ABM of Voters Political Positioning

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Abstract

This research adapts an agent-based model (ABM) to explore the political positioning of voters in the Colombian context. By simulating various scenarios based on demographic data from the LAPOP survey and different ideological alignments of the government and opposition, we observe a consistent trend towards ideological convergence and moderation. These findings have implications for political strategies, policy development, and fostering social cohesion. By understanding the dynamics of ideological alignment, we can contribute to more effective political decision-making and promote informed and constructive political dialogue in Colombia.

Keywords: Agent-Based Model (ABM), Ideological Positioning, Politic Science, Voter Behavior, Political dynamics.

1 Introduction

The analysis of social and political dynamics has always captivated human interest. From ancient philosophical works like Plato's "The Republic," there has been a continuous pursuit to comprehend the interplay of political actors and translate individual decision-making into collective outcomes. This endeavor presents a significant challenge in the realm of political science (Colomer, 2009).

In the Colombian context, comprehending the ideological positioning of voters is particularly complex due to the intricate political landscape of the country. Colombia's history is marred by political violence, social inequality, and corruption, leading to a fragmented political system with numerous parties, movements, and interest groups. Consequently, understanding how voters navigate this intricate environment and make decisions based on their ideological stances becomes a crucial area of research.

While existing literature has explored voters' ideological positioning using abstract agent-based models (ABMs), most of these models remain theoretical exercises that propose and incorporate factors deemed significant by political scientists. In our previous work, we also developed an abstract model falling into this category. However, in this study, we aim to transcend the abstract nature and adapt an already validated model to the Colombian context, drawing inspiration from works such as Muis (2010) and Laver and Schilperoord (2007).

In Colombia, the absence of fixed political parties distinguishes it from other countries, necessitating the development of a model specifically tailored to its unique political dynamics. Our research builds upon the abstract model we previously developed, incorporating equations, parameters, and decision rules that have been validated by other authors. By doing so, we strive to provide a more accurate representation of voters' ideological positioning in the Colombian context.

The significance of our research lies in its potential implications for the development of more effective political strategies and policies. By gaining a deeper understanding of the intricate dynamics of political decision-making in Colombia, we can assist political actors in aligning their strategies with the needs and interests of voters, ultimately contributing to a more stable and inclusive political system. Additionally, our research has the potential to inform the development of similar models in other countries facing comparable challenges.

The primary question guiding our investigation is: "How can we adapt an agent-based model (ABM) on the political positioning of voters to the Colombian context?"

The rest of this paper is organized as follows. Section 2 provides an overview of the relevant political context in Colombia and discusses its impact on decision-making variables, such as corruption and social inequality. Section 3 introduces the concept of agent-based modeling (ABM) and

explains its functionality in understanding dynamic systems. In Section 4, we discuss the scarcity of research on this topic in Colombia and highlight the absence of fixed political parties as a key argument. Section 5 outlines our research methodology, including data sources, model development, and validation processes. Section 6 presents our results and analyzes the changes in ideological positioning observed in our simulations. Finally, in Section 7, we conclude with a summary of our findings, their implications, and potential avenues for future research.

2 State of the art

Adapting an agent-based model (ABM) to the political positioning of voters in the Colombian context is a timely and relevant research topic given the critical moment in the country's political history. Colombia's political landscape has long been characterized by a deep ideological divide, resulting in social polarization and, at times, even violence (Colomer, 2009). To gain a comprehensive understanding of this complex phenomenon, it is essential to explore various theoretical models in political science that explain voters' ideological positioning.

One prominent theoretical framework is the rational choice model proposed by Downs (1957). According to this model, voters act as rational actors who seek to maximize their individual interests. Voters evaluate political parties and candidates based on their policy positions and align themselves with the party that best represents their preferences (Downs, 1957). This model assumes that voters are primarily motivated by policy outcomes rather than ideological commitments.

Another influential perspective is the sociological model, which suggests that voters' political decisions are shaped by their sociodemographic characteristics, such as age, gender, social class, and education (Lazarsfeld et al., 1968). This model emphasizes the role of social identity and group affiliation in shaping voters' preferences. For example, individuals may vote for a particular party because they identify with its platform and perceive it as representing their social or economic interests.

