Research Question:

What are some explanatory variables that can explain the difference between voter turnouts by high-income voters and low-income voters? Do "having more resources," and "having more knowledge about the importance of voting," lead to higher turnout for rich voters? Can adding more polling locations reduce this disparity?

Literature Review:

Unequal political participation between high-income voters and low-income voters in the US has been well documented. As many studies have demonstrated, voter turnout is positively correlated with family income level, and rich people are more likely to vote than poor people (Simeonova et all., 2018). According to a 2021 report released by US Census, in the 2020 Presidential Elections, voter turnout is 81% for individuals with family income ranging from $100k-$150k, while the turnout is 63.6% for people whose income was $30k - $40k.

The sheer disparity in civic participation raises important concerns. For one, the disparity in turnout leads to unequal distribution of resources and skewed policies that favor the rich (Gilens 2012, Bartels 2009). In U.S., income distribution is also highly correlated with different racial and ethnic groups. In a country that has historically disenfranchised voters of color through discriminatory voting laws and policies, the disparity in turnout further widens socio-economic inequality among different racial groups.

But what drives the disparity in voter turnout between high-income voters and low-income voters? This question remains contentious and empirically less tested. Some political scientists like Andrew Gelman suggest that lower income people tend to be less politically informed, less educated, and therefore they are less likely to participate in the democracy (Gelman et all., 2012). This assumption is not being empirically tested. Randall Akee also echoes Gelman's point. In their empirical study on the impact of exogenous unconditional cash transfers to poor households on voting behavior, Akee el all find that children of poor household receiving unconditional cash transfers are more likely to vote compared to their counterparts. They attribute higher propensity to vote on increasing human capital that stems from the additional cash transfers (Akee et all., 2018). Other studies note that voting is costly, and it requires time, skills, information, a certain level of health, and access to transportation to do so (Akee, 2018). Rich people tend to have more resources, and they are more likely to vote. This theory has not been tested empirically, partially because it's hard to isolate the effects of "having resources and less constrains to vote" as poor and rich people generally reside in segregated neighborhoods and have different types of jobs.

My research seeks to tackle these questions. Do resources, or education, contribute to the disparity of voter turnout between rich and poor. This study will isolate the effects of "knowing the importance about voting," and "having more resources, less constrains to go to the polling locations," on voter turnout. It also demonstrates that, making voting easier by adding more polling locations, and increasing the voting periods will drastically reduce the disparity in turnout across different socio-economic groups. This is important as to policy implications. Previous studies suggest that increasing household income for poor household can reduce voting disparity,

but this is costly and not sustainable. My study suggests that adding more polling locations and reducing the cost of voting can make a difference to reduce civic participation disparity.

Methods:

I used agent-based model (ABM) to simulate voting behaviors. In an agent-based model, there are many agents operating according to simple rules. With those simple rules, however, complex, macro-level patterns will emerge. Those patterns are dependent on several controlling parameters we can set based on real-world situations. This approach has several advantages. For one, it allows us to observe how different combinations of factors (parameters) can produce different results. The nonlinear interactions between different factors, such as "knowing the importance of voting," and "having more resources, less constrains to go to the polling locations," are nearly impossible to be captured by mathematical functions. In addition, parameters described above are hard to measure in real life. "Internalizing the importance of voting," and "having less constrains to go to the polling locations," data are hard to collect, if not nearly impossible to observe.

My ABM has three types of voters, mirroring "rich voters," "poor voters," and "middle class voters". Voters have different attributes of "speed," and "vision." "Speed" will affect their travel time to the nearest polling locations. Voters with faster speed mean that they go to the polling locations faster, or with less time and resources. In the real world, this could be interpretated as "have greater transportation, more spare time to vote, living closer to the polling locations, or no language barriers to voting." Essentially, voting is easier for them. All the factors listed above are positively correlated with being rich. "Vision," in the model, represents the range of grids they can see per time step. Voter agents with higher visions can see if there's a voting machine within their vision. Poor vision agents need to move around to find a polling location if there's no voting machine in their sight. This mirrors "education," in a sense that people with higher level of education tend to consumer more electoral information and know the importance of voting. For poor voters, it is hard to navigate the voting landscape in a short amount of time! Poor voters may still consume political information related to the candidates, but it takes more time for them.

