Incentivizing Political Inclusion of Disenfranchised Ethnic Groups using Approval Voting System: Case Study in Ethiopia

With Great Power Comes Great Responsibility

Oren Rimonor, Daniela Shuman

April 29, 2023

1 Context

Ethiopia, a developing country in the horn of Africa, is a highly diverse country with over 80 ethnic groups. Over the past few decades, Ethiopia has undergone a transformative political journey marked by shifting political ideologies, political instability, and democratization efforts. The introduction of a multi-party democratic rule in 1994 was a significant turning point in Ethiopia's political history, as it represented a shift towards a more inclusive and participatory system of governance. However, the journey toward a mature democracy has been marked by several challenges, including voter suppression, which has cast a shadow on Ethiopia's electoral process. Despite national elections being scheduled every five years, political instability has often resulted in their rescheduling, highlighting the fragile nature of Ethiopia's democratic system.

Despite the high voter turnout observed in the recent 2021 national election in Ethiopia, the electoral process was marred by significant challenges that resulted in the suppression of voting in certain regions. While the nationwide voter turnout stood at an impressive 90%, the ongoing civil war in the northern part of the country presented a significant obstacle to the electoral process. As a result, several regions, including Tigray, Somalia, SNNPR, and Harari, experienced delayed or suppressed voting due to political instability and a lack of essential voting infrastructure. The inability of citizens in these regions to exercise their democratic rights is a concerning issue that raises questions about the inclusiveness and fairness of the electoral process in Ethiopia.

The delays and suppression of election in the regions have cascading effects that go beyond the immediate issue of voter disenfranchisement. One of the most significant impacts of this problem is the representation of the people's choice and their freedom to elect their leaders. As a result of the lack of voting in the Tigray region, several seats in the House of People's Representatives are currently vacant, which means that the people of Tigray are not represented in this critical legislative body. This is a cause for concern, as it undermines the principle of inclusivity and fairness in the democratic process.

Further, the issue of voter suppression also has implications for the composition of the House of Federation in Ethiopia. As per the current system, the members of the House of Federation are composed of members of the political parties with seats proportional to the votes they received in the national election. For instance, in the 2021 election, the Prosperity Party received 90% of the votes cast, which translates to 90% of the seats in the House of Federation. The number of seats a political party gets is critical, as it directly affects the power it has in enacting legislative change in the country.

The number of seats a party gets is important as it is a direct proxy for the power it has in enacting legislative change in the country. Particularly, there are two forms of power in this government.

1. A party can win plurality, in which case they are responsible for electing the prime minister and their entire cabinet. Thus, the dominant party is responsible for the voting infrastructure.

2. A party can vote for certain measures to pass. If a party has $x\%$ of the seats in the house, then they contribute $x\%$ of the votes in favor or against a measure. In order for a measure to pass, the measure must have $y\%$ of the approval. In the case of Ethiopia, $y = 66\%$.

Voter suppression is not a problem that is unique to Ethiopia. It is a widespread phenomenon that can be observed in many countries where the ruling party or dominant group seeks to maintain power by suppressing the votes of opposition groups or minority communities. For example, in the United States, voter suppression tactics have been used to prevent African Americans, Native Americans, and other marginalized groups from exercising their right to vote. In India, voter suppression has been reported in areas where minority communities reside, and in Russia, allegations of voter suppression have been made in connection with parliamentary and presidential elections.

Therefore, this research paper seeks to address the issue of voter suppression by proposing a novel voting system that encourages political parties in power to actively seek votes from all regions, regardless of the potential voting preferences of the region. The primary objective of the proposed system is to promote a more inclusive and equitable electoral process that removes any incentives for malicious intent towards voter suppression. By promoting fair and transparent elections, the proposed system aims to strengthen democratic values and principles.

While the voting proposed is inspired by Ethiopia, it is extendable to other countries with similar instances of voter suppression.

2 Proposed Solution

We want to come up with a voting system that will encourage the dominant party, who is responsible for laying the voting infrastructure, to seek votes from all regions regardless of their preference profiles.

