means that an increase in the income in the surroundings of a certain municipality encourages voting for Le Pen in that municipality, or what is the same, it means that the existence of spatial income inequalities significantly promotes, on average, support for that candidate. The value of this parameter is slightly greater in the second round, suggesting that spatial income inequalities may be more relevant in determining the anti-system vote when political alternatives are limited. The results seem to support that the vote for Le Pen not only resides in the most disadvantaged municipalities but could also be cultivated in medium-income municipalities that could be worse off relative to their neighbours. An increase in median income increases support for Le Pen, which suggests that the municipality's income growth does not necessarily exempt it from an anti-system vote. This is what recent literature, such as that of Rodríguez-Pose et al. (2024), also observes. Voters who experience a stagnant economy, especially those of middle income, may be the ones who are potentially most dissatisfied with their disadvantaged situation compared with other places that achieved high levels of economic development. Another issue that seems to support this question is that increases in unemployment are not positively related to Le Pen support, which suggests that the anti-system vote is not necessarily limited to places with depressed economic conditions.

Table III.1 reflected in Annex III presents the estimated marginal effects from SDM estimates on the vote for Le Pen in the second round. It is relevant to focus on seeing the direct and indirect impacts of the income level on the support for the radical option in the last round of the presidential elections. The results confirm what was previously discussed. The direct effect regarding income is significant and positive which means that increases in income in a specific municipality, for instance, we can take as reference Paris, generate an increase in the vote for Le Pen in that municipality. However, what is truly relevant is that the indirect effect of income on the vote for Le Pen is significantly larger than the direct impact. In our example, this means that increases in the income level in Paris would greatly increase support for Le Pen in neighboring municipalities. In summary, these results suggest that, first, increases in the economic status of a certain municipality can be positively related to voting for the radical option (direct effect), which denotes that the vote for Le Pen is not strictly concentrated in most disadvantaged areas. Second, increases in the level of income in a certain area are going to substantially promote the anti-system vote in the surroundings. These results linked to the indirect effect demonstrate once again that in situations in which spatial economic inequalities appear the anti-system vote could be increased, on average.

5.3. The role of history and institutions

It is necessary to add some elements to understanding the characteristics of voting in the Paris region, which are linked to historical or institutional developments at the regional and national level.

France is an extremely centralised country dominated by Paris and its agglomeration both at the economic and political/ institutional levels. Public authorities have tried many times to combat this through decentralisation measures, which have mostly partially failed. The most recent, in 2015, is the "Notre" Law, which contributed to the creation, at the national level, of so-called 'Metropolises,' which bring together the

largest cities, with Paris as their head (Torre and Bourdin, 2023). Far from reducing centralisation, this policy has led to a concentration of power in large conurbations, which now have extended powers compared with medium-sized cities, for example (Griffith, 2017). Metropolises are thus able to enter into contracts with their hinterland, which is the case for the Paris agglomeration, with the areas located to the West and especially the east and south of the region, which are dependent on Paris. While these areas produce goods for consumption in the Paris Metropolis and host the leisure areas for city residents, they do not benefit from the same advantages, especially in terms of transport and communication (Mayer and Trevien, 2017). While transportation is very straightforward within Paris, or even between Paris and other cities such as Lille or Lyon (with the TGV), it is very difficult and, above all, takes a very long time to reach eastern Île-de-France, where residents feel isolated and abandoned.

In addition, it should be noted that the areas located east and north of Paris, which are on the edge of the capital, have a very particular sociological and historical profile. As heirs to a long tradition of struggle against the central government, these areas have long been the main voting base of the Communist Party and have thus been called the "red suburbs" or "red belt" (Stovall, 1989). Due to the existence of a strong network of social housing at very low rents, these areas are characterised by the presence of large populations of immigrants and the children of immigrants, who often have low incomes and thus live in ghettos won over by the left (Albecker and Fol, 2013). Unlike other working class areas in the rest of France that now vote for the *Rassemblement National*, these municipalities continue to vote massively in favour of Jean-Luc Mélenchon because they are opposed to anti-immigration policies. For the same reasons, their votes were transferred to Emmanuel Macron in the second round of the presidential election to block Marine Le Pen's anti-immigration initiatives.