By setting different parameters of "speed" and "vision" for agents, we can observe how these factors, respectively and collectively, create an output (macro-level pattern) in which poor voter turnout is lower than that of rich voters. Adding time steps, we can observe at a given time period, the disparity in turnout between rich and poor voters. This mirrors the fact that there's always a limited voting period in which voters can cast their ballots. We can also test the effect of having more polling locations per 100 voters on voter turnout by changing the corresponding parameters.

Voting Model Setup:

Agents: Voter

- We have a fixed number (adjustable parameter) of Voter agents that are initially assigned to random cells in the 50 x 50 grid.
- There are 3 types of voters with different attributes of "speed" and "vision": Rich Voters (high speed, high vision), Middle-Class Voters (mid speed, mid vision), and Poor Voters (low speed, low vision).

- Agents' level of resources (transportation, spare time to vote, living closer to the polling locations, or no language barriers to voting) is reflected by their "speed" in the model: Rich Voters can move 6 times faster than Poor Voters, and 2 times faster than the Middle-Class Voters. This simple setting mirrors an important aspect of the real-world scenario: Rich people have more time, energy, and resources, to travel far to the polling locations.
- Agents' level of education (how much time they need to consume political information and realize the importance of voting) is reflected by their "vision" in the model.
- Rich Voters constitute 10% of the total population, Middle Class Voters are 30% of the population, and the majority 60% are Poor Voters.
- Voter agents move to the nearest voting machines to cast their votes within their vision. If they don't see any voting machines in their vision, they will move to the neighboring cell and check the nearest voting machines.
- Agents' other attribute are all assumed to be equal in this model. We'd like to isolate the impact of "having more resources to vote" and "knowing the importance of voting" on turnout.
- Once voter agents get to the nearest voting machine and cast their vote, they will be removed from the grid. Agents left on the grid are disenfranchised because they can't vote on time.
- No two agents can be in the same cell at the same time.

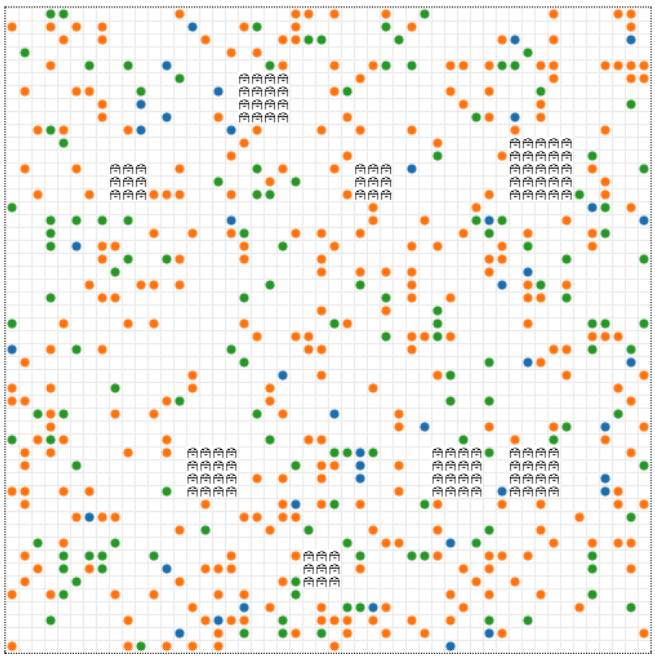
Agents: Polling Location

- We also have a fixed number of polling locations (voting machines) on the grid. We assume each polling location has one voting machine. I use polling location and voting machine interchangeably in this report.
- When a voter agent arrives at the polling location, the voting machine will be occupied, and no other agents can vote here at the same time. The voting machine will be available to use once the voter agent casts his/her vote and is removed from the grid.

Please run "run.py" to access the interactive model that shows the movement of Fig.1-3.

