None-of-the-Above Voting and Policy Responsiveness: Theory and Evidence from India

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Abstract

This paper investigates the impact of None-of-the-Above (NOTA) voting on the responsiveness of policy-making. We develop a career concerns model in which voters – classified as 'strategic' or 'engaged' – derive expressive utility from voting and share common priors about candidate competence. The model shows that NOTA facilitates information aggregation by allowing strategic voters to delegate electoral decisions to engaged voters, thereby improving selection while weakening disciplinary incentives. The effect on policy responsiveness depends critically on voter information quality and the degree of political competition. To test these predictions, we exploit the exogenous introduction of NOTA in Indian state assembly elections in October 2013. Using constituency-level panel data between 2012 to 2021 and an instrumental variable strategy, we find that NOTA adoption led to a 7.5%-10% increase in log nighttime luminosity – a proxy for local economic activity. Consistent with the model, the effects are concentrated in moderately competitive constituencies. While richer voter information attenuates the impact of NOTA, the overall effect remains positive and statistically significant. Robustness checks confirm that our results are credible. Our findings highlight the nuanced role of expressive voting mechanisms in enhancing democratic accountability and economic performance.

Keywords: None-of-the-Above (NOTA), Career Concerns, Nighttime Lights, India
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1 Introduction

In a representative democracy, elections aggregate private observations of performance to determine whether or not to reelect an incumbent. Two key features of elections – monitoring and selection – function as safeguards for any democracy (Besley, 2006). First, elections serve as a disciplinary mechanism. If the elected politicians deviate significantly from the preferences of their electorate, voters would vote the incumbents out of office. The threat of losing office therefore induces incumbents to exert more effort (Barro, 1973; Ferejohn, 1986). Secondly, elections provide a mechanism for voters to select the good *type* of politician who would act on their behalf independent of re-election incentives (Fearon, 1999).[1]

In rational choice models, voters make informed decisions and turn out to vote if their expected benefits outweigh the costs and cast their ballot in favor of the candidate most aligned with their own preferences. The incumbents know this and implement voter-preferred policies to maximize their chances of re-election. However, if voters get sufficiently high 'expressive' benefits from voting such as ethics, civic duty, political agency, social norms or social image concerns (Riker and Ordeshook, 1968; Ali and Lin, 2013; DellaVigna et al., 2016), it might distort the voting calculus and result in voters who turn out to vote being dissatisfied with *all* the candidates on the ballot. The lack of suitable candidates to choose from might be especially relevant for countries with weak political institutions where political market frictions create high entry barriers into politics and weaken electoral accountability (Keefer and Khemani, 2005). For example, data from the National Election Study 2024 conducted by the Centre for the Study of Developing Societies in India reveals that 12.2% of the respondents voted for a party because there were no good alternatives available. Moreover, amongst abstainers, 8.3% were not interested in voting, another 2.6% felt that voting would not change the outcome while 1.1% said that the candidate was not good (link). To avoid alienating voters, one practical approach is to allow voters to cast a 'nil' vote to signal their disapproval of the candidates. However, there is little evidence on whether 'nil' voting leads to more responsive policy-making. We address this question in this paper.

When voting is not compulsory, voters may register their disapproval through abstention. For an uninformed voter, abstaining will not only avoid the swing-voter's curse and improve expected electoral outcomes as suggested by Feddersen and Pesendorfer (1996),

[1] While both accountability and selection contribute to responsive public policy, Fearon (2011) emphasizes the role of selection in ensuring that democracy is self-enforcing. In fact, electoral accountability may not be necessary for responsive policy-making when voters can discern the good *type* of politician, even if the chances of doing so are small (Fearon, 1999). This notion is echoed by Besley (2005), who argues that elections serve to select the good type when the quality of a politician is a valence issue, i.e., when all voters prefer a more competent politician over a less competent one.