Let us introduce the mathematical set up of our solution:

- $R :=$ set of regions
- $P :=$ set of parties
- $K \subset R$; $K :=$ set of supressed regions.
- $S :=$ the number of seats in the parliament
- $N :=$ set of people eligible to vote
- $r_r :=$ population of eligible voters in region r
- $p_i :=$ party i
- $v_{rp} :=$ the number of voters in region r that voted for party p; v_r is the total number of voters in region r.
- $s_i :=$ number of seats given to party i. We know that $s_i = \frac{\sum_{p \in P} v_{ip}}{\sum_{r \in R} \sum_{p=1}^{r_i} v_{rp}}$, or the fraction of the total number of voters who voted for party i over the total number of voters.

Defining Dominant Party:

We define a dominant party to be the party who won plurality In the previous election since this party is currently the head of the government and is assumed to be responsible for the voting infrastructure. Party d is a dominant party if in the previous elections, $\forall j \neq d$:

$$\forall j \in P \setminus \{d\}, \frac{s_d}{S} > \frac{s_j}{S}$$

It is important to note that the dominant party in the previous election is not necessarily the dominant one in the current election results.

Defining Region Seat Allocation:

Each region gets a portion of seats proportional to their population. Voters in each region vote directly to their preferred party, and there are no representatives of regions. The reasoning is that when we penalize a dominant party, no seat is attached to a particular region.

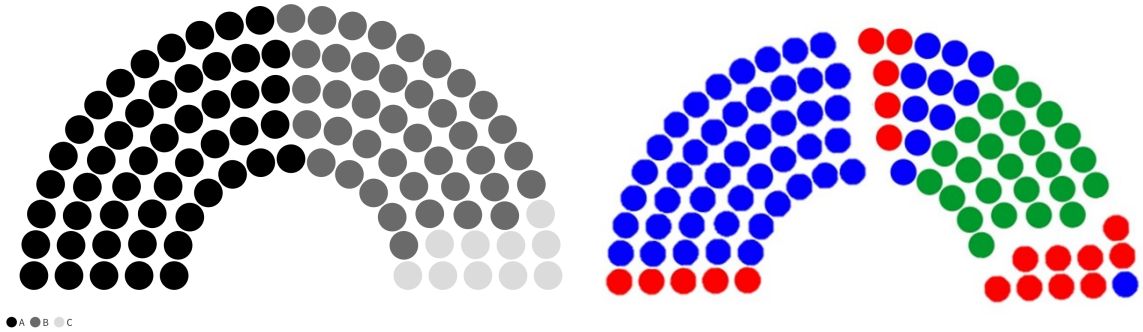
Figure 1a illustrates the proportional seat allocation by region population size in a case where the country has three regions.

Thus, party i gets the fraction of seats that is equal to the fraction of voters who voted for them in each region.

$$s_i = S * \sum_{r \in R} \frac{r_r}{N} * \frac{v_{ri}}{v_r}$$

When seats are allocated as such, then the House of Federation will be divided by party, as shown in Figure 1.

Region Party Preferences			
	Region A	Region B	Region C
Party 1	5	5	9
Party 2	45	10	1
Party 3	0	25	0



(a) Proportional Seat Allocation by Region Population size where $|R| = 3$

(b) Illustrates the reorganization of the above diagram by Region

Figure 1: Region Seat Allocation by Party

Defining Voter Suppression

There are two potential ways to define voter suppression. The first way is by defining a critical threshold for the voting rate. If the percentage of voters in a region r is less than a threshold ϵ, then we define this region as voter suppressed. If the region's voting rate is above the threshold, the region is not suppressed

$$\exists r \in R, s.t. \frac{v_r}{r_r} < \epsilon$$

The second way to examine voter suppression is by looking at the levels of the suppression per region. We will define an ϵ as the expected voting rate in a functioning democracy. If the voting rate is less than this threshold, we penalize the dominant party as a continuous function of the deviation of the voting rate from ϵ.