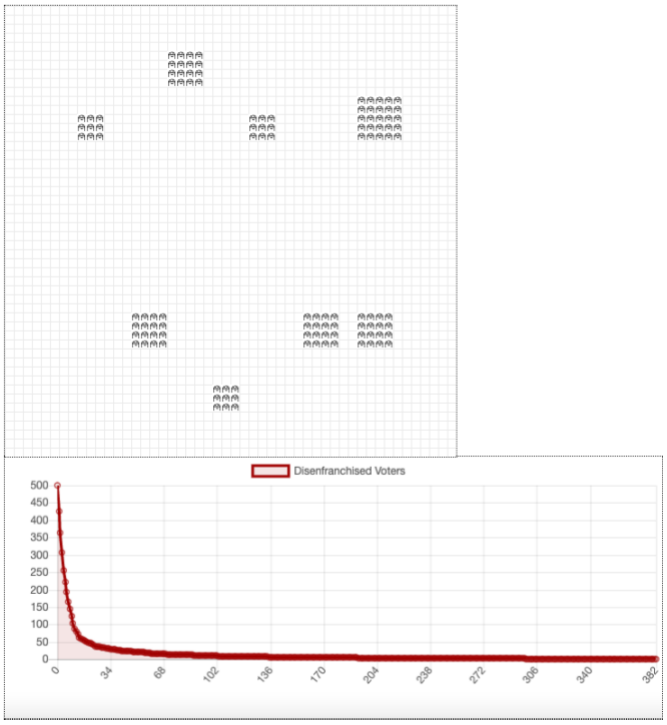
Figure 1 shows the initial setup of the model.

- Blue Dots: Rich Voters, 10% population, Speed = 6, Vision = 10
- Green Dots: Middle-Class Voters, 30% population, Speed = 3, Vision = 10
- Orange Dots: Poor Voters, 60% population, Speed = 1, Vision = 10
-  : Polling location / Voting Machine icon. 1  represents 1 voting machine.



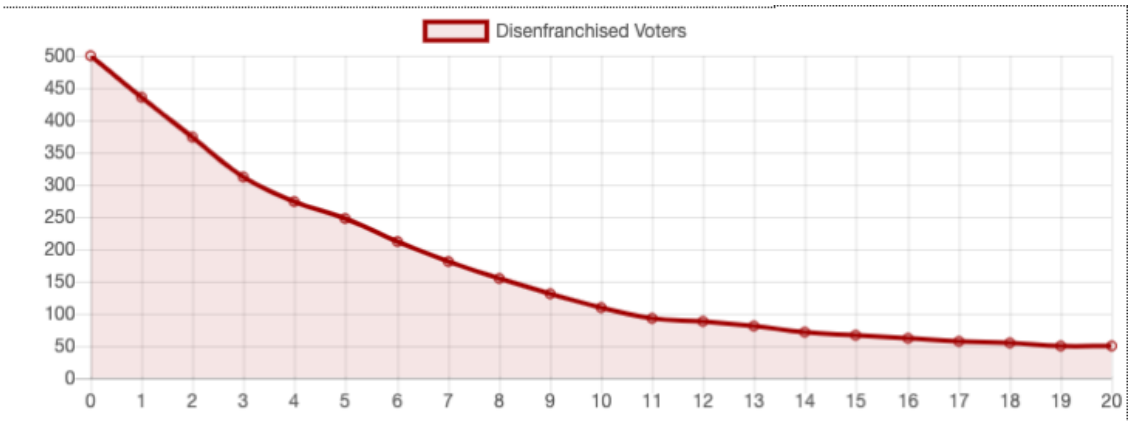
(Fig. 1)

Figure 2 shows the situation in which all voters cast their votes; no one is disenfranchised!



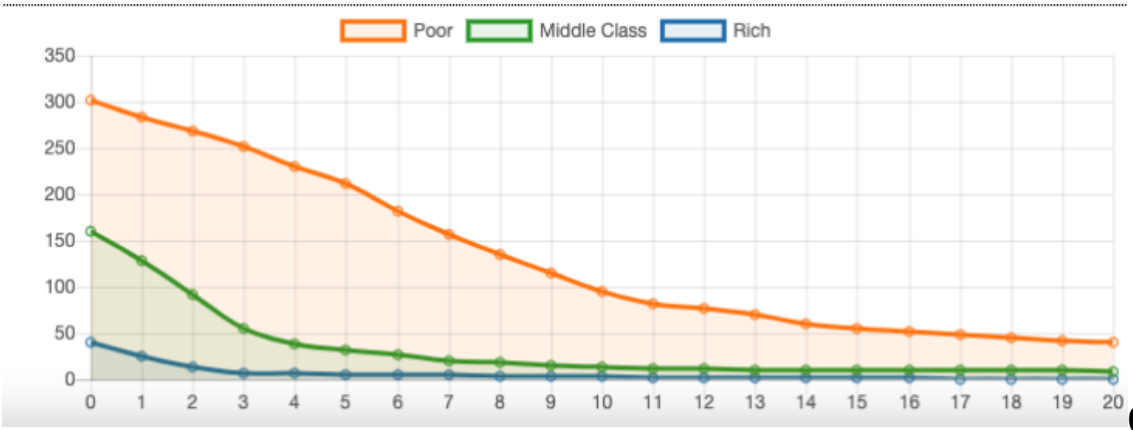
(Fig. 2)

Figure 3 is a line chart that dynamically shows the number of disenfranchised voters on the grid throughout the simulation. At step 0, the disenfranchised voters equal to the total population. Here, we have 500 initial voters. No one has voted yet!



