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The political price of superblocks. Electoral outcomes of sustainable transport interventions in Barcelona

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ABSTRACT

Urban and transportation policies are increasingly recognized for their potential to mitigate climate change impacts and address transport externalities. Amidst efforts to shift modal preferences and reduce transport emissions, cities are turning to spatial-based policies, such as Superblocks, to reshape urban mobility. This research examines the electoral outcomes associated with the implementation of Superblocks in Barcelona, focusing on their impact on political support for Barcelona en Comú (BEC) during the local elections of 2015 and 2023. Utilizing a combination of adjusted difference-in-differences and propensity score matching methods, we assessed the public's electoral response to the Superblock initiative amidst a backdrop of declining city-wide support for BEC. Our findings reveal that Superblock areas demonstrated significantly stronger support for BEC, suggesting a political premium for the party responsible for these urban interventions. Specifically, electoral support in Superblock districts saw an increase of 10–14% compared to the rest of the city. This result highlights the potential of urban transformation policies to influence political preferences locally and potentially validate the use of local electoral data as a tool for evaluating public response to highly contested urban policies.

1. Introduction

Policy evaluation and policy impact assessments have become staples of our urban political landscape that is pushing for an increased need for mitigation actions against climate change (Aldred et al., 2019; Manaugh et al., 2015; Moeinaddini & Habibian, 2023; Zhang et al., 2022). Urban and transportation policies, in particular, are at the forefront of this battle, as they hold significant potential to reduce environmental impacts at the same time that they reduce well-known transport externalities (Cubells et al., 2024; Lindsey & Santos, 2020; Luz et al., 2022; Pereira et al., 2021). Despite multiple recent efforts to curve transport emissions and introduce significant modal change shifts, key transport indicators such as modal splits and Vehicle Kilometers Traveled (VKT), which measures the total kilometers traveled by all vehicles within a specified region over a given period, have remained frustratingly steady (Lamb et al., 2021; Milovanoff et al., 2021). In order to break this standstill and achieve a much-needed breakthrough in urban mobility, cities around the world are increasingly focusing on spatial-based policies that aim to transform mobility by changing the built environment design of cities and streets (Gil Solá & Vilhelmson, 2018;

Marchigiani & Bonfantini, 2022; Næss, 2022; Silva et al., 2023; Vilhelmson & Eldér, 2021; Yan, 2021).

Recent initiatives aimed at reducing car use and inducing modal change include purely traffic demand management tools (Ben-Dor et al., 2023; Moeinaddini & Habibian, 2023) such as carbon pricing (Ben-Dor et al., 2022), congestion charging (Hosford et al., 2021; Milenković et al., 2019) or low emission zones (Gonzalez et al., 2022; Player et al., 2023), as well as area-based measures such as parking restrictions and low traffic neighborhoods (Petraiki et al., 2022). Most importantly, they also include policies such as 15-minute cities or Superblocks, that aim to nudge changes in travel behavior by not explicitly forbidding non-sustainable behaviors, but making them more difficult and making street design to promote more sustainable behaviors such as utilitarian walking and cycling (Anguelovski et al., 2023). This latter set of policies significantly diverges from conventional traffic demand transport planning, which often centers on vehicles, by emphasizing sustainable and reachable local journeys. It shifts the emphasis on transportation efficiency from high-speed travel to the closeness of destinations (Handy, 2020), with a particular focus on promoting walking and cycling (Silva, 2023).***

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While these policies are promising and have been validated by numerous academic studies around the world, in practice, political implementation has been fraught with controversy and dissent. In 2023, protests erupted in British cities like Oxford and London against Low Traffic Neighborhoods and 15-minute cities (Grant, 2023). Similarly, in Edmonton, Canada, proposed neighborhood changes led to 'Hunger Games-style district' fears (Gerson, 2023), and in Rivas-Vaciamadrid, Spain, new bike lanes and proximity-based urban models faced public opposition (mimutos, 2022).

Within this context, this study addresses a critical gap in urban planning literature: understanding the political acceptability of new policies aimed at transforming urban environments to encourage behavioral change. Specifically, it examines the electoral consequences for progressive mayors and city politicians who advocate for and implement these policies using the case of Barcelona as an example. Traditional acceptability analyses, while valuable in deciphering the perspectives of citizens and stakeholders, do not adequately measure the impact of these policies on political support and voter turnout. To address this, our research focuses on whether these new urban policies influence electoral outcomes by investigating if individuals express their support or opposition to these policies at the ballot box. This approach enables us to assess not only if mayors aligned with sustainability initiatives receive increased electoral support from sustainability-focused constituents but also if the opposition, often vocal in social media and press, actually translates into tangible voter backlash.

2. Background

Recent protests against initiatives like 15-minute cities and low-traffic neighborhoods (LTN) reflect a complex tapestry of public opinion and underscore the necessity of understanding the multifaceted nature of policy acceptability. As cities worldwide strive to implement sustainable and environmentally friendly policies, the challenge now lies not just in the conception of these initiatives but significantly in their acceptance by the public whom they are designed to serve. In this light, the concept of policy acceptability has gained importance across climate change policies and mitigation strategies.

In the context of transportation policies, there has been substantial analysis of factors influencing the acceptability and opposition of various travel demand strategies and infrastructural projects. These studies offer crucial insights into how residential location choices and life preferences work at different scales to shape policy acceptability (Ettema & Nieuwenhuis, 2017; Wang & Lin, 2019). They reveal that support for measures restricting car use or promoting alternative modes is often contingent upon the perceived personal impact of these policies (**Manville & Cummins, 2015; Palm & Handy, 2018), as well as differing according to personal values (Hansla et al., 2017; **Huijts et al., 2012; Manville & Cummins, 2015; Sun et al., 2016). The acceptability literature has also explored factors such as institutional trust (Christiansen, 2018; Lim & Moon, 2022; Zografos et al., 2020), policy-specific beliefs (Eriksson et al., 2008), or procedure legitimacy (Jagers et al., 2017; Oltra et al., 2021), along with perceived efficacy of the policy (Sun et al., 2016). Finally, these factors are often mediated by perception of individual and collective fairness perceptions (Kallbekken & Sælen, 2011; Maestre-Andrés et al., 2019), distribution effects (Semple & Fountas, 2022), as well as partisanship dynamics (Douenne & Fabre, 2020; Sokoloski et al., 2018).

However, two critical gaps are evident in the current body of research. Firstly, the concept of policy acceptability has not been comprehensively applied to a range of progressive and advanced built environment policies that aim to reduce travel demand and promote sustainable practices (Thaller et al., 2023). While substantial research has focused on the acceptability of policies such as congestion pricing (Ben-Dor et al., 2022; Gu et al., 2018; Hårsman and Quigley, 2010; Milenković et al., 2019; Sun et al., 2016), carbon taxes and (Carattini et al., 2018; Drews et al., 2022) and low traffic emission zones

(Mehdizadeh & Shariat-Mohaymany, 2021; Morton et al., 2021; Oltra et al., 2021; Player et al., 2023), there is a notable lack of research on built environment-based travel behavior policies. These include transformative concepts like 15-minute cities, Superblocks, and urban center densification strategies, which are increasingly becoming part of municipal plans worldwide.