but it will also save on the physical and time costs involved in voting. However, this may not be an option for voters who obtain a sufficiently high expressive benefit from participating in elections. Alternatively, voters could vote for an insurgent or anti-establishment party to reflect the lack of acceptable mainstream candidates. This form of protest voting, however, is difficult to distinguish from straight issue-voting, which somewhat limits its efficacy. Another option is that voters could vote tactically for a less preferred party with the intention to stage a protest but at the same time wanting their most preferred candidate to win (Myatt, 2017). Voters could also intentionally cast blank, null or spoiled (BNS) ballots. A problem with BNS votes, however, is that it is observationally equivalent to unintentional voting error which makes it difficult to draw sharp inferences about voters' dissatisfaction.[2] Another possibility is to vote for the 'None of the Above' (NOTA) option, when it is available (also called a 'nil' or 'blank' vote). The idea of a NOTA option is not new. The state of Nevada in the USA has had an explicit NOTA option on its ballot since 1976. Other countries that have a blank vote or NOTA option include India, Colombia and Ukraine (see Ambrus et al., 2025). In comparison to the other protest instruments just discussed, a distinguishing feature of NOTA votes is its unambiguity in expressing voters' dissatisfaction of the candidates.

To understand the effect of NOTA on policy-making, as a first step, we develop a quantitative framework to characterize the equilibrium public policy with a NOTA option in place and examine key comparative statics. We study this in the context of India, the world's largest democracy. In October 2013, the Supreme Court, India's apex judiciary, mandated the inclusion of a NOTA option in all direct elections held across the country. The suddenness of the change in electoral rule serves as a quasi-natural experiment that allows us to isolate the effect of NOTA from other potentially confounding factors and offer fertile ground to test our theoretical predictions.

The NOTA option is distinct in comparison to the other candidates on the ballot since even if it secures the maximum votes, the politician who gets the most votes wins the seat.[3] This lack of 'legal consequences' (link) has led mainstream media to declare that NOTA is a 'failed idea' (link). However, in this paper, we contend that such claims do not hold up to closer scrutiny as far as policy-making is concerned. We provide systematic evidence that the 10.6 million votes that NOTA received in our sample as of 2021 have led to a meaningful increase in welfare. The main idea behind this is that political competition encourages office-motivated incumbents to perform in order to persuade NOTA voters to

[2]See Alvarez et al. (2018) for a useful review of the taxonomy of protest voting.

[3]In direct elections to the third tier of governance – gram panchayats and urban local bodies – the state election commissions of Maharashtra and Haryana have amended their laws in November 2018 to conduct a re-election if NOTA wins majority votes in municipal councils, municipal corporations or nagar panchayats. However, this does not affect parliamentary elections or legislative assembly elections.

switch to their fold and tilt the outcome decisively in their favour. In fact, in 6.7% of the constituency-year pairs in our sample, the share of NOTA votes surpassed the margin of victory – the difference in vote share between the winner and the runner-up. For example, during the 2017 Gujarat assembly elections in India, NOTA votes exceeded the winning margin in 18.2% of its constituencies, influencing the electoral dynamics. Similarly, in the 2013 and 2018 Madhya Pradesh assembly elections, NOTA received more votes than the victory margin in 10.7% and 9.6% seats, respectively. In Jharkhand, it was 14.3% in 2014, 12.1% in Bihar in 2020 and 11.8% in Tamil Nadu in 2016 (see Table B2 for details). Despite the prevalence of constituencies where the NOTA vote share exceeds the win margin offering incumbents the opportunity to convince such 'swing' voters, there is little evidence on the impact of NOTA – a formalized, expressive form of strategic abstention – on policy-making. To address this knowledge gap, we construct a theoretical framework that yields testable predictions which we take to data from real-world elections.

To fix ideas, we consider two politicians – an incumbent and a challenger – who are both office-motivated. The incumbent commits to a policy and may differ from the challenger in terms of competence, which could be either high or low. We assume that neither the politicians nor the voters know their true types, as is standard in the career concerns literature (Holmström, 1999; Ashworth et al., 2017). Voters, of which there are two – engaged and strategic – observe a noisy signal of the incumbent's performance, update their beliefs about the politician's competence, and decide to reelect or remove the incumbent. Voters have common values – they prefer more competent over less competent politicians – and identical priors regarding the incumbent's competence. However, they differ in their willingness to use the NOTA option which is due to the different psychological costs they face from not voting decisively for one of the candidates. In our set-up, the engaged voter always votes decisively for one of the two candidates – rewarding the incumbent for good performance and nominating the challenger otherwise. By contrast, the strategic voter has four options to choose from: voting for the incumbent or for the challenger, voting for the NOTA option when it is available, or abstaining altogether. While both the NOTA option and abstention inflict a psychological cost to the voter, it is higher for the latter. This is because in the case of NOTA, voters obtain some degree of satisfaction from performing their civic duty even if they have to sacrifice the possibility of being pivotal. Abstention, on the other hand, incurs the full psychological cost since there is no participation at all.