The suppression in region r is defined as:

$$suppression_r = \epsilon - \frac{v_r}{r_r}$$

We acknowledge that it is challenging to determine ϵ. The expected voter turnout in a functioning democracy can be impacted by many factors that are unrelated to suppression, such as the level of political engagement among citizens or the timing of the election. Therefore, we determined the value of ϵ from empirical evidence of voter turnout across the world. Below Figure 2 is a plot of the average voter turnout across the world over the past few decades. As this plot shows, the average voter turnout has been mostly above 60% (except for a one year deep in Africa around 1975).

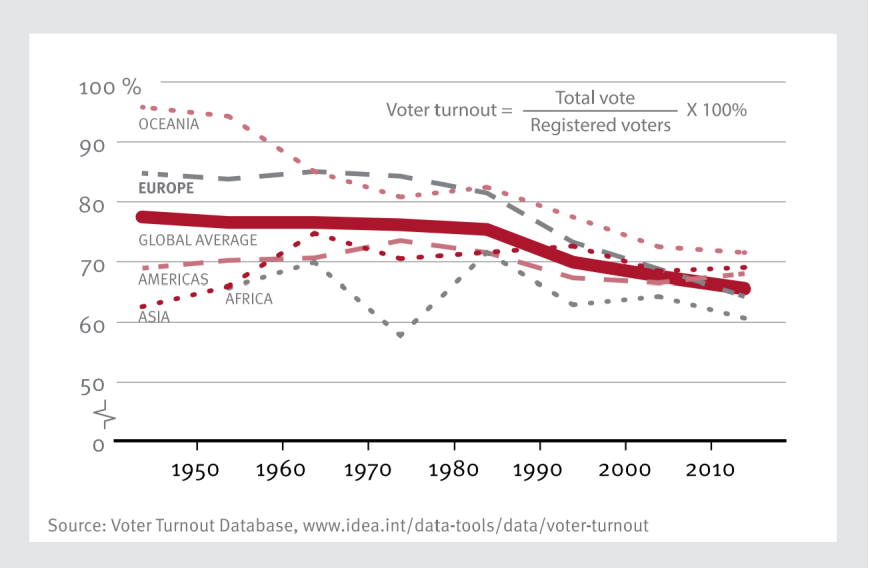


Figure 2: Report of Global voter turnout by region for lower house elections that took place 1945–2015. Report by The International Institute for Democracy and Electoral Assistance (International IDEA)

As such for our paper, we set the epsilon to be 60%. This means that if the voter turnout falls below 60%, it may indicate potential voter suppression. It is important to note that this threshold is not definitive and may need to be adjusted depending on the context and specific circumstances of the election. However, using empirical evidence of average voter turnout across the world provides a reasonable starting point for setting the threshold of ϵ.

Figure 2 also shows that there is variation in voter turnout across different countries and regions, indicating that factors such as cultural norms, political systems, and electoral laws can have a significant impact on voter turnout. Therefore, when assessing potential voter suppression, it is essential to consider these contextual factors and not rely solely on the threshold of ϵ. However, given that this is a simplified mathematical model of voter suppression, we are holding these extraneous factors constant and setting epsilon to 60%.

$$\epsilon = 60\%$$

We define our $\epsilon = 60\%$, meaning we expect the voting rate in a functioning democracy to be 60%.

Defining a Penalty

Let d be the dominant party. Let s_d be the number of seats allocated to party d in this election. We define our penalty function to be the following piecewise function:

$$penalty_r = \left\{ \begin{array}{ll} S * \frac{r_r}{N}(\epsilon - \frac{v_r}{r_r}), & \text{if } \frac{v_r}{r_r} < \epsilon \\ 0, & \text{if } otherwise \end{array} \right\} \tag{1}$$

Our penalization function is a continuous function of the voting rate up until the expected voting rate of a functioning democracy, ϵ. When the voting rate in a certain region is greater than ϵ, then the dominant party doesn't get penalized based on this region.