These policies distinguish themselves by not overtly restricting or taxing unsustainable behaviors but rather employing behavioral nudges and spatial allocation patterns (Ajuntament de Barcelona, 2023; Aldred et al., 2021; Aldred & Goodman, 2021; Allam et al., 2022; Anguelovski et al., 2023; Da Silva et al., 2020; Ferrer-Ortiz et al., 2022). They leverage design, traffic management, and tactical urbanism to subtly encourage sustainable transport modes like walking and cycling. Given their novelty, localized implementation, and distinct approach compared to traditional policy instruments, these policies have not yet received substantial attention regarding their societal acceptance. This oversight becomes particularly evident in light of recent international protests against certain implementations of 15-minute cities or low-traffic neighborhood strategies (Marquet, Anguelovski, et al., 2024). These movements underscore the urgent need for comprehensive research into the acceptability of these innovative urban strategies (Marquet, Mojica, et al., 2024).

Secondly, most analyses to date rely heavily on individual-level, self-reported measures. This reliance poses a challenge, as it becomes difficult to correlate these subjective perceptions with tangible outcomes in elections – the ultimate measure of a politician's success. A significantly lower number of studies have tried to use electoral data in their analysis. However, these studies have predominantly focused on vote results from single-issue elections or referendums concerning specific transport measures. Noteworthy examples include referendums on road pricing measures held in Edinburgh in 2005 (Gaunt et al., 2007), Milan (Boggio & Beria, 2019; Percoco, 2017), Stockholm in 2007 (Eliasson & Jonsson, 2011), Manchester in 2008 (Sherriff, 2015) or Gothenburg in 2014 (Hansla et al., 2017; Hysing, 2015). More recently, the Paris e-scooter ban was confirmed through a referendum. These referendums are typically characterized by low voter turnout rates, raising questions about their ability to accurately reflect broader public opinion. Additionally, a common criticism of using referendums for transport policy decisions is the significant informational demands placed on voters (Hensher & Li, 2013). These voting processes often address city-wide or national policies without adequately considering the more nuanced impacts of localized interventions. Consequently, while referendums provide a direct form of public engagement, their applicability, and effectiveness in capturing the complex dynamics of policy acceptability, especially for transport and urban planning policies, remain limited.

The utilization of electoral data from local or national elections in policy acceptability research has been largely restricted to highly specific issues where conditions conducive to a quasi-experimental approach existed. Notable in this context is the work of Carattini et al (2017) analysis of green taxes in Switzerland using national electoral data at the national level. Similarly, Reed et al (2019) examined the electoral response to a ballot initiative on a state carbon tax in Washington State (US). Another interesting case is the study by De La Calle & Orriols (2010), which explored the political benefits accruing from metro expansion in Madrid, demonstrating how infrastructure development can influence electoral outcomes. Additionally, Stokes (2016) provided a nuanced analysis of the political repercussions of wind turbine implementation. Their study revealed a political loss ranging from 4 to 10 % in local elections among residents living in close proximity to the turbines, employing a research design similar to ours.

This paper aims to fill in some of the gaps identified above by measuring the political repercussions of the Superblock program in Barcelona. By using Geographic Information System (GIS) data to pinpoint where Superblock program interventions are taking place and coupling it with the availability of disaggregated electoral data at the census area level, we are able to use methods such as Difference-in-

Differences (DiD) and Propensity Score Matching (PSM) to investigate whether citizens living within areas that received a Superblock between 2015 and 2023 retrospectively punished or benefitted the incumbent local government. Our research design also aims to test the potential to use local political election results as a barometer for gauging citizen opinions on controversial transport and built environment interventions. Our approach goes beyond traditional self-report measures, seeking to link tangible electoral outcomes with public sentiment towards urban policy initiatives. In doing so, this paper not only contributes to the academic discourse on urban planning and policy acceptability but also offers practical insights for policymakers navigating the complex landscape of urban environmental interventions.

3. Case study: Barcelona's Superblocks

3.1. Barcelona en Comú and the Superblocks

The Superblock strategy aims to significantly reduce car traffic in specific areas, thus fostering a more livable, quieter, and cleaner setting that promotes walking, biking, and community engagement (Rueda et al., 2019). Emphasizing pedestrian needs above those of vehicles, this approach seeks to enhance the environmental quality and overall livability within urban neighborhoods. Barcelona's archetype Superblock involves nine city blocks, in which traffic is diverted in and away from the center block, thereby transforming four vehicular intersections into four public plazas (Ajuntament de Barcelona, 2023). This process leads to the almost pedestrianization of the area and redirects through traffic to major roads around it. Despite the ambitious original plans for widespread implementation across Barcelona, the actual number of established Superblocks has been limited (Fig. 1). These interventions, often employing tactical urbanism, bring about substantial changes in the physical layout of the areas.

Earning international accolades, Barcelona's Superblock program is

often lauded for its pioneering reconfiguration of public space and mobility networks (Eggimann, 2022) alongside its significant health benefits (Li & Wilson, 2023; Mueller et al., 2020). Born in the early 2010s, the program has been acclaimed for its radical approach to rethinking the city's transportation grid, utilizing Barcelona's grid-pattern central district to its full potential while maintaining the flexibility necessary for application elsewhere (Eggimann, 2022). Because of the role that transportation networks have on the urban social fabric, as both generator and catalyzer of existing spatial injustices (Hananel & Berechman, 2016), the Superblock model was seen at the time as a refreshing departure from conventional transportation management, marking the dawn of a new urban design era that prioritizes the everyday needs of citizens (Amorim-Maia et al., 2023). The central tenet of the program was that increased barriers to car travel through the city, combined with restricted parking access and dedicated spaces would encourage drivers to choose alternative travel modes for those trips on which they were available (Ajuntament de Barcelona, 2023). The expectation was that those alternatives would take the form of more sustainable and healthier forms of transportation. As such, the Barcelona model shared a causal mechanism with other famous policies implemented in Europe at the same time, such as 15-minute cities, or low-traffic neighborhoods.

While the Superblock experience has been lauded internationally and has inspired other municipalities to adopt similar initiatives (Maing, 2022; Scoppa et al., 2018), the program has also created intense controversy at the local level, both in the public opinion and the political stage (Zografos et al., 2020). Although the inception of the Superblock program predates the tenure of Barcelona en Comú (BEC) and Mayor Ada Colau's administration, Superblocks have grown synonymous with BEC's vision for Barcelona (Nello-Deakin, 2022). The Superblock program was the flagship policy of the Ada Colau BEC administration, sparking extensive controversy and becoming a battleground of political ideologies. In fact, public pressure and the struggles to push forward