The main prediction from our theoretical model is that allowing voters to cast a NOTA vote improves the incumbent's performance. The reason is simple: a NOTA vote reflects voters' uncertainty over the quality of the contestants. The incumbent, motivated to win elections, anticipates this and endogenously responds by improving in-office performance to make them more desirable and sway the NOTA vote in his favour. Interestingly, the model reveals that higher electoral non-participation—whether through NOTA or abstention—can generate a trade-off between the selection and the disciplining functions of elections. On one hand, allowing voters to effectively withdraw from the election increases the electorate's ability to aggregate information akin to the swing-voter's curse mechanism described by Feddersen and Pesendorfer (1996): uninformed voters can opt for the NOTA option, thereby delegating the decision to better-informed voters. On the other hand, once a less capable incumbent is identified, these NOTA votes weaken the electorate's ability to sanction and remove him from office. The interplay between these effects ultimately shapes the impact of the NOTA option on politicians' in-office behavior, particularly with respect to public investment. This result is important since it outlines the political conditions which foreshadow NOTA's success. It suggests that NOTA is more likely to pressurize incumbents to perform when the monitoring capacity of the electorate is *low* or when constituencies are *moderately competitive*, that is, when the electoral advantage is not too large so as to make the election contest completely one-sided. Next, we bring these predictions to the data.

For our empirical analysis, we exploit the plausibly exogenous variation in the timing of the 2013 Supreme Court judgment directing the Election Commission of India (ECI), a non-partisan body in-charge of conducting elections in India, to include the NOTA option in all ballots, together with the staggered timing of state assembly elections held across the country, to identify the impact of NOTA on economic activity. Using constituency-level panel data for assembly elections from 2012 to 2021, we estimate the causal effect of introducing the NOTA option on log nighttime luminosity – a proxy for local economic activity (see Section 5 for a discussion on the use of nighttime lights in the literature) – after controlling for key political confounds, accounting for a constituency's pre-treatment nighttime luminosity interacted with a time trend, and including constituency and year fixed effects. We cluster the standard errors at the constituency level to account for intra-cluster correlations over time.

We find that, consistent with predictions from theory, the introduction of NOTA led to an increase in log nighttime lights, specifically by around 8%-10% on average across different model specifications. To understand the intensive margin effect of NOTA votes on economic activity, we use an instrumental variable (IV) strategy where we instrument the percentage of NOTA votes with an indicator for whether the election is held after the 2013 Supreme Court mandate and include the full set of controls. In Section 7.1.2, the IV2SLS results show that a one-percentage point increase in NOTA votes leads to about an 8% increase in log nighttime luminosity. We complement these findings with results from a regression discontinuity design (RDD) in Section 7.1.1, where we estimate local linear regressions in a narrow time window on either side of the date a constituency had its first election with the NOTA option to obtain precise local treatment effects. The RDD estimates corroborate the least squares and IV2SLS estimates which reinforces our confidence in the results.

These results are however likely to vary with the degree of electoral competition and the difference in voters' access to information. As mentioned before, the electoral competitiveness in a constituency might intermediate the impact of NOTA on nighttime luminosity. To investigate this, we compare the results from safe constituencies with competitive seats and find that, in line with theory, the impact of NOTA is maximum in constituencies with moderate levels of political competition, that is for the sub-sample where the vote margin is between 10% to 25%. The results in Section 7.2 is revealing – the effect is smaller but positive in constituencies where the vote margin is less than 10%. Importantly, the effect becomes statistically insignificant in constituencies with an overwhelming electoral advantage, that is, when the vote margin exceeds 25%.