6. Main conclusions

In this work, the relationship between spatial economic inequalities at the local scale and the anti-system vote has been studied in the case of the Paris region (Île-de-France). Various socioeconomic and demographic factors that are available at the selected disaggregation scale (LAUs) that the empirical literature considers to be determining factors of voting behaviour were used as control variables. For this purpose, various models have been estimated using a spatial econometric approach that allowed us to study the influence of spatial interrelationships on the voting behaviour of Île-de-France municipalities. Specifically, these models allowed us to observe how environmental conditions, such as the ideology or socioeconomic circumstances of surroundings areas, can determine the vote in a certain municipality.

In general, the results obtained for the studied case of Île-de-France confirm the main ideas of the growing literature on the 'geography of discontent.' Spatial imbalances in income between municipalities in the Île-de-France region are significantly and positively associated with the vote for Le Pen, the anti-system option. In other words, the increase in the level of income in the surroundings of a given municipality contributes to a rise in the anti-system vote in the considered municipality, which essentially means that being economically worse off relative to neighbouring municipalities encourages the populist vote. Notably, while the most common analyses on the 'geography of discontent' distinguish between large rural and urban areas for explaining voting patterns, our study allows us to observe that the determinants of voting are more complex and, above all, much more localised at the micro level, with intra-regional spatial economic inequalities being an especially strong driver of anti-establishment support.

In line with what was mentioned, the results suggest that increases in municipalities' absolute level of income are not associated with decreases in the anti-system vote, which implies that radical support is not exclusive to extremely economically depressed places; it could also be found in middle-income municipalities that have strong income gaps

between their high-income neighbours. These results reveal the importance of considering that the ‘geography of discontent’ goes beyond economically depressed areas and extends to all territories that observe economic inequalities in their environment. In addition, beyond the weight of income inequalities in the propensity to vote for anti-system options, sociodemographic aspects, such as immigration, also matter. Île-de-France is one of the regions with the greatest immigration pressure where the immigrant population is intensely concentrated in the northern and eastern suburbs of the Paris agglomeration. The econometric analysis confirmed that the concentration of immigrants is inversely related to the vote for Le Pen, which is logically justified given the opposition of this large group of the population to the anti-immigration policies that typically characterise anti-system political parties. This concentration of the immigrant population has notable effects on spatial voting patterns that are observed not only in the localities with the highest immigration levels but also in their surroundings.

All the results are clearly in line with the observed spatial divide in voting behaviour in the Île-de-France region. This break is spatial, social, and historical. In the second round of the French presidential elections in April 2022, the poorest populations, located in east of the Île-de-France region, in peripheral, rural, and rather isolated territories, voted massively for the *Rassemblement National*, the anti-establishment option led by Le Pen. On the other hand, support for Macron, the pro-system option, was strongly concentrated in the Paris conurbation for two reasons. First, in the city of Paris and the west of the Paris agglomeration, the political base comprises the upper classes, who are both rich and educated. Second, in the eastern part of the Paris agglomeration, it comes from a transfer of votes from left-wing voters, who, although relatively poor, turned to Macron in opposition to the anti-immigration doctrine of the *Rassemblement National*. The observed voting panorama is clearly explained by the factors that are found to be determinants of the anti-system and pro-system vote. In conclusion, the spatial inequalities found in the most remote areas of Paris (east of Île-de-France) promote anti-system support, whereas Paris and its surroundings, due to the greater concentration of highly skilled populations or the greater rejection of anti-immigration policies, show greater support for the pro-system option.

Our work shows that the growth of spatial inequalities can potentially collapse the European project, and for its survival, a forceful effort is required to limit the gaps between territories. According to these results, which reinforce those in the literature, a territorial cohesion policy

or other policies with a strong spatial component represent an effective instrument to curb the rise of anti-system political options. Likewise, action must occur at a local or even intra-metropolitan level. These local differences between rich, middle-income, and poor neighbourhoods could cause the most dissatisfaction with the system, which can easily become the main source of political discontent.