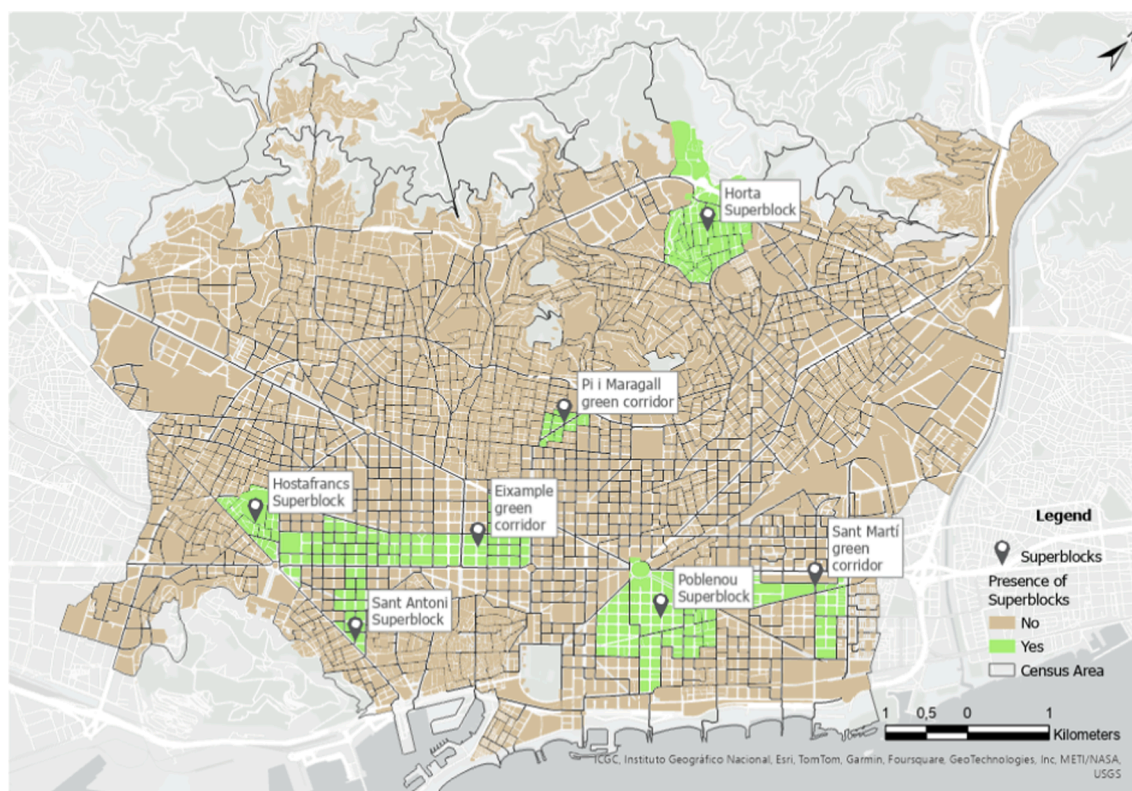


Fig. 1. Superblock and green corridors implemented during BEC 2015–2023. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

with urban transformations caused a slight approach change by the BEC-led city government. To circumvent the contentious reactions associated with the “Superblock” nomenclature, the municipality opted for alternative designations for other significant urban projects, like the Eixample and the Sant Martí green corridors (Ajuntament de Barcelona, 2023).

This association between the Superblock initiative and heightened political scrutiny peaked during the local elections 2023. These elections underscored divergent visions of urban development for the city: one championed by Colau and BEC, advocating for a city designed for its neighbors, caring for everyone’s need, inclusivity, and a focus on residents over tourists; and the other, a right-leaning perspective emphasizing car use and freedoms, critiquing the city’s recent transformations as excessive (Nello-Deakin, 2023). The 2023 election saw the Superblocks as a symbol of contrasting urban visions. This intense political debate around Superblocks underscores the deep divisions in perceptions of urban development and the future direction of Barcelona.

Given the highly contested nature of this policy, which has been a central theme in political discussions and can be precisely identified on the map, the Superblock program provides a unique opportunity to study the potential impact of locally ambitious transformation programs on voting behavior. The distinctiveness of the Superblock interventions and their central role in the political discourse suggests that any observable voting differences between comparable areas with and without Superblock implementations could be attributed to the policy itself. This setting offers a rich context for analyzing how urban planning initiatives like the Superblocks influence political outcomes, reflecting the broader societal and political dynamics at play in Barcelona.

4. Methods

4.1. Data sources

We used official Barcelona data to geolocate the main urban interventions that could be effectively classified as Superblocks, and that had been implemented between 2015 and 2023 (see Fig. 1). Since we wanted to relate the possible impact the Superblocks may have on the electoral results, we used the census areas as our basic unit of information. Thus, then we needed to categorize each of the city’s census areas based on the presence or absence of a Superblock within their boundaries. Using census areas as our primary analytical unit enabled the compilation of a comprehensive array of socioeconomic indicators for each sector. These indicators included the average rental price per square meter, levels of education, demographics concerning sex and age, motorization car rates, average household size, proportion of immigrants, average household income, and the Gini coefficient, drawing from data provided by Spain’s National Institute of Statistics (INE) and the Barcelona Open Data platform, and spanning both 2015 and 2023. Finally, electoral data from the 2015 and 2023 local municipal elections were gathered from the official results provided by the city council. Our analysis focuses on two primary outcomes: the total share of electoral votes from the valid ballots cast and the variation in the share of votes for Barcelona en Comú (BEC) between the 2015 and 2023 elections.

4.2. Empirical approach

We aim to assess the impact of the Superblocks implementation on the electoral support for BEC incumbent party in the affected census areas (i.e., the average treatment effect on the treated, ATT). As it is not possible to observe electoral outcomes at the same point in time in the treatment census areas with and without the existence of the Superblocks, we turn to non-experimental methods. In particular, and following previous literature recommendations (Abadie, 2005; Curto-Grau, 2017), we use a combination of adjusted difference-in-differences (DiD) and propensity score matching (PSM) methodologies. This allows us to relax the strong assumption of parallel trends on

which the conventional DiD is based. On the one hand, Adjusted DiD enables us to examine temporal shifts in electoral outcomes between areas affected by the Superblocks and those that are not, effectively isolating the impact of this urban policy intervention from other concurrent changes. This approach allows us to account for confounding factors, thereby enhancing the accuracy of our causal estimates. On the other hand, PSM simulates the conditions of a randomized experiment in an observational study setting. This method addresses the issue of non-random treatment assignment, which is crucial in urban planning contexts where controlled experiments are often unfeasible. It helps create a balanced comparison by matching areas with and without Superblocks on similar characteristics, thereby mimicking a randomized experiment setting.

The central idea behind using the two methods relies on the random or non-random assignment of Superblocks location in Barcelona. If one assumes that the allocation of Superblocks by the city council has been purely random, then using Adjusted DiD would be enough to gauge their political result properly. However, if the implementation has been guided by some observable pre-existing factors –such as preexisting political support or other socioeconomic characteristics– then using PSM becomes necessary, as it allows us to match treated and not treated census areas based on their probability of receiving a Superblock intervention. In other words, using PSM allows us to match treatment and control areas based on a similar sociodemographic pattern, so the outcome comparison is not influenced by baseline sociodemographic differences. By leveraging the strengths of both Adjusted DiD and PSM, we expect to thoroughly assess any electoral outcomes that can be attributed to the implementation of Superblocks in Barcelona.