Furthermore, voter information might act as a substitute for NOTA. If this were true, it would attenuate the impact of NOTA on economic activity, resulting in downward-biased coefficient estimates. The theoretical model shows that the benefits of NOTA accrue from uninformed voters avoiding the wrong decision in equilibrium when discerning the incumbent's competence is relatively challenging, that is, when public outcome is a noisy signal of the incumbent's type. Thus, when the quality of the signal is already sufficiently precise, NOTA does not create any additional electoral pressure on the incumbent with further increase in the signal's quality. To investigate this, in Section 7.3, we construct a measure of cell-tower density that captures access to mobile network connectivity at the constituency level and include this as an interaction term in our regression model. We find that, although the coefficient on the interaction terms is negative, the overall effect of NOTA remains unchanged even after controlling for voter information. However, this result is only suggestive since the location of cell towers might itself be endogenous.

Nevertheless, there are some potential threats to our empirical strategy. One concern is whether we are inadvertently picking up the effect of political budget cycles which might affect our estimates. In Section 7.4.2, we show that our results remain qualitatively unchanged even after accounting for the effect of political budget cycles. In addition, we conduct a battery of robustness tests in Section 7.4 to ensure that our main result is credible. We show that our results are robust to: alternative transformation of the dependent variable; estimating the empirical model on an election-year sub-sample, addressing potential biases due to staggered adoption of NOTA in two-way fixed effect regressions; and, examining the sensitivity of the linear instrumental variable estimation to allowing for flexible covariate specification using double-debiased machine learning. This ensures that our IV estimates depend only on treatment effects and not on potential outcome levels (Blandhol et al., 2022).

In summary, our paper contributes to the literature on strategic models of voting in informational contexts (Feddersen and Pesendorfer, 1996; Ashworth et al., 2017). Specifically, we examine the role of NOTA votes as a way for voters to express uncertainty over the candidates and find that it positively affects public policy. In related work, Ambrus et al. (2017) and Ambrus et al. (2025) study the effect of a nil vote on both voting behavior and electoral outcomes using a combination of laboratory and lab-in-the-field experiments in USA and Austria. Ujhelyi et al. (2021) use reduced form and structural estimation to examine the effect of NOTA on turnout and political competitiveness in India. To the best of our knowledge, we are the first to demonstrate that NOTA votes can act as an informative signal for incumbents to improve in-office performance even when voters have the same priors regarding the candidate's competence. Using panel data from India, we find convincing evidence that the effect is causal. Furthermore, our theoretical model predicts that NOTA might lead to a trade-off between the selection mechanism and political accountability mechanism of elections. We find empirical evidence that is broadly consistent with theory. Overall, these results contest the claim made by lawmakers appearing for the Union of India and relayed in popular media that NOTA is a 'failed idea' since it has no 'legal consequence'.[4] Contrary to this, we find evidence that NOTA strengthens democracy and improves the responsiveness of policy-making.

The structure of the paper is as follows. Section 2 provides a brief institutional background necessary to interpret the results. It outlines the process of electronic voting in India, and discusses the NOTA policy. Section 3 reviews the related literature. Section 4 develops a theory model which yields a set of key predictions which we bring to data. Section 5 introduces our data and provides key descriptive statistics. Section 6 provides our identification strategy. We discuss our empirical results in Section 7. Section 8 concludes.

2 Background

In this section, we provide a brief overview of India's institutional background and outline the key elements of the NOTA policy.

[4] P. Sathasivam, the 40$^{\text{th}}$ Chief Justice of India, summarises Mr. Malhotra, the additional solicitor general of India's argument as "... negative voting (NOTA) has no legal consequence and there shall be no motivation for the voters to travel to the polling booth and reject all the candidates, which would have the same effect of not going to the polling station at all." (see para. 47 [here]). This statement neither considers that voters may derive 'expressive' benefits from voting, nor that a NOTA vote is more informative as a signal that expresses disapproval of the candidates than abstention which may be driven by a number of factors. We refer to Dhillon and Peralta (2002) for a review of factors affecting turnout.