Furthermore, the model of partisan identity developed by Campbell et al. (1960) highlights the significance of individuals' long-term attachments to political parties. This model argues that individuals develop a psychological attachment to a particular party based on their socialization experiences and ideological beliefs. Partisan identities can be stable over time and influence voters' political behaviors and decision-making processes.

While these theoretical models have been extensively studied in other contexts, their applicability and explanatory power in the Colombian context remain understudied. By adapting an ABM to the Colombian context, we aim to incorporate and test the assumptions and mechanisms proposed by these theoretical models. This approach will allow us to explore how rational calculations, sociodemographic factors, and partisan identities interact to shape voters' ideological positioning in Colombia.

There has been a lot of literature on social behaviors recently, and the application of technological tools such as mathematical models has revolutionized the way politics is conducted. In the field of politics, there has been a great revolution with the use of big data. As Palacio, E. (2016) explains, new political campaign strategies are focused on social media, which is a virtual environment that simulates reality. This concept is purely derived from mathematical models, where Nagel (2010), Sobkowicz, P. (2016), Jiménez, Raúl and Thurner, Stefan and Pericchi, Luis and Klimek, Peter. (2018) have made significant contributions. The first paper discusses the decisions made by voters and whether they choose the optimal candidate. The second paper creates a regression model that

detects signs of fraud through outlier behaviors in the vote count. The third paper explains the dynamics of opinions in society using an agent-based model. The surge of digitization in the world has contributed to this significant increase by providing access to vast amounts of data, which has been used to create political strategies.

Most of the papers focus on the perspective of voters, aiming for transparent control and understanding social dynamics. In the case of exemplary political strategies, Qiu, Lin and Phang, Riyang (2020) and Mebane, W. and Baltz, S. and Vasselai, F. (2019) are noteworthy. These authors combine the dynamics of opinions with the impact of political decisions made by candidates. They quantify the number of votes according to a theoretical distribution. However, the study of these dynamics does not consider the rational behavior of voters, opposition parties, government, and media, as explained by political science theories (Downs, A. (1957) and Colomer, Josep M. (2009)).

Other important papers that served as inspiration for this investigation are Muis, J. (2010) and Majmudar, J. et al. (2019). We consider these papers as top references for our model because the first one provides an empirically validated model, while the second one examines the interaction and other relevant factors, such as the interaction between voters. Muis, J. (2010) examines the dynamics of political stability and change in the Netherlands, using an agent-based model to simulate the effects of media coverage on voting behavior. Majmudar, J. et al. (2019) analyze how external factors, including the media, can influence voter behavior in an agent-based model. The authors demonstrate that small changes in the model's parameters can lead to significant changes in the election outcome. This paper is particularly relevant in the Colombian context, where media bias and misinformation have been significant issues in recent elections. By incorporating these external factors into the model, we may gain a better understanding of how they impact voter behavior.

3 Methodology

To study the ideological positioning of voters in the Colombian context, we developed an agent-based model (ABM) that incorporates elements from the sociological model and utilizes data from the LAPOP (Latin American Public Opinion Project) survey conducted in Colombia in 2021. The following methodology outlines the key steps involved in the development and implementation of the ABM.

Model Design:

- We designed a one-dimensional line representing the ideological self-perception of voters, ranging from -20 to 20. This line is divided into five quadrants: left, center-left, center, center-right, and right.
- The position of individuals on the ideological line is determined based on their age and gender, using the LAPOP survey data. The data is categorized into age groups of 5 years and further divided by gender (male and female).
- By mapping individuals' age and gender to their corresponding ideological position on the line, we create an initial distribution of voters in the model.

Data and Variables:

- We utilized the LAPOP survey data to determine the percentage of individuals within each age and gender category that identify with each ideological quadrant. This information allows us to assign the initial positions of individuals on the ideological line.