4.3. Adjusted DiD

Our primary method, Adjusted DiD, is a quasi-experimental design that compares outcome changes over time between groups subjected to an intervention (in this case, Barcelona’s Superblocks) and those that are not. Adjusted DiD is commonly used when evaluating the impact of policy changes or interventions over time, in this case, the implementation of Superblocks in specific census areas in Barcelona. Adjusted DiD assumes that, absent the intervention, the difference between these groups would remain constant over time (parallel trends assumption). In our context, it allows us to discern the electoral impact of introducing Superblocks in Barcelona, controlling for other covariates like socioeconomic variables, thus providing a more accurate estimate of the Superblocks’ effect. This method is particularly suited to estimate causal effects when random assignment is not feasible and is strengthened by the inclusion of control variables that account for confounding factors, thereby isolating the impact of the intervention from other concurrent changes. The main variable of interest is support for BEC in the 2023 election, measured as a share of votes over all valid votes in each census area. Control variables at the census area level include average rental price per square meter, education levels, sex and age demographics, motorization rates, average household size, immigrant share, average household income, and the Gini coefficient. These covariates, available for 2015 and 2023, are used to build interaction terms that allow us to observe how each covariate changes its explanatory influence over the BEC vote between 2015 and 2023.

Using Adjusted DiD models, we address biases from unobserved factors that remain constant over time. By controlling for observed variables that vary between groups and over time, like socioeconomic factors, we refine our causal estimates. This method enables us to approximate the causal effect of urban transport policies at the street level on political outcomes.

4.4. Propensity Score Matching (PSM)

The second method is Propensity Score Matching (PSM), a statistical technique used in observational studies to estimate the causal effects of

interventions, policies, or treatments (Heckman et al., 1998). This method is particularly relevant in scenarios where randomized controlled trials are not feasible (Curto-Grau, 2017; Cusimano et al., 2021), such as urban planning interventions like the Superblocks in Barcelona. PSM enables the creation of a statistically equivalent control group by matching each unit in the treatment group with units in the control group based on observed covariates, thereby mimicking the conditions of a randomized experiment. The method assumes that if treated and control units are matched on observed covariates, biases arising from non-random treatment assignments can be significantly reduced. This approach is crucial in our context, as it allows us to isolate the effect of Superblocks from other factors that might influence electoral behavior.

In this study, the treatment group consists of census areas in Barcelona where Superblocks were implemented (n = 83), while the control group comprises (n = 1003) areas without such interventions. Our primary outcome of interest reflects the change in voting support for BEC between the 2015 and 2023 elections. The control variables in our PSM model, identical to those in the DiD model for the baseline year (2015), cover demographic and economic factors that might influence both Superblock implementation and residents' political preferences. Using logistic regression, we estimated the propensity scores, representing the probability of an area receiving the treatment based on observed characteristics. To enhance the precision of our matching strategy, we implemented a kernel-based matching approach. This method weights control units according to their distance in propensity scores from treated units, using a bandwidth of 0.03 to ensure that matches are local. That allows each treated unit to be matched with a weighted average of control units, where the weights are determined by a Gaussian kernel function of the distance in propensity scores. As usual in PSM methods, the matching process is predicated on the assumptions of Conditional Independence and Common Support, ensuring that comparisons are made between comparable units. By controlling for a range of potential confounders and approximating the conditions of a randomized experiment, we aim to offer robust estimates of the impact of Superblocks on electoral dynamics in Barcelona.

5. Results

In the 2023 local elections, Barcelona en Comú (BEC) experienced a decline in electoral support, securing only 19.77 % of the valid votes. This represented a marginal drop from their 2019 results (20.7 %) and a more significant decrease from the 2015 elections (25.2 %), where they first assumed control of the Barcelona city council. While detailed analyses of the socioeconomic and spatial dynamics across these election periods, along with the factors contributing to BEC's loss of 45,000 votes between 2015 and 2023, have been explored in other studies (Feenstra & Tormey, 2023; Nicolas & Ramirez, 2019), it is pertinent for our analysis to note the electoral behavior in areas with Superblock interventions.

In 2015, prior to any Superblock implementations, areas later hosting Superblocks showed 25.2 % support for BEC's mayoral candidate, Ada Colau, slightly lower than the 25.8 % in other city areas. By 2023, amid intense public debate over Superblocks, BEC garnered 24.1 % support in Superblock areas, compared to 19.5 % in non-Superblock areas, marking a significant 4.57 percentage point difference (Fig. 2). Fig. 3.

This trend suggests that Superblocks might have mitigated BEC's overall electoral decline, with these areas showing relatively stronger support for the party. However, simply interpreting these figures as a direct impact of Superblock implementation overlooks crucial considerations. Firstly, there's a risk of endogenous bias: Superblocks may have been implemented in areas already demographically inclined towards BEC, potentially obscuring the real effect of the intervention. Secondly, the demographic and social shifts within these areas, and across the city, might be influencing the results. For instance, a demographic change driven by the appeal of Superblocks could lead to population replacement, affecting electoral outcomes. Additionally, this dynamic might inadvertently silence dissent by displacing critics from Superblock areas due to gentrification effects, thereby changing the voting patterns in those areas.

To accurately assess the impact of Superblocks on electoral outcomes, it is thus crucial to adjust for demographic changes between 2015 and 2023. This necessitates a two-pronged approach: employing Adjusted Difference-in-Differences (DiD) to account for temporal changes, alongside Propensity Score Matching to balance out

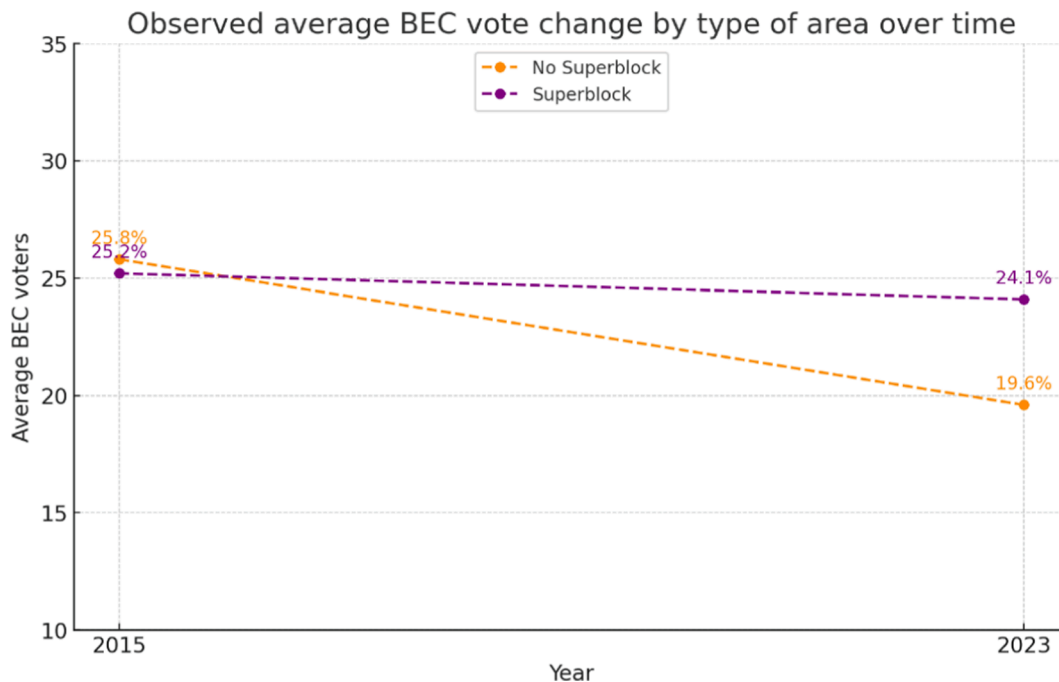


Fig. 2. Observed average BEC vote change by type of area over time.