Institutional Background: In India's decentralized system of governance, citizens elect their representatives at the national, state, and local levels. The Seventh Schedule of the Indian Constitution demarcates the relationship between the Centre and the States. While issues of national importance such as defence, foreign affairs, vital transport and communication links, are the Centre's prerogative, public order, local governance, agriculture and land rights, industries among others are the State's responsibility. This paper focuses on state-level legislative assembly elections which elect representatives who affect policies that relate to local economic development. Assembly elections appoint a single representative from each assembly constituency typically for a five-year term. Direct elections to the state legislature follow a first-past-the-post rule where the candidate who wins the most votes is declared the winner and is elected a member of the State's Legislative Assembly (MLA).

A key feature of state legislative assembly elections in India is that the timing of these elections is staggered across states. That is, groups of states follow distinct electoral cycles instead of all states holding elections simultaneously across the country. While the primary reason for the staggered design of assembly elections is to ease the logistical burdens that holding elections impose on the administration,[5] it means that states implement the NOTA policy in a staggered manner, which we exploit in our empirical analysis.

Electronic Voting: India witnessed a notable shift in its voting technology with electronic voting machines (EVMs) replacing paper ballots. All state assembly elections since 2001 and parliamentary elections since 2004 have been using EVMs to electronically record and count votes. Thus, different voting technologies do not overlap in our sample, which starts from 2012, when electronic voting was already well established across the country. The introduction of EVMs brought about several benefits: it reduced the turnaround time to count votes – from 30-40 hours under a paper ballot system to 2-3 hours with EVMs – a reduction by a factor of almost 15. In addition, electronic counting reduced errors common in manual counting. It also reduced printing, transportation, storage, and distribution costs. EVMs curbed electoral fraud as it permits the recording only 5 votes per minute which made vote capture or mass rigging very unlikely. In addition, EVMs prevented voters from unintentionally casting invalid votes. At this point, a brief discussion of the electronic voting process is needed to understand the issue that EVMs introduced in the electoral process and how the NOTA policy was aimed to address it.

Figure 1 depicts an EVM consisting of a Ballot Unit (BU), a Control Unit (CU) and a voter-verifiable paper audit trail (VVPAT).[6] A BU can have up to 16 candidates, including

[5]This includes, for instance, moving paramilitary security forces across the country, arranging several thousands polling booths, deploying voting machines.

[6]The VVPAT allows voters to verify that their vote was cast as intended. It was introduced in a

NOTA, and up to 24 BUs can be connected to a CU forming an EVM set. Thus, one set of EVMs can accommodate up to 384 candidates, including NOTA. In addition, EVMs and VVPATs are powered by their own batteries and do not require an extended power supply. This is useful for servicing remote locations with unreliable power supply. When a voter arrives to cast her vote, the presiding officer presses the ballot button of the CU to activate the BU. The voter then presses the 'blue button' on the BU corresponding to the name of her desired candidate in secrecy. A red light glows against her selected option on the BU and an audible sound emanates from the machine confirming the vote. No further votes can be recorded until the presiding officer re-activates the BU thereby preventing its misuse.

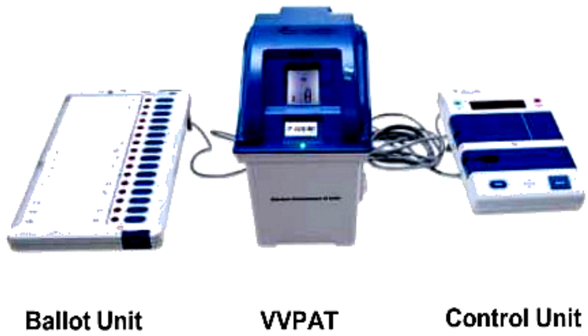

Figure 1: Electronic Voting Machine (EVM).
Source: Election Commission of India.

NOTA Policy: An unintended consequence of electronic voting was that voters could not register their disapproval of all the candidates on the list without disclosing her identity. With EVMs, no sound would emanate if the voter did not press any button, which anyone in the polling booth could notice. Thus, unlike in the paper ballot system where a voter could cast a BNS vote, this was not possible with EVMs. Instead, voters who disapproved of all the candidates had to leave a remark with the presiding officer along with her signature or thumb impression, which compromised her right to secret ballot. This prompted People's Union for Civil Liberties (PUCL), a civil rights organization, to file a writ petition with the Supreme Court in 2004 questioning the constitutional validity of the conduct of elections.