- Additionally, we consider the positions of the government and the opposition on the ideological line. These positions can be adjusted to simulate different scenarios and observe the effects on voters' ideological positioning.

Simulations and Analysis:

- We run simulations using the ABM to observe the dynamics of voters' ideological positioning under different scenarios.
- By altering the distribution of individuals on the ideological line and adjusting the positions of the government and the opposition, we can assess how these changes influence the overall ideological landscape.
- We analyze the results of the simulations, particularly focusing on the changes (delta) in individuals' ideological positions and the resulting shifts in the distribution of voters across the ideological spectrum.

Sensitivity Analysis:

- By systematically adjusting key parameters, such as the initial distribution of voters and the positions of the government and the opposition, we assess the model's sensitivity to different inputs and observe the resulting changes in ideological positioning.

The ABM implementation was carried out using the NetLogo software, which provides a platform for agent-based modeling and simulation. The model was programmed with the necessary equations, rules, and parameters based on the theoretical framework and empirical data.

By employing this methodology, we aim to gain insights into the factors that shape voters' ideological positioning in Colombia and understand how changes in the distribution of voters and the positions of political actors impact the overall ideological landscape.

Our agents movement is support by the VP-function describe by Norpoth, H. (1991) as function that explain the change of the voters (V in VP-function) for the government. The P in the VP-function represent the popularity that we are going to represent has the euclidean distance between the economic position of the voter and the government. We take only the average of all this parameters. In general, the max change of the voters are between $\pm 5\%$ and the average change is -1.6%. With this we are going to simulate the different scenarios.

4 Results

In this section, we present and discuss the outcomes obtained through simulation in various scenarios. It is divided into multiple subsections, each focusing on a different scenario. The main graphical representation used is a histogram, illustrating the distribution of individuals based on their error ratio.

The error ratio is calculated as follows: the current ideological position of the voter divided by the ideological position of the government, multiplied by 100. This yields a percentage value between -100

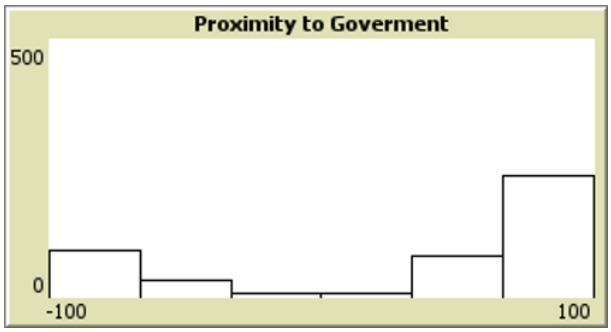

Figure 1: Start of the Simulation

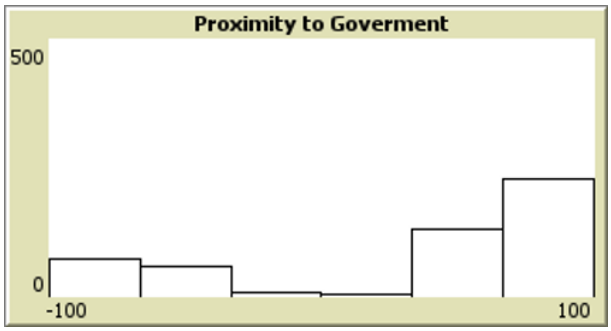

Figure 2: End of the Simulation

4.1 Simulation with Extreme Government and Opposition Positions

This subsection presents the simulation results using the initial distribution of voters based on the LAPOP survey for Colombia 2021. The ideological positions of the government and opposition are set at the extreme values of 20 and -20, respectively. The first graph illustrates the initial distribution, showing a polarized landscape with a higher concentration of individuals near 100%, indicating support for the government. This aligns with the findings of the LAPOP survey, suggesting a higher proportion of right-leaning individuals. As the simulation progresses, the second graph demonstrates a slight tendency towards the center, although the distribution remains similar to the initial graph.