In future analyses and continuing with this line of research into the ‘geography of discontent’, we wish to delve deeper into the direction that these results point out, analyzing whether the effects of spatial income inequalities can vary throughout space. First, controlling for the effects of spatial heterogeneity seems interesting to us, and we consider it especially relevant to observe whether the location of the spatial economic inequalities can condition their significance and impact on radical parties’ support throughout the geography. Second, in this study, we have verified that in Île-de-France, the region with the highest level of economic inequality in France, imbalances in terms of income do significantly favour support for anti-system parties, on average. It would be interesting to analyze in future studies whether this same logic operates at the national level. This would allow us to contrast whether spatial inequalities in terms of income are relevant regardless of their intensity, in addition to allowing us to see whether the need for local policies is not only needed in a specific region and that the development of local policies could be necessary on a national scale.

CRedit authorship contribution statement

Tania Fernández García: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **André Torre:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Fernando Rubiera Morollón:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of Competing Interest

All authors declare any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work.

All authors declare that they do not use artificial intelligence (AI) and AI-assisted technologies in the writing process.

Annex I. ESDA analysis first round of the presidential elections. LISA cluster map and Moran’s I scatterplot

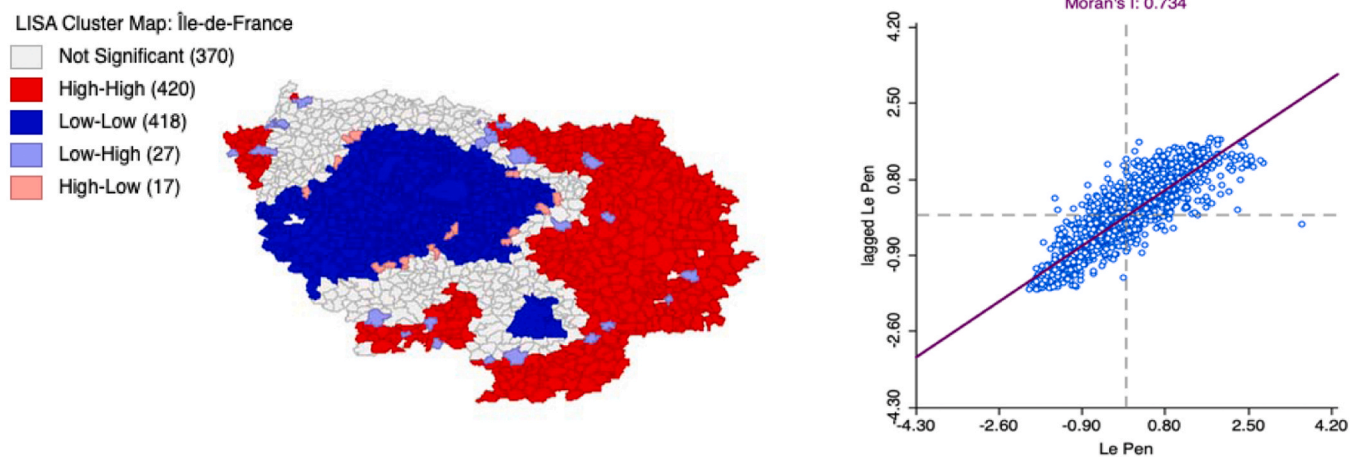


Fig. AI.1. LISA cluster map and Moran’s I of Le Pen first-round presidential elections vote share. Source: Author’s elaboration using data from the French Ministry of the Interior.

LISA Cluster Map: Île-de-France

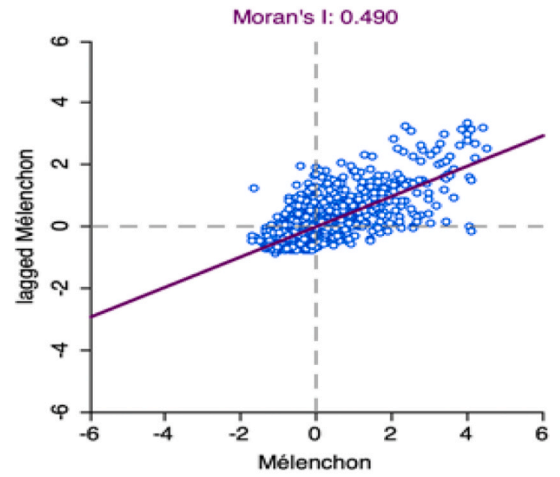
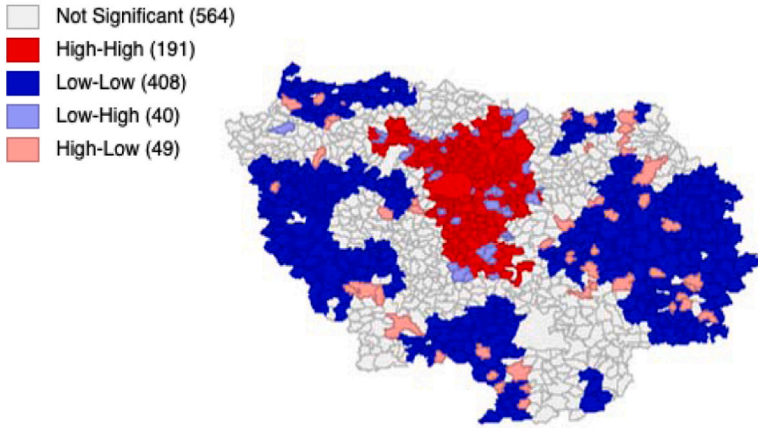