(Fig.3)

Figure 4 is a line chart that dynamically shows the number of disenfranchised voters separated by their income levels induced by "speed" and "vision" on the grid throughout the simulation.



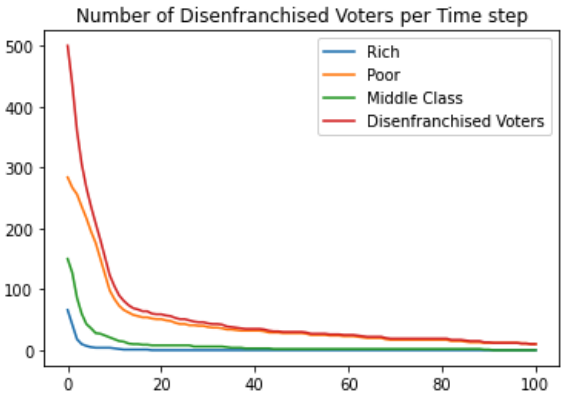
(Fig.4)

Major Findings:

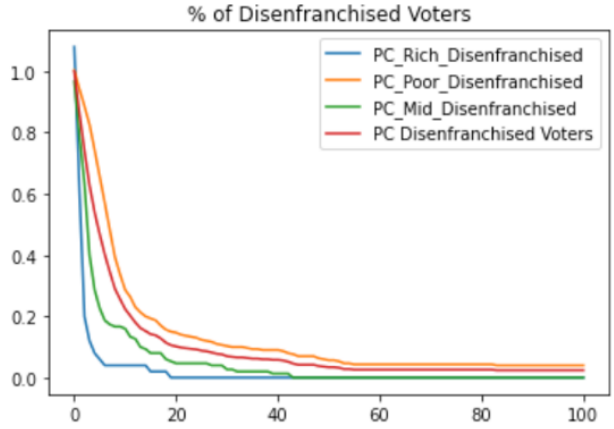
We first isolated the effect of "speed" on voter turnout and observed that:

a. **Holding "vision" constant, voters with higher speed are more likely to vote on time within limited time frame. ➔ Simply having more resources, ie, more spare time to go to the polling locations, no language barriers, greater transportation, leads to higher turnout.**

Figure 4 and Figure 5 shows the number of disenfranchised voters, % of disenfranchised voters per time step, separated by different speed levels. Here, Rich Voters can move 6 times faster than Poor Voters, and 2 times faster than the Middle-Class Voters. They have the same vision (vision = 10). A closer examination of the data shows that at step 10, only 2% of rich voters are disenfranchised, compared to 30% poor voters, and 12% middle class voters.



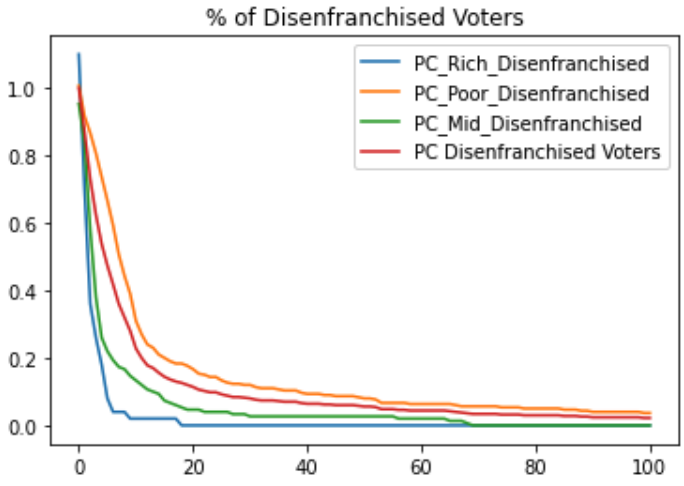
(Fig.4)



(Fig.5)

Then we'd like to isolate the effect of "vision" on voter turnout:

b. ***Holding "speed" constant, voters with higher vision are more likely to vote on time within limited time frame. ➔ Simply having more education, ie, consumer electoral information faster, more politically informed, leads to higher turnout.***