4.2 Simulation with Center-focused Distribution

In this subsection, the government and opposition positions are maintained at 20 and -20, respectively, while the distribution of voters is adjusted. Extremist left and right-leaning voters are removed, focusing on individuals in the center, center-left, and center-right. The initial graph

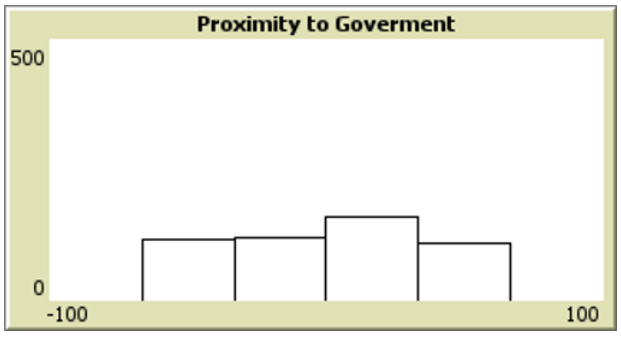

Figure 3: Start of the Simulation

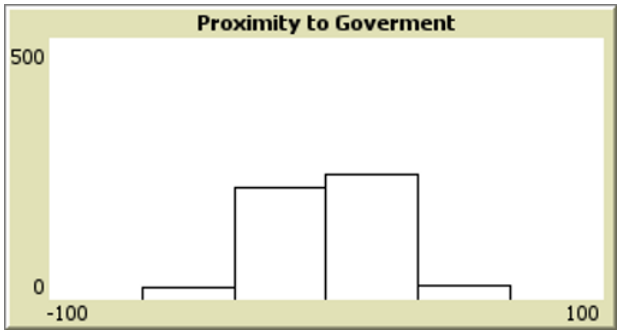

Figure 4: End of the Simulation

displays a distribution without values close to -100% or 100%, indicating a central alignment. Throughout the simulation, the trend towards the center intensifies, resulting in a significant concentration of individuals near the center by the end.

4.3 Simulation with Extreme Left and Right Distribution

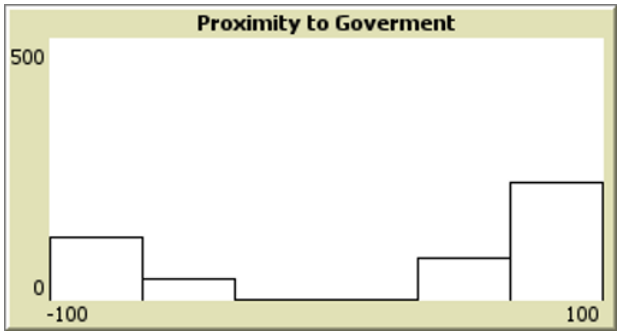

Figure 5: Start of the Simulation

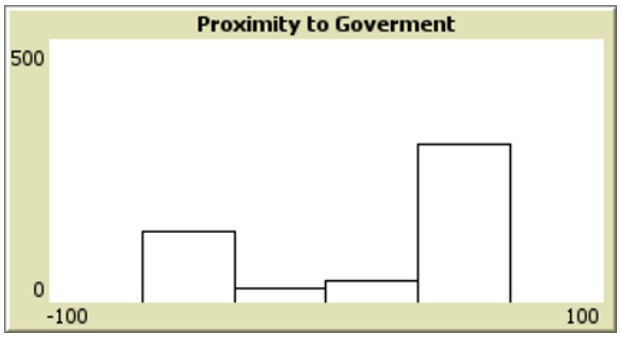

Figure 6: End of the Simulation

This subsection examines the simulation results with a distribution limited to extreme left and right ideological positions. The government and opposition positions remain at 20 and -20, respectively. The initial graph exhibits values predominantly near -100% and 100%, reflecting the extreme ideological positions. However, as the simulation progresses, these individuals move towards the center, with a majority converging around center-left and center-right, while a minority remains in the center.