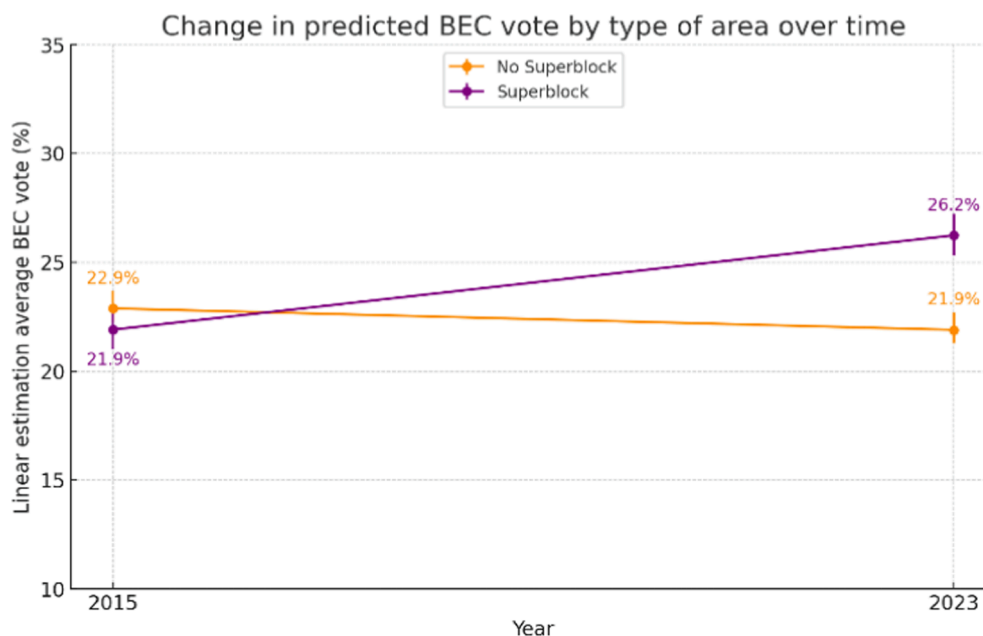


Fig. 3. Change in predicted BEC vote by type of area over time.

demographic differences and potential biases in Superblock allocation.

5.1. Adjusted DiD

The model reveals a statistically significant interaction between the implementation of Superblocks and the year 2023 ($\beta = 0.0199$, $p < 0.001$, 95 % CI [0.008, 0.032]). This finding suggests that in 2023, areas with Superblocks exhibited a higher vote share for Barcelona en Comú (BEC) compared to those without Superblocks, even after adjusting for key sociodemographic factors. Such a result implies that the introduction of Superblocks positively influenced electoral support for BEC. Specifically, after accounting for relevant sociodemographic variables, areas with Superblocks outperformed those without by approximately 0.8 to 3.2 percentage points in terms of BEC vote share. While this increase might appear modest, it's important to contextualize it in light of the average support for BEC across each census area in the city being 19.9 % and their overall city-wide support standing at 19.8 % in 2023. This means that in areas with Superblocks, BEC's performance exceeded the city average by approximately 4 % to 16 %, a substantial over-performance relative to their general electoral support.

Notably, the individual effects of Superblocks ($\beta = 0.0044$, $p = 0.281$, 95 % CI [-0.004, 0.012]) and the year variable ($\beta = -0.0365$, $p = 0.558$, 95 % CI [-0.159, 0.086]) were not statistically significant. This indicates that neither the presence of Superblocks in general across Barcelona nor the mere passage of time from 2015 to 2023 was associated with a significant change in BEC's vote share when considered independently and once we accounted for sociodemographic covariates.

Most importantly, the lack of significance in the individual Superblock variable suggests that areas destined to have Superblocks were not already predisposed to higher BEC support in 2015. This provides some evidence against potential endogeneity concerns, where Superblocks might have been implemented in areas already favoring BEC. However, while this mitigates the likelihood of endogeneity related to pre-existing political preferences, we cautiously note that it does not eliminate all potential sources of endogeneity.

In terms of how the voting patterns changed between 2015 and 2023, the support in 2015 for BEC was stronger in areas characterized by lower educational attainment ($\beta = 0.4753$, $p < 0.001$), lower income levels ($\beta = -0.0025$, $p = 0.001$), but also lower income inequality ($\beta = -0.0034$, $p < 0.001$). Demographically, a higher percentage of females ($\beta = 0.1777$,

$p = 0.023$), and higher motorization rates ($\beta = 0.0362$, $p = 0.049$), were also associated with higher support for BEC.

In contrast, while 2023 BEC's support remained stronger in areas with lower educational attainment, the association decreased in strength ($\beta = 0.1379$, $p = 0.035$ in 2023, compared to $\beta = 0.4753$, $p < 0.001$ in 2015). Notably, areas with higher percentages of highly educated residents, which did not significantly favor BEC in 2015, showed significant positive support in 2023 ($\beta = 0.3081$, $p < 0.001$), indicating a broadened appeal across educational backgrounds. The positive association with the female population remained relatively stable, continuing to show support for BEC ($\beta = 0.1819$, $p = 0.02$ in 2023, compared to $\beta = 0.1777$, $p = 0.023$ in 2015). The negative impact of higher rental prices on BEC's vote share also persisted but was slightly less pronounced ($\beta = -0.0055$, $p < 0.001$ in 2023, compared to $\beta = -0.0060$, $p < 0.001$ in 2015), suggesting a continued trend of lower support in areas with higher living costs.

A significant shift was observed in the age demographics' influence on BEC support. The negative influence of both young and senior populations on BEC's vote share became more pronounced in 2023, particularly among the young population ($\beta = -0.7772$, $p < 0.001$ for young; $\beta = -0.6052$, $p < 0.001$ for seniors in 2023, compared to $\beta = -0.1201$, $p = 0.041$ for young; $\beta = -0.6171$, $p < 0.001$ for seniors in 2015). Economically, wealthier areas continued to show less support for BEC, with a more pronounced negative impact from household income in 2023 ($\beta = -0.0041$, $p = 0.012$, compared to $\beta = -0.0025$, $p = 0.001$ in 2015). The Gini coefficient retained its negative correlation with BEC support, indicating an ongoing trend of lower support in more unequal areas ($\beta = -0.0034$, $p < 0.001$ in both years). Finally, and in contrast to the slight positive association in 2015, motorization rates showed a significant negative association with BEC support in 2023 ($\beta = -0.1311$, $p = 0.018$ in 2023, compared to $\beta = 0.0362$, $p = 0.049$ in 2015), suggesting that areas with higher motorization rates were less likely to support BEC in 2023.

To ease interpretation of the Superblock effects over voting patterns we estimated the marginal effects of Superblock implementation across different years (Fig. 2). The results indicate that while the adjusted city-wide support for BEC decreased slightly over time, areas that received Superblocks saw a substantial increase in support, emphasizing the localized impact of this urban policy.