(Fig.6)

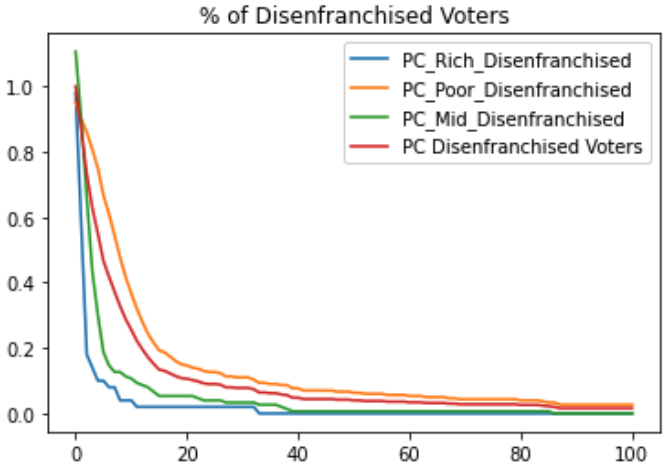
Figure 6 shows the % of disenfranchised voters per time step, separated by different speed levels. Here, Rich Voters have vision 6 times higher than Poor Voters, and 2 times higher

than the Middle-Class Voters. They have the same speed (speed = 10). A closer examination of the data shows that at step 10, only 4% of rich voters are disenfranchised, compared to 34% poor voters, and 14% middle class voters.

Let's run the model again when those two parameters interact with each other…

- Rich Voters, 10% population, Speed = 6, Vision = 16
- Middle-Class Voters, 30% population, Speed = 3, Vision = 13
- Poor Voters, 60% population, Speed = 1, Vision = 10

c. Voters with higher vision and higher speed are more likely to vote on time within limited time frame. ➔ Having more education, ie, consumer electoral information faster, more politically informed, and having more resources leads to higher turnout.



(Fig.7)

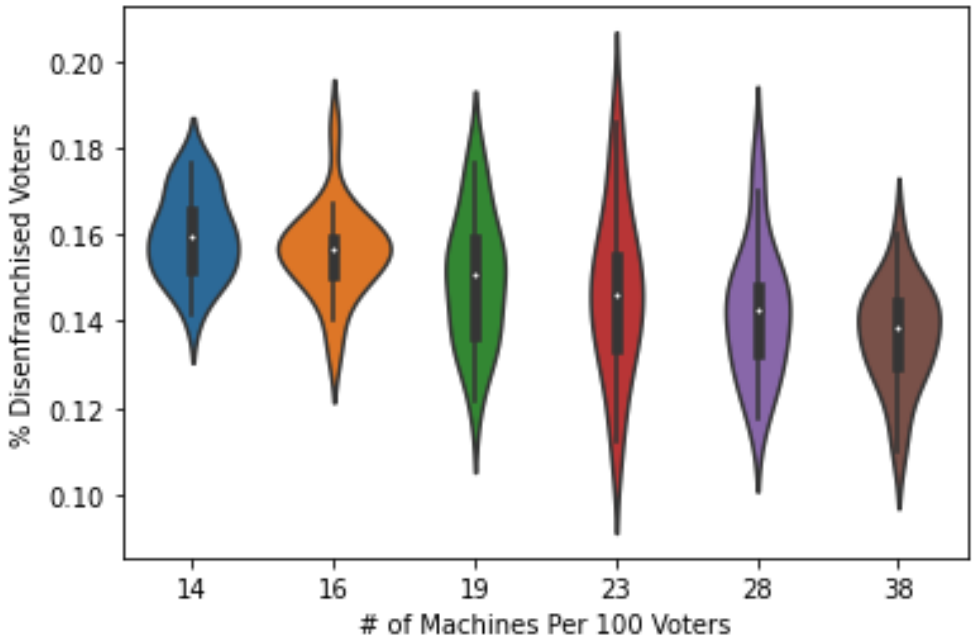
Figure 7 shows the % of disenfranchised voters per time step, separated by different speed levels. Here, Rich Voters have vision 6 times higher than Poor Voters, and 2 times higher than the Middle-Class Voters. Rich, Middle class, and Poor voters have speed 16, 13, 10. A closer examination of the data shows that at step 10, only 2% of rich voters are disenfranchised, compared to 30% poor voters, and 10% middle class voters.