Fig. AI.2 LISA cluster map and Moran's I of Mélenchon first-round presidential elections vote share.

Source: Author's elaboration using data from the French Ministry of the Interior.

LISA Cluster Map: Île-de-France

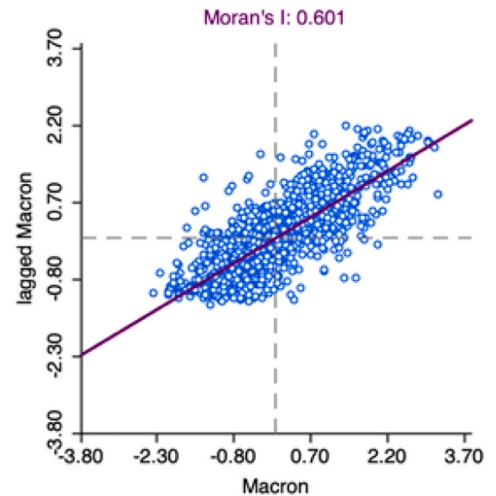
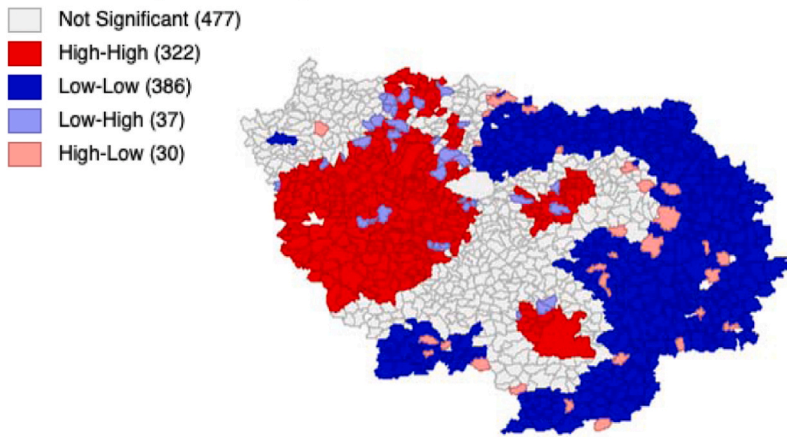


Fig. AI.3. LISA cluster map and Moran's I of Macron first-round presidential elections vote share.

Source: Author's elaboration using data from the French Ministry of the Interior.

Annex II. Results: First round of the French presidential elections of April 2022

Table II.1

Summary estimates. Dependent variable: Votes for Le Pen (%) in the first round of the presidential elections