5.2. Propensity score matching

As a second step in our analysis, we used Propensity Score Matching (PSM) with a kernel matching strategy (bandwidth 0.03) to assess the impact of Superblocks on voting behavior in Barcelona. This approach allowed us to compare treated areas (with Superblocks) against a weighted average of control areas (without Superblocks). Kernel matching assigns weights to control units based on their propensity score distance from each treated unit, with the weighting scheme determined by the specified bandwidth. In practical terms, control units with propensity scores closer to that of an area with a Superblock (within the 0.03 bandwidth) receive higher weights in the analysis, ensuring that the matched control group is a weighted average of controls that are most similar to the intervened areas in terms of their propensity scores. This method enhances the quality of the matches by prioritizing control units that are more comparable to the areas that have received Superblocks without artificially limiting the amount of control units.

5.3. Estimating propensity scores

Our first step involved estimating propensity scores using logistic regression. The model's coefficients, outlined in Table 2, indicate the relationship of each covariate with the likelihood of an area having received a Superblock between 2015 and 2023. The model highlights some key factors regarding the likelihood of Superblock implementation, such as the fact that areas with higher rental prices, and higher presence of either younger population or seniors were less likely to have received a Superblock intervention. While useful as a means to build the propensity score estimations, these values don't indicate a strong spatial or demographic bias in Superblock allocation. Table 3.

5.4. PSM matching quality

After running the kernel matching, we conducted a balance test to assess the quality of our matches. The results, presented in Table 1, demonstrate the effectiveness of our matching strategy as we have effectively balanced the covariates between the treated and control groups, as evidenced by the reduced % bias across most variables in Table 1. After this matching process, both the treated areas and the selected control areas displayed highly similar mean values in all the variables of interest. Further, after matching the Mean Absolute Bias across all covariates was substantially reduced to 2.8 %. This reduction is indicative of a well-balanced match between the treated and control groups, as it reflects a minimal average difference in the covariate values between these groups. On the other hand, the percentage of Bias Reduction, a critical measure of the improvement in balance achieved through matching, was observed to be 50 %.

The overall balance was thus substantially improved compared to the pre-matching scenario, which is critical for isolating the Superblocks' effect from other confounding factors as it allows us to attribute the observed differences in outcomes (voting behavior) to the intervention (Superblocks) rather than to underlying differences in the covariates.

5.5. Impact of Superblocks after PSM

In the evaluation of the impact of Superblocks on voting behavior in Barcelona, our analysis reveals a notable mitigating effect on the decline in support for Barcelona en Comú (BEC). Table 4 presents the comparison of the changes in vote for BEC between treated (Superblock) areas and control areas, both before and after matching. In the unmatched scenario, the treated areas exhibit a smaller decrease in BEC support by 5.15 percentage points compared to control areas. However, after applying PSM and adjusting for various covariates, the Average Treatment Effect on the Treated (ATT) indicates a more nuanced effect. The matched analysis shows that areas with Superblocks experienced a 2.68

Table 1
Adjusted DiD model results.

	Coefficient	std. err.	T	P > t	[95 % conf. interval]
Superblock	0.0044	0.004	1.08	0.281	-0.004; 0.012
Year	-0.0365	0.062	-0.59	0.558	-0.159; 0.086
Superblock * Year 2023 – Yes	0.0199	0.006	3.32	0.001	0.008; 0.032
Year * Rental price ^a 2015	-0.0060	0.001	-5.19	<0.001	-0.008; -0.004
2023	-0.0055	0.001	-4.02	<0.001	-0.008; -0.003
Year * Low education % 2015	0.4753	0.052	9.15	<0.001	0.374; 0.577
2023	0.1379	0.066	2.1	0.035	0.009; 0.266
Year * High education % 2015	-0.0157	0.041	-0.39	0.747	-0.096; 0.064
2023	0.3081	0.045	6.86	<0.001	0.22; 0.396
Year * Female population % 2015	0.1777	0.078	2.28	0.023	0.025; 0.331
2023	0.1819	0.078	2.32	0.02	0.028; 0.335
Year * Young population % 2015	-0.120	0.059	-2.04	0.041	-0.235; -0.005
2023	-0.7772	0.073	-10.54	<0.001	-0.915; -0.628
Year * Seniors % 2015	-0.6171	0.045	-13.74	<0.001	-0.705; -0.529
2023	-0.6052	0.063	-9.55	<0.001	-0.729; -0.481
Year * Motorization rate ^b 2015	0.0362	0.018	1.97	0.049	0.000; 0.072
2023	-0.1311	0.055	-2.37	0.018	-0.239; -0.023
Year * Household size ^c 2015	-0.0807	0.001	-8.33	<0.001	-0.1; -0.062
2023	-0.0061	0.004	-1.49	0.136	-0.014; 0.002
Year * Immigration % 2015	0.0269	0.027	0.99	0.32	-0.026; 0.080
2023	-0.0332	0.034	-0.98	0.328	-0.099; 0.033
Year * Household income ^d 2015	-0.0025	0.001	-3.43	0.001	-0.004; -0.001
2023	-0.0041	0.002	-2.53	0.012	-0.007; -0.001

(continued on next page)

Table 1 (continued)

	Coefficient	std. err.	T	P > t	[95 % conf. interval]
Year * Gini coefficient					
2015	-0.0034	0.001	-6.09	<0.001	-0.005; -0.002
2023	-0.0034	0.001	-4.44	<0.001	-0.004; -0.002
_cons	0.6179	0.040	15.32	<0.001	0.540; 0.697

Table 2

Logistic Regression Results for Propensity Score Estimation.

Variable	Coefficient	Std. Error	z-Value	P > z	95 % Confidence Interval
Rental price (sq. m)	-0.242	0.060	-4.01	0.000	[-0.360, -0.124]
Rental price (per unit)	0.000	0.001	0.15	0.879	[-0.001, 0.001]
Low education %	1.950	2.991	0.65	0.515	[-3.913, 7.812]
High education %	2.187	1.841	1.19	0.235	[-1.421, 5.796]
<16 y.o. %	-11.151	2.780	-4.01	0.000	[-16.599, -5.703]
>65 y.o. %	-9.122	2.288	-3.99	0.000	[-13.607, -4.638]
Motorization	-0.001	0.001	-0.42	0.671	[-0.002, 0.001]
Immigration %	-1.597	1.103	-1.45	0.148	[-3.760, 0.566]
Household income	0.000	0.000	1.43	0.153	[-0.000, 0.000]
Gini coeff.	0.013	0.030	0.44	0.662	[-0.046, 0.073]
_cons	3.645	1.474	2.47	0.013	[0.756, 6.534]

Table 3

Balance Test Results.