In its ruling, the Supreme court agreed:

> "The fundamental right under Article 19(1)(a) read with statutory right under Section 79(d) of the RP Act is violated unreasonably if right not to vote

phased manner since October 2013 (link)

> effectively is denied and secrecy is breached. This is how Articles 14 and 19(1)(a) are required to be read for deciding the issue raised in this writ petition. The casting of the vote is a facet of the right of expression of an individual and the said right is provided under Article 19(1)(a) of the Constitution of India."

In upholding the spirit of democracy, it states:

> "Democracy is all about choice. This choice can be better expressed by giving the voters an opportunity to verbalize themselves unreservedly and by imposing least restrictions on their ability to make such a choice. By providing NOTA button in the EVMs, it will accelerate the effective political participation in the present state of democratic system and the voters in fact will be empowered."

Thus, one can think of NOTA as an instrument that allows voters to voice their dissent and perform their civic duty to vote while preserving ballot secrecy. The natural question that follows is whether NOTA, viewed as a strategic way to send a clear message of disapproval, can influence public policy. This is the central question we engage with in this paper.

3 Related Literature

Our paper is closely related to the literature on strategic models of voting under asymmetric information. A key insight from this literature is that uninformed voters face a swing-voter's curse (Feddersen and Pesendorfer, 1996): a poorly informed voter may strictly prefer to delegate their vote in equilibrium to more informed voters by abstaining even if voting is costless. This is because abstaining would prevent her uninformed vote from deciding the outcome in the wrong direction.[7] Analogously, in our model, casting a NOTA vote can be interpreted as a rational decision to delegate the decisive vote to better-informed voters. However, our analysis departs from the standard information-aggregation literature in two important ways. First, we do not assume heterogeneity in the prior distribution of signals among voters; instead, a voter's decision to select NOTA is conditional on the observed signal of the incumbent's policy choice and the posterior belief about how voters' choices will influence the election outcome. Second, rather than focusing on the welfare properties of the voting equilibrium, we mainly examine how introducing the NOTA option affects the incumbent's public policy choice in equilibrium.

[7]Battaglini et al. (2010) conduct a laboratory experiment and find evidence of voting behaviour that is consistent with the awareness of a swing-voter's curse.

We also build on models in which voters obtain psychological benefits from voting that are independent of the candidates' policy choice or the electoral outcome. In their seminal paper, Riker and Ordeshook (1968) identify several mechanisms through which these preferences arise, such as the ethics of voting, affirming allegiance either to the political system or to partisan preferences. Blais (2000) provides empirical evidence from university students and voters in Canada to support the idea that voters are motivated by a sense of civic duty. Feddersen and Sandroni (2006) provide an alternative framework in which some voters gain utility from voting ethically, with the relevant type-specific norm determined endogenously in equilibrium. More recently, evidence from field-experiments suggests the role of social-image concerns in creating social pressure which motivates people to vote (Gerber et al., 2008; DellaVigna et al., 2016; Bursztyn and Jensen, 2017).

A separate branch of the literature considers voting as a signaling device that helps aggregate information that is dispersed among voters. People may take costly political action before an election to signal their dissatisfaction in order to influence others' voting decisions (Lohmann, 1994). Piketty (2000) considers multi-candidate repeated elections in which the first-period election results may affect second-period results by communicating voters' beliefs regarding their most-preferred candidates. On the other hand, Lohmann (1993) and Razin (2003), among others, study the effect of signaling in influencing politicians' policy-making. Ashworth and Fowler (2020) consider a formal model in which incumbent's performance affects both vote choice and turnout. In their setting, abstention functions as a signal of dissatisfaction from partisan voters, and incumbents internalize the risk of demobilizing their own base or mobilizing opposition. Additionally, citizens can communicate their dissatisfaction with the mainstream candidates by voting for a minority party (Myatt, 2017; Kselman and Niou, 2011). This may affect policy either by effectively constraining the power of the mainstream party or by motivating an endogenous change in policy such as dropping an unpopular policy (Myatt, 2017). An important observation from the same study is that when winning candidates respond endogenously to the election result "the offset effect may be stronger than the direct effect". However, voting for a minority party in protest is risky since coordination failure may result in the minority party winning the election which voters may not desire. Moreover, inferring the true extent of protest from observing the election results is likely to be inaccurate.