The total amount of seats allocated to the dominant party will be the number of seats they got in the election minus the penalties they got from every region.

$$s_d = \left\{ \begin{array}{ll} s_d - \sum_{r \in R} \lfloor penalty_r \rfloor, & \text{if } \sum_{r \in R} penalty_r < s_d \\ 0, & \text{if } otherwise \end{array} \right\} \tag{2}$$

This means that the most the dominant party can get penalized is all of their seats. If the party that was dominant in the previous election was dominant again in the current election but got penalized such that it is not dominant anymore, the party who won the second place becomes the dominant party and forms the government. In order to remove a seat, the penalty from a particular region needs

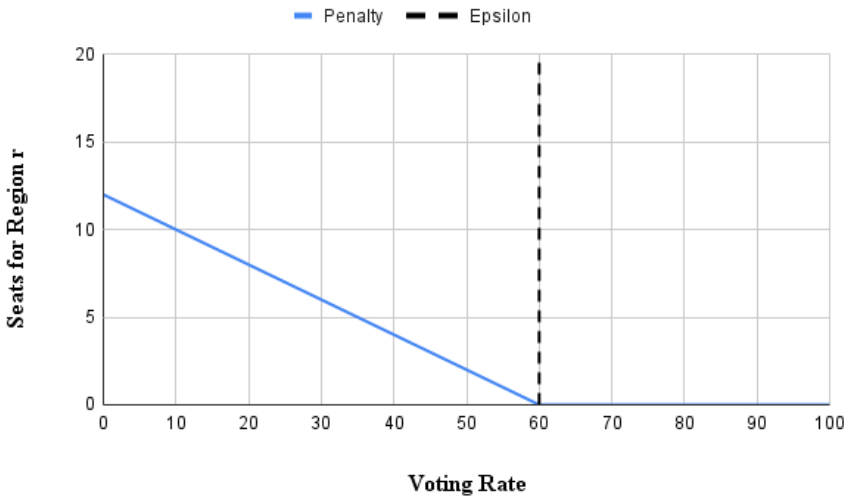


Figure 3: The penalty received and the remaining seats of a dominant party in a region that would contribute 20 seats.

to surpass an integer. We use the floor function to make sure the number of seats is rounded to an integer.

Redistribution Policy

Let us define $s' = \sum_{r \in R} penalty_r$ to be the penalized seats, We now want to redistribute s' to all parties except party d. The redistribution algorithm should incentivize voters to vote even if their preferred party is not the dominant party. To avoid a zero-sum game, we assume that there is no coalition formed across all $j \in P \setminus \{d\}$.

There are two options for the redistribution policy:

1. *Random:* For each seat $i \in s'$ and for all $j \in P \setminus \{d\}$, seat i will be given to party p_j with probability $\frac{1}{|P|-1}$.
$$P(i \to p_j) = \frac{1}{|P| - 1}$$
2. *Proportional:* For each seat $i \in s'$ and for all $j \in P\{/d\}$, seat i will be given to party p_j with probability $\frac{s_{pj}}{S - s_d}$.
$$P(i \to p_j) = \frac{s_{pj}}{S - s_d}$$

We choose the random redistribution. When using the proportional redistribution, the penalized seats are redistributed based on all of the existing regions preferences (whether or not they are voter suppressed). Implicitly, we are making an assumption that the suppressed region's actual party preferences reflect the existing party preferences. In the case of intentional voter suppression, this is likely to be wrong. Thus, we chose the random redistribution system.

3 Correctness

Below we clarify the integration of our model through case work. Then, we will prove correctness by demonstrating that our algorithm incentivizes the dominant party to seek votes from the suppressed regions even if the region votes only for alternative parties, and that any voter from any region is incentivized to vote.

3.1 Proving Strategy Proofness

We want to show that our model is strategy proved for both the dominant party and voters.

Dominant Party:

We want to show that even if every seat of region r is expected to be allocated to non-dominant parties, the dominant party will have an incentive to include the region in the election. We assume that the dominant party aims to maximize the number of seats it can get, regardless of the number of seats other parties have. In other words, the dominant party cares about its own share and does not care about its relative share compared to other parties.