4.4 Simulation with Moderate Government and Opposition Positions

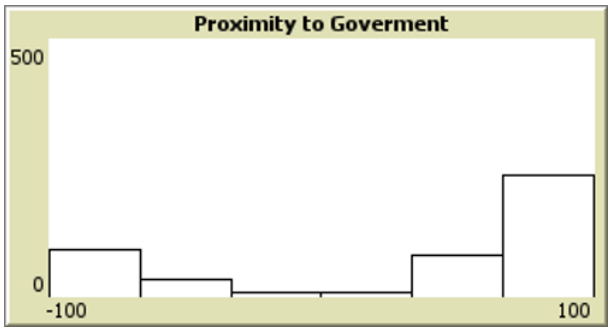

Figure 7: Start of the Simulation

Here, the distribution of voters is the same as in the first subsection, but the ideological positions of the government and opposition are changed to 10 and -10, respectively. The graph at the beginning of the simulation mirrors the initial graph of the first subsection. However, as the simulation progresses, the distribution of error ratios shows a more pronounced trend towards the center.

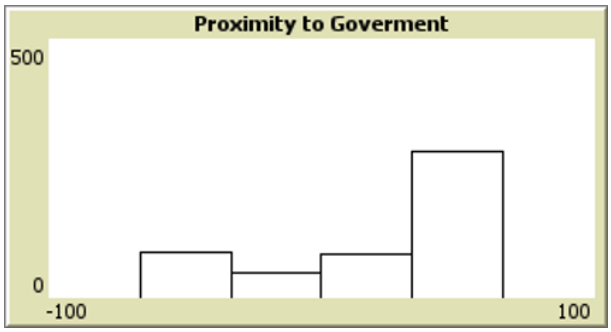

Figure 8: End of the Simulation

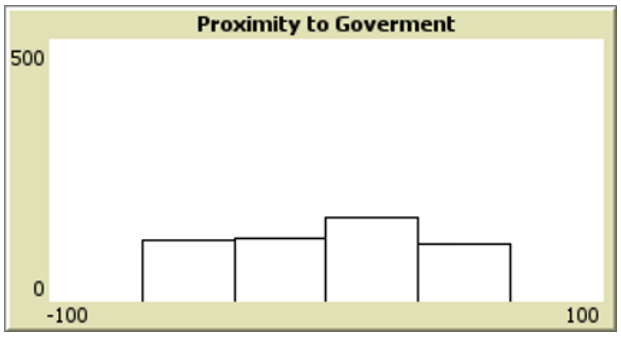

Figure 9: Start of the Simulation

4.5 Simulation with Center-focused Distribution and Moderate Positions

This subsection retains the distribution of voters from the second subsection, with adjustments made to the government and opposition positions (10 and -10, respectively). The initial graph is similar to the corresponding graph in the second subsection. Throughout the simulation, the convergence towards the center becomes even more evident, with a significant concentration of individuals around the center.