| | OLS | | SAR | | SEM | | SDM | |
|---|--------|----|---------|----|--------|----|----------|----|
| Intercept | 42.810 | ** | -15.085 | | 9.741 | | -115.010 | ** |
| Median income | 2.596 | | 6.084 | ** | 4.674 | ** | 5.919 | ** |
| Unemployment rate (%) | -0.180 | ** | -0.182 | ** | -0.212 | ** | -0.205 | ** |
| Agriculture (%) | 0.042 | | 0.012 | | 0.008 | | 0.003 | |
| Artisans, merchants and entrepreneurs (%) | 0.021 | | 0.015 | | 0.015 | | 0.011 | |
| High skill occupations (%) | -0.089 | ** | -0.061 | ** | -0.060 | ** | -0.057 | ** |
| Immigrants (%) | -0.693 | ** | -0.382 | ** | -0.499 | ** | -0.453 | ** |
| People over 60 (%) | -0.301 | ** | -0.245 | ** | -0.267 | ** | -0.256 | ** |
| Highly qualified (%) | -0.522 | ** | -0.385 | ** | -0.393 | ** | -0.376 | ** |
| Distance to Paris | 0.000 | | 0.000 | | 0.000 | ** | 0.000 | |
| Lag Median income | | | | | | | 10.504 | * |
| Lag Unemployment rate (%) | | | | | | | 0.181 | |
| Lag Agriculture (%) | | | | | | | 0.043 | |
| Lag Artisans, merchants and entrepreneurs (%) | | | | | | | -0.071 | |
| Lag High skill occupations (%) | | | | | | | -0.036 | |
| Lag Immigrants (%) | | | | | | | 0.210 | ** |
| Lag People over 60 (%) | | | | | | | 0.039 | |
| Lag Highly qualified (%) | | | | | | | -0.131 | |
| Observations | 1252 | | 1252 | | 1252 | | 1252 | |

(continued on next page)

Table II.1 (continued)

| | OLS | | SAR | | SEM | | SDM | |
|--------------------------|-------|-----|--------|-----|--------|-----|--------|-----|
| AIC | 7018 | | 6806.3 | | 6859.1 | | 6793.3 | |
| Rho (ρ) | - | | 0.441 | *** | - | | 0.431 | *** |
| Lambda (λ) | - | | - | | 0.813 | *** | - | |
| Moran's I over residuals | 0.111 | *** | - | | - | | - | |

Note: *, **, and *** indicate statistical significance at 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration

Table II.2

Summary estimates. Dependent variable: Votes for Macron (%) in the first round of the presidential elections

| | OLS | | SAR | | SEM | | SDM | |
|---|----------|-----|----------|-----|--------|-----|----------|-----|
| Intercept | -210.500 | *** | -172.530 | *** | 9.923 | | -121.840 | *** |
| Median income | 21.200 | *** | 17.025 | *** | 6.890 | *** | 18.928 | *** |
| Unemployment rate (%) | 0.129 | *** | 0.126 | *** | -0.212 | *** | 0.102 | ** |
| Agriculture (%) | -0.104 | *** | -0.084 | *** | -0.017 | | -0.106 | *** |
| Artisans, merchants and entrepreneurs (%) | 0.011 | | 0.012 | | 0.012 | | 0.001 | |
| High skill occupations (%) | 0.040 | *** | 0.019 | * | -0.070 | *** | 0.016 | |
| Immigrants (%) | 0.201 | *** | 0.115 | *** | -0.604 | *** | 0.144 | *** |
| People over 60 (%) | 0.218 | *** | 0.186 | *** | -0.335 | *** | 0.149 | *** |
| Highly qualified (%) | 0.239 | *** | 0.166 | *** | -0.497 | *** | 0.167 | *** |
| Distance to Paris | -0.001 | *** | -0.001 | *** | -0.001 | *** | -0.001 | *** |
| Lag Median income | | | | | | | -7.652 | |
| Lag Unemployment rate (%) | | | | | | | 0.069 | |
| Lag Agriculture (%) | | | | | | | 0.114 | * |
| Lag Artisans, merchants and entrepreneurs (%) | | | | | | | 0.101 | |
| Lag High skill occupations (%) | | | | | | | -0.034 | |
| Lag Immigrants (%) | | | | | | | -0.063 | |
| Lag People over 60 (%) | | | | | | | 0.131 | ** |
| Lag Highly qualified (%) | | | | | | | 0.084 | |
| Observations | 1252 | | 1252 | | 1252 | | 1252 | |
| AIC | 6528.4 | | 6498.6 | | 6530 | | 6486.6 | |
| Rho (ρ) | - | | 0.393 | *** | - | | 0.449 | *** |
| Lambda (λ) | - | | - | | 0.813 | *** | - | |
| Moran's I over residuals | 0.126 | *** | - | | - | | - | |

Note: *, **, and *** indicate statistical significance at 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration.