According to our penalty function, the most the dominant party can get penalized by completely suppressing region r is ϵ times the number of seats allocated to the region:

$$\epsilon \cdot S\frac{r_r}{N}$$

When no one votes in the region, the entire set of seats of the region gets reallocated to every $j \in P \setminus \{d\}$, as well as the entire set of penalized seats. If there are 10 seats in the region, the dominant party will lose 6 seats, and 16 total seats will be reallocated to the other alternative parties. However, if the dominant party does not suppress the region it does not lose any seat and 10 seats are going to be allocated to the alternative parties (according to the true preference profile of the region.)

Voters:

We want to show that under any one of the following two contexts the expected change in the number of seats for the preferred party i is greater if the individual votes than if the individual does not vote.

$$\Delta E(s_i)|vote > \Delta E_(s_i)|don'tvote$$

By the nature of this voting system, q people in region r are responsible for selecting one seat in the region (the convention is q because it denotes a quota).

$$q = \frac{S \cdot \frac{r_r}{N}}{v_r}$$

q depends on the number of seats allocated to the region and the voting rate in the region. It follows that q differs across regions. Hence, a penalty seat from region r can be triggered every q_r voters. That is, the dominant party can be penalized one seat in region r for every q_r voters that withhold their votes. Similarly, a party gains an additional seat with every additional q_r voters in region r who vote for them. There are two ways in which a voter who prefers a non-dominant party can be a pivotal voter:

1. They could be a pivotal voter for triggering an additional seat for their preferred party (by voting).
2. They could be a pivotal voter for triggering an additional seat to be taken away from the dominant party (by not voting).

In the following proof, we assume that no voter is able to deduce that they are indeed the pivotal voter. We believe this is a reasonable assumption practically. In other words, no voter who is the pivotal voter knows they are pivotal.

We can think of the delegated seats in buckets of q. Each bucket of people represents one seat in the house. We know that for a region r that has $S \cdot \frac{r_r}{N}$ seats allocated to it and v_r voters who ended up voting, each seat is represented by q_r people, where

$$q_r = \frac{v_r}{S \cdot \frac{r_r}{N}}$$

This means that without ordering, any particular individual in region r could be the pivotal individual with probability

$$\alpha_r = \frac{S \cdot \frac{r_r}{N}}{v_r} = \frac{1}{q_r}$$

Since we penalize the dominant party only when the voting rate in the region is below ϵ, the probability of being a pivotal voter for an additional penalized seat is $\alpha \cdot \epsilon$ which is smaller than α. Thus we know that for every voter $i \in N$ who supports a non-dominant party j, the expected seat gain party j will have by voter i NOT voting is:

E(party j seat gain by voter i not voting) = P(i is a pivotal voter for party j) E(seat gain | i is a pivotal for voter party j) + P(i is a pivotal voter for penalty)* E(seat gain | i is a pivotal voter for penalty) + P(i is a regular voter)* E(seat gain | i is a regular voter)*

Mathematically, we can write this as follows;

$$E(\Delta s_j|novote) = \alpha * (-1) + \alpha\epsilon * \frac{1}{|P|-1} + 0 =$$

$$= -\alpha + \frac{\alpha\epsilon}{|P|-1} < 0$$

Thus, every voter $i \in N$ who supports a non-dominant party j is expected to have a higher gain by voting.

3.2 Case Work

There are three cases that we will lay out to build clarity in the intuition. Let the total number of seats in the house be 110 for the below two cases. Let the penalty for the below two cases be 51% of the seats in the suppressed regions.

1. *Case 1 (large region suppression):* Let there be a large region r. Let $S\frac{r_r}{N} = 100$, or the number of seats that the large region has is 100 out of the 110 seats. In this case, the $penalty = \lfloor 51\% * S\frac{r_r}{N} \rfloor$, so the dominant party looses 51 seats.

2. *Case 2 (small region suppression):* Let there be a small region r. Let the total number of seats dedicated to the small region to be 10: $S\frac{r_r}{N} = 10$. In this case, the penalty is still $penalty = \lfloor 51\% * S\frac{r_r}{N} \rfloor$, but since we are rounding down, the dominant party looses only 5 seats (instead of 5.1).