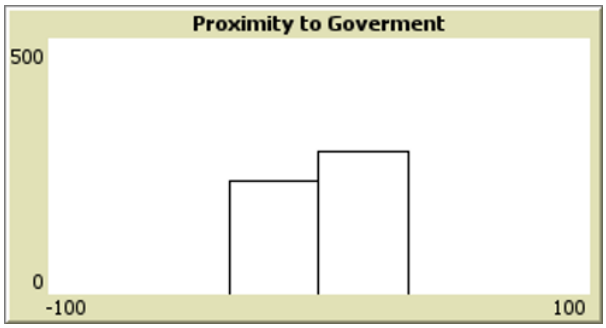

Figure 10: End of the Simulation

4.6 Simulation with Extreme Left and Right Distribution and Moderate Positions

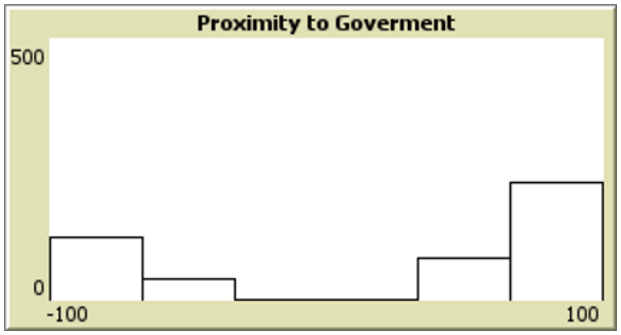

Figure 11: Start of the Simulation

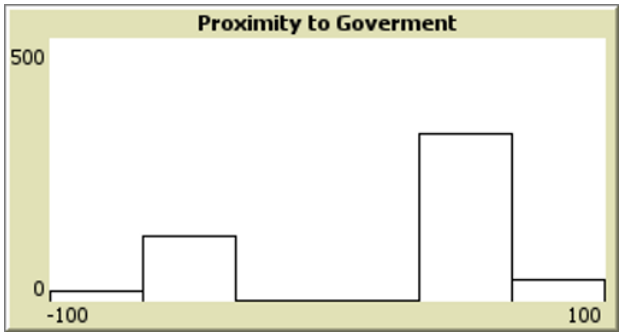

Figure 12: End of the Simulation

In this subsection, the distribution of voters follows the pattern of the third subsection, while the government and opposition positions are adjusted to 10 and -10, respectively. The initial graph resembles the graph from the third subsection, emphasizing extreme left and right positions.

However, as the simulation progresses, individuals gravitate towards the center, with a diminishing number remaining at the extremes.

5 Conclusions

The adaptation of an agent-based model (ABM) to explore the political positioning of voters in the Colombian context has provided valuable insights into the dynamics of ideological alignment and its relationship with the government and opposition positions. Through simulations based on demographic data from the LAPOP survey and varying ideological scenarios, we have observed significant patterns and trends.

First, when considering extreme government and opposition positions, the initial distribution of voters displayed a polarized landscape, with a higher concentration of individuals leaning towards the government's ideology. However, as the simulations progressed, there was a slight tendency towards the center, indicating a moderation of ideological positions. This suggests that despite initial polarization, there is a potential for shifting attitudes and convergence towards more centrist ideologies over time.

In the second scenario, focusing on individuals in the center, center-left, and center-right, we observed a more pronounced trend towards the center. The initial distribution was already centered, and as the simulation unfolded, individuals increasingly gravitated towards the center, indicating a strong pull towards moderate ideological positions. This highlights the influence of a central alignment and the potential for a convergence of political attitudes.

Similarly, when considering simulations with extreme left and right distributions, the initial polarized landscape evolved towards the center. Individuals from the extreme positions gradually shifted towards center-left and center-right positions, reflecting a moderation of ideological preferences. This suggests that even individuals with more extreme ideologies can experience shifts towards more centrist positions.

Furthermore, simulations with moderate government and opposition positions reinforced the trend observed in the previous scenarios. The initial distributions resembled the respective initial graphs, but as the simulations progressed, there was a clear movement towards the center. This indicates that the positioning of the government and opposition, even when relatively moderate, can still influence the ideological alignment of voters, leading to a convergence towards the center.

Overall, the findings from our simulations highlight the potential for ideological convergence and moderation in the Colombian political context. Despite initial polarization and diverse ideological distributions, there is a consistent trend towards the center, suggesting a tendency for voters to adopt more moderate positions over time. This has significant implications for political strategies, policy development, and fostering social cohesion.

Our research contributes to the field of political science by utilizing agent-based modeling to analyze the dynamics of ideological positioning in a specific context. By adapting the model to the Colombian political landscape, we have shed light on the factors influencing ideological alignment and the potential for ideological convergence.

The implications of this research extend beyond academia, with practical implications for policymakers, political analysts, and the general public. Understanding the complex interactions that shape political attitudes and behaviors can inform the development of more effective political strategies, policies, and campaigns. Moreover, promoting informed and constructive political dialogue is crucial for a functioning democratic society, and our research provides insights into fostering such

dialogue by recognizing the potential for ideological moderation and convergence.

In conclusion, our study demonstrates the potential for ideological convergence and moderation in the Colombian political landscape. The findings underscore the importance of understanding the dynamics of ideological positioning and its relationship with government and opposition positions. By adapting an ABM to the Colombian context, we have contributed to the broader understanding of political science and provided insights that can inform policy development and promote constructive political dialogue.

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