Variable	Mean (Treated)	Mean (Control)	% Bias	t-Value	P > t	V (T)/V(C)
Rental price (sq.m)	12.04	12.10	-4.6	-0.33	0.741	0.59
Rental price (per unit)	871.8	869.6	1.1	0.08	0.936	0.61
Low education %	0.127	0.130	-3.5	-0.24	0.809	0.56
High education %	0.426	0.424	1.5	0.10	0.922	0.62
<16 y.o. %	0.203	0.203	1.9	0.13	0.897	0.88
>65 y.o. %	0.207	0.206	3.3	0.22	0.827	1.10
Motorization	281.7	280.9	1.0	0.07	0.948	0.80
Immigration %	0.311	0.317	-5.3	-0.33	0.740	0.83
Household income	18,275	18,072	5.1	0.36	0.720	0.45
Gini coeff.	32.95	32.92	0.7	0.04	0.966	0.69

percentage point smaller decrease in BEC support relative to similar areas without Superblocks. This result, with a T-Statistic of 3.43, confirms the positive net effect of Superblocks on electoral behavior, suggesting that the implementation of Superblocks has helped to mitigate the overall declining trend in support for BEC in Barcelona.

Table 4

Impact of Superblocks on voting for BEC.

Variable	Sample	Mean (Treated)	Mean (Control)	Difference	Std. Error	T-Statistic
BEC15-23 diff.	Unmatched	-0.0098	-0.0613	0.0515	0.0087	5.93
BEC 15-23 diff.	ATT	-0.0104	-0.0371	0.0268	0.0078	3.43

To further analyze these results, Fig. 4 displays the average voting change for Barcelona en Comú between 2015–2023 in treated areas (areas that received a Superblock), and control areas. The control areas have been split into control within bandwidth – those areas with propensity scores closely aligned to the treated units, thereby representing more comparable units- and control units outside the bandwidth – areas that while still serving as potential matches differ more substantially in their characteristics to the treated areas. The treated areas exhibit a distinct pattern compared to both control groups, which underscores the unique impact of Superblocks on BEC voting behavior.

6. Discussion

This study has explored the political impacts of Superblock implementation at the local level, using highly disaggregated electoral data from Barcelona’s 2015 and 2023 local elections. We have used an adjusted difference-in-differences method and compared the results with a propensity score matching approach while controlling for several relevant covariates. Our aim was to test whether local election data was able to assess citizens’ support for a highly contested urban policy such as Superblocks. The consistency of robust findings across both analytical methods, displaying similar magnitudes and directions in their results, makes us confident when assessing the effectiveness of our research strategy and supports the viability of our methodology for future evaluations of transport-related policies. Because the starting assumptions and requirements for the methods used –particularly the propensity score matching method- are usually quite high, this method has not been extensively used to date in transport-related analysis (Artés et al., 2022; Kazemzadeh & Sprei, 2024; Meriläinen et al., 2024; Patnala et al., 2023). In fact, policy evaluation on transport-related issues has been dominated by survey-based self-reporting methods (Lanzendorf et al., 2023). Using local elections in combination with matching methods for policy evaluation is more typical of other fields (Furceri et al., 2023; Xu & Guo, 2023), but given the increasing quality of electoral data –with more precise data becoming available at each new election-, and the concentrated nature of some transportation policies such as pedestrianization, bike lanes or Superblocks, this method could become a useful method in the future.

Our analysis reveals that Barcelona en Comú (BEC) experienced improved electoral outcomes in districts that had implemented Superblocks. Our difference-in-difference models estimated a voting premium for BEC in Superblock areas equivalent to 2 percentage points, that would represent a 10 % positive differential with respect to BEC city average support in 2023. According to the Propensity Score Matching analysis, this enhancement in electoral support is quantified as a 2.7 percentage point increase, equating to a 14 % rise relative to BEC’s average support in the 2023 election. In the context of an election where BEC finished third and experienced a city-wide decrease in votes, our findings suggest that areas with Superblock interventions exhibited a stronger resilience to the general downtrend in support for BEC. This resilience indicates that Superblock policies might have contributed to maintaining or even enhancing voter support for BEC in these specific regions, despite the broader electoral challenges faced by the party across Barcelona.

On the one hand, these findings may indicate that Superblocks exert a particularly strong appeal on residents in their immediate vicinity, suggesting that the policy’s impact on voting behavior is distinctly localized. On the other hand, there is a possibility that the electorate across Barcelona recognized and valued the Superblock initiative,

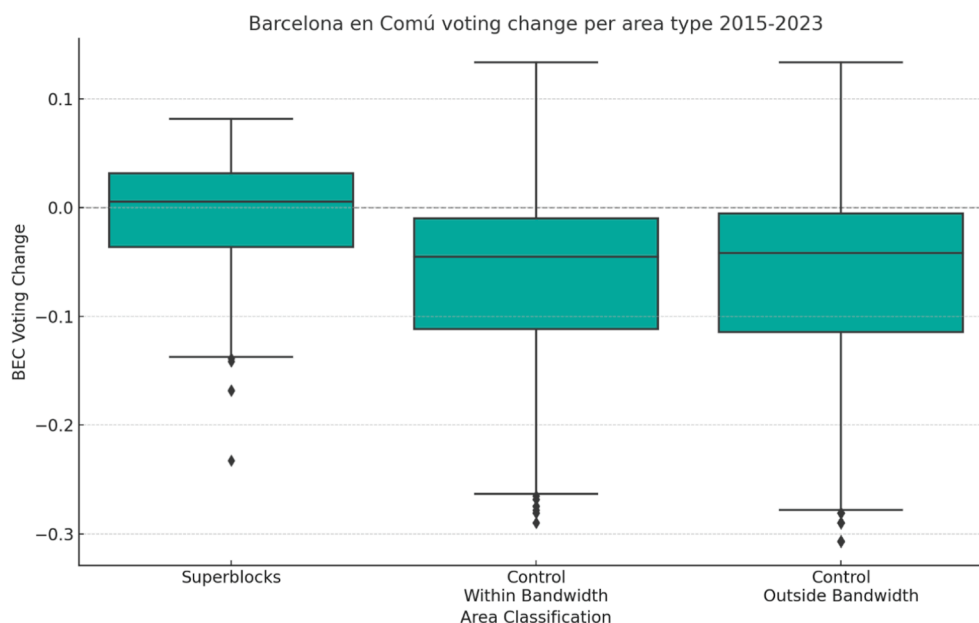


Fig. 4. Changes in vote for Barcelona en Comú 2015–2023 per area type.

leading to an uplift in support for BEC city-wide. Nonetheless, this support might have been more pronounced in areas directly enjoying the benefits of Superblocks. Should this city-wide appreciation for the Superblocks be confirmed, it would imply that our current methodological approach might not fully capture the comprehensive influence of the Superblock policy. This is because our study primarily assesses the contrast in electoral responses between neighborhoods with and without Superblock interventions, possibly not accounting for the potential existence of a city-wide electoral premium towards BEC and caused by potential support for the Superblock program.

The case of Barcelona's Superblocks could serve as a motivating example for future policymakers interested in pursuing bold, sustainable transportation policies rooted in the transformation of the built environment, who may be concerned about potential electoral backlash. In that sense, our analysis demonstrates that even in a supercharged political environment and a storm of negative views and opinions from the press and political opponents (Nello-Deakin, 2023), implementing a sustainable travel intervention in the form of the Superblocks resulted in: (1) no negative voting repercussions in those areas that received the Superblocks, and (2) a modest yet meaningful increase in support for BEC, estimated between 10–14 % in these areas compared to city-wide voting trends. Important to note here is that our study does not preclude the possibility that other areas of the city may have reacted negatively towards BEC because of the Superblock implementation, potentially neutralizing the positive local impacts of the program.