Our model parallels Ashworth and Fowler (2020), but reinterprets abstention (or NOTA) as a strategic, non-partisan act. Rather than signaling disaffection with a specific party, a nil vote reflects broader uncertainty over the incumbent's ability, and as such, creates an accountability mechanism that operates even in the absence of partisanship. Furthermore, a nil vote sends a clear message and avoids any ambiguity in interpreting the election results. This has spurred active research studying the positive and normative implications of a nil vote. Ambrus et al. (2017) conduct a field-experiment with 292 subjects to study the effect of a nil vote when some voters are uninformed and find that it reduces uninformed and invalid votes, which increases the probability of selecting the right candidate. This, in turn, leads to higher welfare for all voters. In a follow-up study, Ambrus et al. (2025) conduct lab-in-the-field experiments in two contexts – in five US states before the 2016 US presidential elections (1930 respondents) and in Austria before the presidential elections run-off round (2999 respondents) – alongside a separate laboratory experiment (414 student participants). They find that while a NOTA option increases participation, it reduces the chances that a non-establishment (or protest) candidate wins the election. This reduces the possibility that a mainstream candidate loses office which leads them to cater less to voters. In the context of India, Ujhelyi et al. (2021) use a combination of reduced form regression and an adapted version of the demand-supply framework from the industrial organization literature – the Berry, Levinsohn and Pakes (BLP) methodology – to structurally estimate the effect of NOTA on electoral outcomes. They find that while NOTA promotes electoral participation, it does not affect the supply of viable candidates nor the level of electoral competition. However, they do not examine the impact of NOTA on policy formation, which is the main focus of this paper.

Finally, our work adds to the literature on electoral institutions and its effect on political accountability. Foundational models, such as Barro (1973) and Ferejohn (1986), depict elections as repeated principal-agent model in which voters disciplining politicians by rewarding or punishing incumbents based on observed performance.[8] Our theoretical framework is built on Holmström (1999)'s model of career concerns in which an incumbent may be of different types, but neither the politician nor the voters directly observe the incumbent's ability prior to the election. Persson and Tabellini (2002), Ashworth (2005) and Ashworth and Bueno De Mesquita (2008) also study dynamic political agency models in the tradition of Holmström (1999) where voters observe noisy performance signals and condition re-election decisions on incumbents' actions, thereby inducing effort through career concerns. These models generally share the assumption of full voter participation where voters can only choose between an incumbent and a challenger, focusing on the effectiveness of re-election incentives under symmetric learning.

We extend the theoretical framework of career concerns in two ways. First, inspired by Ambrus et al. (2017), we expand the voter's choice set to include the NOTA option with the added assumption that the closer the NOTA option is considered to resemble a valid vote, the lower would be the voter's psychological cost from voting NOTA compared to abstention. Thus, if NOTA is viewed as equivalent to a valid vote, casting a NOTA vote will inflict no psychological cost at all to the voter. Secondly, while most studies

[8]See Duggan and Martinelli (2017) for a comprehensive literature review of political agency model.

on strategic abstention assume that voters hold heterogeneous prior beliefs about the candidates' quality, we do not assume any asymmetry in their prior beliefs. By contrast, in our model, voters' signal about the incumbent's action and quality is drawn from the same distribution and they only differ in their willingness to use the NOTA option. We show later in Section 4 that the presence of strategic abstention in the form of NOTA can present a trade-off between *selection effect*, the ability to identify high-quality candidates, and *disciplining effect*, the ability to remove low-quality incumbents from office. To our knowledge, this is the first study to tie this trade-off with the NOTA option within a career concerns framework.

4 Theoretical Framework

In this section, we develop a stylized model of political economy to examine how politicians adjust their in-office performance in response to the NOTA option. The model is based on the career concerns framework of Persson and Tabellini (2002, Section 4.4) and Ashworth et al. (2017). A key distinction between our approach and the existing literature is that voters in our model can choose neither candidate, effectively withdrawing from the election through the act of abstention or the NOTA option. This extension allows us to analyze how the introduction of NOTA influences both the voting behaviors and politicians' in-office performance.