Simulation:

We tested our penalty function on a simulation, whose basis was influenced largely by Ethiopia (details in Appendix). From the simulation, we find that by suppressing the votes of there regions, the dominant party is negatively impacted in the number of seats it gets from the regions. In our simulation, we find that the dominant party's seats reduce from 68 with suppression and no penalty, to 59 after enacting the penalty.

While the penalty has a clearly targeted impact on the number of seats the dominant party has, the redistribution of the penalty can have a significant improvement on the number of seats other parties have. For instance, the number of seats a party TPDP has post-redistribution is 1.6X more than what it had pre-redistribution.

Further, we notice that high suppression of regions ends up having as large of an impact on the number of seats penalized by the dominant party. For instance, in the simulation, Tigray has only a 6% voting rate while contributing 6 total seats to the house. As such, the dominant party is penalized 4 seats – a significant portion of the total number of seats contributed by the region.

4 Conclusion and Future Work

4.1 Findings

We were able to find a novel seat allocation system in which the dominant party is incentivized to seek votes from suppressed regions even when these regions are expected to only vote for alternatives. Moreover, our seat allocation system also incentivizes all voters to vote for their preferred party. To the best of our knowledge, there is no existing literature in the Computer Science field that addresses the issue of voter suppression in the developing world. Below, we discuss the limitation of our findings as well as potential future work.

4.2 Limitations

There were two assumptions that we made in our solution that when challenged, fail strategy proofness:

Assuming Voters Do Not know they are Pivotal

In our proof of correctness, when we do not operate under the assumption that voters do not know if they are pivotal, our solution is not strategy-proof for the pivotal voter triggering an additional penalty seat. We demonstrate why below.

- *Pivotal Voter for an Additional Non-Dominant Party Seat:*
  This happens when the voting rate in the region for party p increases such that it surpasses the nearest rounded quota after the pivotal voter votes.

  $$(\frac{v_{rp}+1}{v_r}) \mod q_r = 0$$

  In this case,

  - *Vote:* $\Delta E(s_j) = 1$
  - *Don't Vote:* $\Delta E(s_j) = 0$

  Clearly, the expected number of seats for the voters preferred party is higher if they vote than otherwise.

- *Pivotal Voter for an Additional Penalized Seat:*

  This happens when the voting rate in region r drops such that it surpasses the nearest rounded quota after the pivotal voter does not vote. When $\frac{v_r}{r_r} < \epsilon$,

  $$\frac{v_r - 1}{r_r} \mod q_r = 0$$

  $$\Delta penalty_r = 1$$

  In this case, the pivotal voter can:

  - *Vote:* The penalty will not change by an additional seat if this voter votes. Thus, the only contribution to the expected change in the number of seats for the voters preferred party j is based on their direct contribution to the vote count for that party.

    $$\frac{v_{rp}+1}{v_r}$$

    $$P(\Delta E(s_j) = 1) = \alpha$$

  - *Don't Vote:* The penalty is guaranteed to increase by one additional seat. The change in the number of seats for the preferred party is dependent on the redistribution algorithm. We chose the random redistribution algorithm, so each party, no matter the popularity, will gain the extra seat with the same probability:

    $$P(\Delta E(s_j) = 1) = \frac{1}{|P| - 1}$$

    Thus, the vote of the voter goes to their preferred candidate with the probability above.

  As long as $\alpha < \frac{1}{|P|-1}$, the pivotal voter is expected to be better off by not voting.

Dominant Party's Preference

We believe it is a reasonable assumption that voters do not know if they are pivotal. If we relax the assumption that the dominant party only cares about the number of seats it gets and does not care about the relative allocation of seats in the house, our system is not strategy proof. For example, a case in which it will be better for the dominant party to exclude region r is when it is the dominant party in the current election as well, and there is another party i that threatens the dominance of party d after the penalty and the reallocation take place.

Mathematically, according to the initial election results $s_d > s_i$. We know that after the penalty the dominant party is left with $s'_d = s_d - \epsilon \cdot S\frac{r_r}{N}$. Since no one v/oted in region r, there are $s'_d + S\frac{r_r}{N}$ seats that are going to be redistributed. Party i is expected to receive $s'_i = (s'_d + S\frac{r_r}{N}) \cdot \frac{1}{|P|-1}$ of these seats. The dominant party will have an incentive to exclude region r if:

$$E(s_i + s'_i) \geq s_d - s'_d$$

In the real world, it is reasonable to assume that any party that is dominant would only care about the proportion of seats they have in the house, regardless of whether or not they win plurality.