This result is interesting, as compared to (a), we have the same speed for Rich, Mid, and Poor, but we only increase rich and middle voters' vision from 10 to 16, and 10 to 13. The default setting for vision in a is 10 for all voters. The results showing that the proportions of rich and poor being disenfranchised are almost the same values, we only have less disenfranchised middle-class voters. This suggests that we may have diminishing values of having extra "education," or "resources."

Now we'd like to test the effect of having more polling locations on voter turnout:

Number of Voting Machines Per 100 Voters = 116 (fixed number of machines in the grid) / Number of Initial Voters * 100

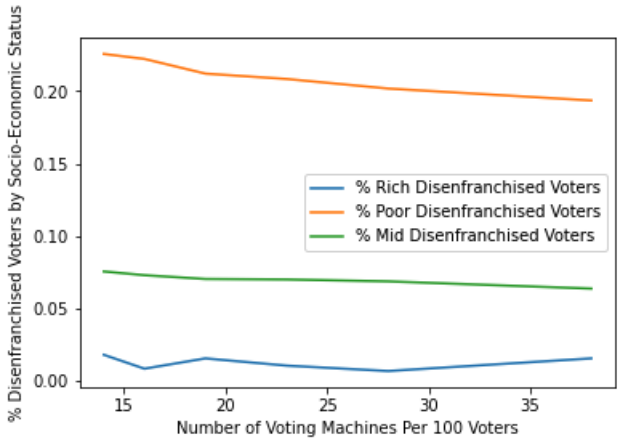
d. Increasing the number of voting machines will reduce disenfranchised voters within limited time period.



(Fig 8)

Figure 8 shows the % of disenfranchised voters for each # of voting machines per 100 voters. As we can see here, if we double the amount of voting machines (from 14 machines per 100 voters, to 28), we can see on average, the % of disenfranchised voters will reduce by 2%. In this setting, I set the max-steps as 15, and iterated each case 20 times. (# of machines per 100 voters is the only variable parameter here).

e. Increasing the number of voting machines will have a relatively large effect on poor voter turnout than that of rich voters.



(Fig.9)

A natural extension from part d is to examine whether the increase of voter machines will disproportionally benefit poor voters. Here, we use the same model: max steps is 15, and iterated each case 20 times, and take the average number. (# of machines per 100 voters is the only variable parameter here). We can see that having more voting machines per 100 voters will reduce the % of disenfranchised poor voters more significantly than the % of rich votes. It seems like adding additional ballots have no effect on rich voters.

Conclusion:

Combining these findings above, we can conclude that voters with more resources and more knowledge related to politics and electoral information, are likely to have a higher turnout than voters with less resources and information. This model generally captures the real-world cases, in which rich people (top 10%), have nearly 20% higher turnout than poor people. It also shows that, by reducing the cost of voting and having more voting machines, will reduce the turnout gap between rich and poor voters. This confirms that, the cost of voting, such as more complicated process to register to vote, going back and forth to provide ID information, less information related to electoral information, and having language barriers that prevent limited-English proficiency voters to vote on time, all may contribute to the lower participation of poor voters.

This study contributes to the broad literature on voting behavior by testing the "intangible cost" of going to the polling locations and consuming electoral information on voter turnout. While most previous studies focus on analyzing the effect of increasing education, and providing unconditional cash transfers on reducing turnout disparity, this study suggests that we may simply reduce the gap of civic participation by reducing the cost of going to the polling locations. This effect also raises more important questions for further study: absentee ballots can also reduce the cost of voting, would that reduce disparity in voter turnout across different socio-economic groups?

Admittedly, this study also has limitations. For one, it is hard to measure the scale of different parameters. In many cases mentioned above, I assume that rich voters are 6 times faster than poor voters. What does that mean in real life? Rich voters have 6 times more resources than poor voters in terms of a combination of spare time, energy, less traveling time, near closer to the polling locations? Same issues with "vision." What does it mean for rich voters to have 2 times more visions than poor voters? Conceptually speaking, it can represent education, internalizing the importance of voting, so they consume electoral information faster without much campaign outreach.

Another issue is that this model do not consider any external factors that may induce the turnout gap. For example, campaign outreach could be an example. Politicians may be more likely to reach out to rich voters because they need them to donate to their causes. Adding these external forces, it's hard to tell how much variation can "resources," and "education," contribute to the civic participation gap.

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