Table II.3

Summary estimates. Dependent variable: Votes for Mélenchon (%) in the first round of the presidential elections

| | OLS | | SAR | | SEM | | SDM | |
|---|---------|-----|---------|-----|----------|-----|---------|-----|
| Intercept | 303.400 | *** | 292.440 | *** | -187.980 | *** | 228.470 | *** |
| Median income | -29.100 | *** | -28.268 | *** | 19.568 | *** | -32.068 | *** |
| Unemployment rate (%) | -0.005 | | -0.004 | | 0.105 | * | 0.036 | |
| Agriculture (%) | -0.087 | *** | -0.077 | *** | -0.114 | *** | -0.007 | |
| Artisans, merchants and entrepreneurs (%) | -0.065 | *** | -0.063 | *** | -0.004 | | -0.042 | ** |
| High skill occupations (%) | 0.015 | | 0.020 | | 0.022 | * | 0.016 | |
| Immigrants (%) | 0.776 | *** | 0.642 | *** | 0.168 | *** | 0.565 | *** |
| People over 60 (%) | -0.105 | *** | -0.107 | *** | 0.159 | *** | -0.069 | *** |
| Highly qualified (%) | 0.142 | *** | 0.128 | *** | 0.185 | *** | 0.074 | *** |
| Distance to Paris | -0.000 | ** | -0.000 | *** | -0.000 | *** | 0.000 | *** |
| Lag Median income | | | | | | | 9.718 | * |
| Lag Unemployment rate (%) | | | | | | | -0.002 | |
| Lag Agriculture (%) | | | | | | | -0.284 | *** |
| Lag Artisans, merchants and entrepreneurs (%) | | | | | | | 0.039 | |
| Lag High skill occupations (%) | | | | | | | 0.011 | |
| Lag Immigrants (%) | | | | | | | -0.286 | *** |
| Lag People over 60 (%) | | | | | | | -0.117 | |
| Lag Highly qualified (%) | | | | | | | 0.089 | |
| Observations | 1252 | | 1252 | | 1252 | | 1252 | |
| AIC | 6945.8 | | 6879.2 | | 6802.6 | | 6770.7 | |
| Rho (ρ) | - | | 0.21 | *** | - | | 0.499 | *** |
| Lambda (λ) | - | | - | | 0.732 | *** | - | |
| Moran's I over residuals | 0.142 | *** | - | | - | | - | |

Note: *, **, and *** indicate statistical significance at 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration.

Annex III. Measured marginal effects from SDM estimates

Table III.1

Direct, indirect and total impacts of the independent variables from SDM estimates. Dependent variable: Votes to Le Pen (%) in the second round of the French presidential elections of April 2022

| | Direct | | Std. Err. | Indirect | | Std. Err. | Total | | Std. Err. |
|---|--------|------|-----------|----------|------|-----------|--------|------|-----------|
| Median income | 9.069 | ** * | 2.385 | 33.274 | ** * | 12.696 | 42.342 | ** * | 12.878 |
| Unemployment rate (%) | -0.221 | ** * | 0.061 | -0.143 | | 0.383 | -0.364 | | 0.395 |
| Agriculture (%) | -0.033 | | 0.031 | -0.079 | | 0.189 | -0.111 | | 0.191 |
| Artisans, merchants and entrepreneurs (%) | 0.002 | | 0.023 | -0.191 | | 0.174 | -0.189 | | 0.180 |
| High skill occupations (%) | -0.069 | ** * | 0.017 | -0.136 | | 0.122 | -0.205 | * | 0.126 |
| Immigrants (%) | -0.537 | ** * | 0.050 | 0.142 | | 0.194 | -0.395 | ** | 0.194 |
| People over 60 (%) | -0.324 | ** * | 0.034 | -0.090 | | 0.173 | -0.414 | ** | 0.174 |
| Highly qualified (%) | -0.488 | ** * | 0.032 | -0.829 | ** * | 0.215 | -1.317 | ** * | 0.220 |
| Distance to Paris | 0.000 | ** * | 0.000 | 0.000 | ** * | 0.000 | 0.000 | | 0.000 |

Note: *, **, and *** indicate statistical significance at 10 %, 5 %, and 1 % levels, respectively.

Source: Author's elaboration.

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