Large Suppression of Small Region

As previously discussed in the Case Work Section 3.2, our model fails to penalize a dominant party much if the party chooses to suppress a small region. Our penalty function is a form of a weighted average of the amount of suppression, weighted

From the simulation, we notice that high suppression of small regions does not end up having as large of an impact on the number of seats penalized by the dominant party. In the case of Tigray, the dominant party was penalized only 4 seats. While four seats are a significant proportion of the total number of seats contributed by the region, it is a small fraction of the total number of seats the dominant party has. As such, the penalty may fail to have as large of an impact to incentivize the dominant party to reduce voter suppression.

4.3 Future Work

4.3.1 Epsilon for Voter Turnout

As addressed in the section 2 and Figure 2, the epsilon value for voter turnout can be impacted by cultural norms, political systems, and electoral laws. Therefore, when assessing potential voter suppression, it is important to propose a value that takes these factors into consideration. As such, the availability of data on voter turnout across regions is essential to understand a potential mathematical abstraction of voter turnout.

Hence, future work can explore how to model the voter turnout rate given empirical data across different regions of the world - with further detail on the subregions. One method could be to use machine learning algorithms to identify and analyze the various factors that impact voter turnout, such as age, education, race, gender, socioeconomic status, and political affiliation. These algorithms could then be used to develop predictive models that estimate voter turnout rates based on demographic and political factors. Additionally, qualitative research methods such as surveys, focus groups, and interviews can be used to gather insights into cultural norms, political systems, and electoral laws that may impact voter turnout. By combining quantitative and qualitative data, it may be possible to develop more accurate and nuanced models of voter turnout that can be used to identify and address potential voter suppression.

4.3.2 Penalty Function

Our penalty function is subject to simplifying assumptions, including the epsilon value for voter turnout and that the dominant party is penalized in proportion to the number of seats the suppressed region contributes. However, as noted in the above limitation, this approach has its limitations, particularly when small regions are suppressed, thereby curtailing the participation of minority groups. In view of this, future work may investigate alternative penalty functions that incorporate the magnitude of the deviation of suppressed regions from the epsilon value. For instance, penalties could be weighted

proportionally to the percentage of the suppressed region's population relative to the total population, or by considering the degree of suppression, such as restrictions on polling access or manipulation of the electoral process. In addition, future research may explore the integration of other factors, such as marginalized group representation, media coverage, and more sophisticated models of voter behavior, such as game theory or social network analysis, with the aim of developing more nuanced, effective, and accurate penalty functions for deterring voter suppression and enhancing democratic participation.

4.3.3 Manipulation From Other Parties

Throughout the setup of the problem, we assumed that suppression is caused by the dominant party who won plurality in the previous elections. While this is true at large, this simplification may not capture the complexity of the situation as other factors could be involved. For instance, it is plausible that opposition parties may collude to suppress votes in regions that are predominantly aligned with the dominant party. Furthermore, it is possible that multiple parties may conspire against a single party to achieve voter suppression. As a result, the situation can become significantly more intricate, and the suppression dynamics could differ from those observed under the assumption of a single dominant party.

4.3.4 Model Relative Dominance

In the proof in Section 3.1 of the dominant party, we assumed that its incentive is to maximize the number of seats it can get, regardless of the relative share it holds compared to other parties. However, in the real-world, the dominant party can be interested to have a higher relative dominance over other parties. As such, future work can model the dominant party's incentive to maintain a higher relative dominance.

5 Appendix

5.1 Simulation

For the purposes of completeness, we have simulated the electorial process of the Ethiopian multiparty election.