When explaining these results, and drawing on the acceptability literature, several factors could be at play. First, it is well established that people are inclined to support policies that protect their self-interest (Klein et al., 2022)—in this case, allowing them to continue or improve their preferred travel behavior. Additionally, people often adopt the opinions expressed by their preferred party on issues where they have not formed a first-hand opinion (Mildenberger & Tingley, 2019). In the case of Barcelona's Superblocks, it seems that the localized impacts support the travel needs of a population group already inclined towards active and public modes of travel, given their residence in a compact city center with ample non-car transportation options. The self-interest aspect of their decision-making is therefore strongly triggered. Simultaneously, because residents can experience first-hand the changes brought to their neighborhood by the Superblocks, they do not need to rely as heavily on their preferred political party for a proxy response to a policy they are not well-acquainted with. This dual effect reinforces

support for the Superblocks among these residents.

Second, the superblock project might have specific characteristics that make it more acceptable or appealing than other urban renovation projects. Previous research has found a positive link between policies that are public led—not a private development, with a clear climate goal and aimed to improve greenness conditions at a local level with increased acceptability and policy support (Bauer & Duschinger, 2024; Wicki et al., 2022).

Third, the 2023 election occurred at a time when most Superblock projects in the city had been completed, giving voters months or even years of experience with the transformed urban environment. This experience likely heavily influences their opinions, particularly in the case of successful policy implementations. As demonstrated by Cherry et al. (2014), when individuals form opinions about the likely effects of proposed policies, they can fall into cognitive constraints that prevent them from making optimal decisions about the true likely effects of such policies. Personal experience with the policy outcome—either as a trial run or as a definitive outcome—can significantly modify individuals' previous positions. This firsthand experience with the Superblocks may have led to a more favorable perception and stronger support for the policies, as voters could directly observe and appreciate the benefits of the interventions in their daily lives.

On the matter of unobserved factors that could be directly or indirectly affecting our results, we focus on the role of gentrification and other potential concurrent policy implementations. First, and because the popular debate and discourse surrounding urban transformative policies frequently centers on the threat of gentrification (Anguelovski et al., 2022; Hirsch et al., 2021), it has been suggested that reactions to gentrification-inducing policies might vary substantially between those who perceive themselves as winners—real estate owners who anticipate future gains from increasing property values—and those who see themselves as losers—renters who perceive a threat of higher rents or even expulsion from their homes. Therefore, an unusual concentration of either owners or renters within the voter pool of the census area could potentially skew results. While the notion that the intervened census areas might contain a higher proportion of owners than other similar census areas may seem unlikely, it cannot be entirely ruled out. This potential skew could influence the observed electoral outcomes and warrants further investigation to understand its impact fully. Second, the issue of a potential unaccounted policy change that can be driving observed electoral support must be considered. Certainly, during the

study period, other urban policies and political events may have influenced voter behavior. However, any such policy change would need to be both highly localized and occur in the same districts as the Superblocks. The use of PSM makes us confident that the observed electoral support is genuinely attributable to the Superblock interventions rather than to other concurrent policies.

Our positive results regarding superblocks capacity to drive up vote for BEC generate two critical areas for future research. Firstly, there is a need to explore whether the observed correlation between urban interventions and electoral support extends to other types of urban transformations like pedestrianization, cycle lanes, and school protection zones. It's essential to determine if the electoral response to Superblocks in Barcelona is a unique phenomenon or part of a broader trend where urban transformations end up influencing political preferences at the local level. In an era where climate change opinions become increasingly ingrained in political views (Marquet, Anguelovski, et al., 2024) and where climate policy acceptability becomes increasingly dependent on partisanship (Marquet, Mojica, et al., 2024), it is likely that sustainable transportation views gain relevance as factors determining voting behavior. In the case this would be confirmed, this would mean that it would be easier to use local election disaggregated results to trace acceptability towards significant transportation policies but would also mean that these opinions may be increasingly ingrained along party lines.

The second area of inquiry concerns the specific context of Barcelona, where Superblocks and similar urban interventions have been a hotbed of political discourse (Amorim-Maia et al., 2023; Anguelovski et al., 2023; Zografos et al., 2020). This raises the question of whether the observed correlation between urban policy implementations and electoral support can be generalized to other contexts, particularly in less politically charged environments where urban planning might not dominate the political landscape. Understanding the extent to which these findings hold true in different urban settings is vital for urban planners and policymakers aiming to grasp the political implications of their projects across diverse scenarios.

At this point, we acknowledge the importance of addressing potential limitations regarding the generalizability of our results to other urban settings or political contexts. While our study focuses on Barcelona, a city with a unique socio-political landscape and a specific set of urban challenges, the dynamics observed here may differ in other cities or regions. The socio-political context in Barcelona is characterized by a strong political engagement and a high level of public discourse around urban intervention, which may have influenced the outcomes observed in our study. To enhance the applicability of our findings to broader contexts, future research should aim to replicate this analysis in different urban environments with varying socio-political dynamics. This would help to determine whether the positive electoral response to Superblocks is unique to Barcelona or indicative of a broader trend that can be expected in other cities implementing similar urban policies.

Additionally, we acknowledge that defining the boundaries of the Superblocks using census areas limits the analysis of the spillover effects on neighboring areas. This methodological decision was made to ensure that the interventions could be accurately correlated with electoral results, as census areas serve as the fundamental and most detailed unit for reporting these results. Related to the spillover effects the Superblocks may have, is the limitation of not being able to assess whether these interventions affected the electoral results of those census areas in which there are no Superblocks. Areas that may still be affected since the traffic is closed and limit their mobility with private vehicles in those specific areas, thus potentially modifying their preferred routes.

7. Conclusions

This study validates the use of local electoral data as a viable tool to assess public support for specific urban policies, a methodology that can have broader applications in urban planning and policy evaluation. Our

analysis of Barcelona's electoral patterns from 2015 to 2023 in relation to the implementation of Superblocks has evidenced how opinions on specific highly localized and intense urban interventions can be tracked by local political support using highly disaggregated voting data. The popularization and accuracy of both GIS and local built environment data, paired with most local administrations opening up access to local election results at the census area level, allow for future testing of this methodology in other areas and with different urban intervention types.

In the specific case of Barcelona's local politics in the 2023 election, the introduction of Superblocks in Barcelona appears to have played a significant role in mitigating the decline in electoral support for Barcelona en Comú (BEC). While the party faced declining support across the city, areas with Superblock projects exhibited a markedly stronger support for BEC, suggesting a political premium attributed by voters to those responsible for implementing the Superblock program.

In sum, this study not only sheds light on the complex relationship between urban planning and electoral outcomes in Barcelona, paving the way for future research into the political consequences of urban interventions. It highlights the potential of local electoral data as a valuable resource in understanding and evaluating public response to urban policies, a tool that can be pivotal in shaping future urban planning strategies and policies. In any case, spatial voting pattern analysis needs to be used in combination with survey level self-reported measures to gain insight regarding how to design urban planning strategies and policies that are both effective and politically viable.

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CRediT authorship contribution statement

Oriol Marquet: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Marta-Beatriz Fernández Núñez:** Visualization, Data curation, Conceptualization. **Monika Maciejewska:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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