For the purpose of the simulation we assumed the following:

- Assumed the suppression of three regions: Tigray, Afar, and Somalia. Thus, these regions have voting rates of less than 60%.
- The remaining 8 regions don't experience voter suppression.
- We assumed that we can randomly generate the voting rate of each region given the presence or absence of voter suppression.
- We used the reported population of each region as reported in 2017 -
- Using the population of each region above, we calculated the proportion of seats in each region in the House of Federation accordingly.
- The apportionment is handled using the Random apportionment law - i.e the remainder seats are randomly redistributed.
- Penalized seats are randomly redistributed
- The Prosperity Party (PP) is the dominant party

Region	Population (Million)
Afar	1.8
Somali	5.7
Tigray	5.2
Amhara	21
Benishangul Gumuz	1.06
Gambela	0.435
Harari	0.246
Oromia	35.5
Sidama	3.2
South West	2.3
Southern Nation and Nationality and Peoples	9.1
Total	85.541

Table 1: Total Population of Each Region of Ethiopia Following 2017 census.

Region	Seats	Min	Apportioned (Random)
Afar	2.356764592	2	3
Somali	7.463087876	7	7
Tigray	6.808431045	6	7
Amhara	27.49558691	27	27
Benishangul	1.387872482	1	2
Gambela	0.5695514432	0	0
Harari	0.322091161	0	1
Oromia	46.48063502	46	46
Sidama	4.18980372	4	4
South West	3.011421424	3	3
Southern	11.91475433	11	12
	112	107	112

Table 2: Seats, minimums, and randomly apportioned values by region in Ethiopia.

Region	Total Voting Rate (%)	PP (%)	TPDP (%)	ANDP (%)	SPDP (%)
Afar	14.00	0.00	29.03	64.32	6.66
Somali	20.00	0.00	17.79	37.28	44.93
Tigray	6.00	0.00	52.01	0.00	47.99
Amhara	62.00	86.53	0.00	13.47	0.00
Benishangul	91.00	85.30	0.00	0.00	14.70
Gambela	73.00	89.53	10.47	0.00	0.00
Harari	73.00	59.37	0.00	14.88	25.76
Oromia	86.00	67.26	0.00	32.74	0.00
Sidama	84.00	52.24	42.79	0.00	4.97
South West	60.00	81.22	0.00	0.00	18.78
Southern	64.00	61.83	9.50	24.73	3.94

Table 3: Voting Rate of Each region along with Votes cast to each candidate party

Region	PP (%)	TPDP (%)	ANDP (%)	SPDP (%)	Remaining Seats
Afar	0	0	1	0	2
Somali	0	1	2	3	1
Tigray	0	3	0	3	1
Amhara	23	0	3	0	1
Benishangul	1	0	0	0	1
Gambela	0	0	0	0	0
Harari	0	0	0	0	1
Oromia	31	0	15	0	0
Sidama	2	1	0	0	1
South West	2	0	0	0	1
Southern	7	1	2	0	2
Total	66	6	23	6	11

Table 4: This table shows the number of seats allocated to each party across each region, given the percentage of votes cast towards each party in the regions in table 3 and the total seats allocated to each region in table 2

From table 4, 11 seats will be randomly redistributed to all P parties - as there are the pure remainder seats after allocation.

Region	PP	TPDP	ANDP	SPDP	**Total**
Afar	0	0	1	2	3
Somali	0	1	2	4	7
Tigray	1	3	0	3	7
Amhara	23	1	3	0	27
Benishangul	1	0	1	0	2
Gambela	0	0	0	0	0
Harari	0	1	0	0	1
Oromia	31	0	15	0	46
Sidama	3	1	0	0	4
South West	2	0	0	1	3
Southern	7	1	4	0	12
	68	8	26	10	112

Table 5: Seats Allocated to each Party across all the regions following random redistribution of the remaining seats and penalities.

Region	Voting Rate	Penalty	Penalty Rounded
Afar	14	1.38	2
Somali	20	2.8	3
Tigray	6	3.78	4

Table 6: Voting Rates and Penalties by Region

Following the penalties in table 6, the total penalized seats are redistributed to only the non-dominant parties. Thus, the final penalized and redistributed seats are:

Party	Seats
PP	59
TPDP	13
ANDP	28
SPDP	12

Table 7: Final Seats Allocated to each party