4.1 Main Model

We analyze a two-candidate election with office-motivated politicians referred to as "he" – an incumbent and a challenger – and two representative voters referred to as "he" – engaged (E) and strategic (S) – indexed by i where $i \in \{E, S\}$.

The incumbent makes a costly investment to produce a public good outcome. The public good outcome, however, is a stochastic function of the public investment that the incumbent undertakes, his competence such as managerial skills needed to work with the bureaucracy and to monitor subordinates.which helps translate spending into a public goods, and an unobserved noise term. Both voters derive utility from the public investment, but they only observe a noisy signal of public goods provision, which can be represented follows:

$$y_i = e + \theta_I + \varepsilon_i, \quad i \in \{E, S\} \tag{1}$$

where $e \geq 0$ denotes the level of public investment which voters cannot observe, $\theta_I \in \{-1, 1\}$ denotes the incumbent's competence, where $\theta_I = -1$ when the incumbent is of *low* type and $\theta_I = 1$ when he is of *high* type. As is standard in the career concerns model, we assume that the incumbent's competence θ_I is not observed by anyone, including the incumbent himself. Additionally, we assume that all agents share a common prior that the incumbent's competence is equally likely to be low ($\theta_I = -1$) or high ($\theta_I = 1$). The voter-specific noise term ε_i captures the effect of non-policy factors, such as ideological bias or candidate charisma, on voter utility.[9] We assume that ε_i is identically and independently distributed according to a normal distribution with zero mean and variance σ^2 and $F(\cdot)$ and $f(\cdot)$ denote its cdf and pdf, respectively. Thus, the observed public good outcome is the voter's private information and her only signal to form beliefs about the incumbent's competence.

Voters' Decision: After observing the policy outcome, the electorate updates its beliefs about the incumbent's competence and decides to either re-elect the incumbent or to nominate the challenger. As public output is positively correlated with the government's competence, both voters would prefer to elect a politician with higher perceived ability. In the main model, we assume that the competence of both the politicians are drawn from the same distribution. We will relax the assumption of symmetric priors in Section 4.2.2 to consider the case of electoral advantage by allowing the prior belief about the incumbent's competence to differ from that of the challenger.

We assume that the engaged voter E is decisive and votes for either the incumbent or the challenger. We can denote voter E's action set by $a_E \in \{C, I\}$ where C and I indicate voting for the challenger and the incumbent, respectively. On the other hand, voter S votes strategically for the option that maximizes her expected payoff. The set of possible actions for voter S, denoted by a_S, depends on whether NOTA is available as an explicit option in the ballot for that election round. When NOTA is not yet available, then the set of actions is $a_S \in \{\phi, C, I\}$, where ϕ indicates abstention and C and I are as defined before. And, when NOTA option is appended to the ballot, then $a_S \in \{\phi, C, I, N\}$, where N denotes casting a NOTA vote.

The winner is determined by majority rule and the candidate who receives both votes from E and S wins the seat. If there is a tie, each candidate has an equal probability of winning.

Incumbent's Pay-off: Given the public investment level e, the incumbent who holds office receives a payoff of $w(e)+R$, where the function $w(\cdot)$ reflects the cost of implementing a certain policy or a preference for rents captured from voters, and $R \geq 0$ represents the

[9] Note that different from Feddersen and Pesendorfer (1996), we do not assume any difference in the prior distribution of information between the two voters. Voter S's decision to abstain (or NOTA) is conditional on her observed signal and the posterior belief of how her vote will affect the election outcome.

additional benefits of holding office such as 'ego rents' in Rogoff (1990). We assume a quadratic form for the incumbent's cost function, $w(e) = -e^2$, which guarantees that the incumbent's payoff is twice differentiable and has a unique maximizer at $e = 0$. The politician's payoff is $w(e)$ if he is not in office and $w(e) + R$ if he gets re-elected. Denote $v(e)$ the probability that the incumbent will be re-elected in equilibrium given the policy choice e. Then, we can write the incumbent's payoff as:

$$\pi(e) = Rv(e) - e^2 \tag{2}$$

We focus on the case where the incumbent chooses a pure-strategy in equilibrium.[10] We assume that:

Assumption A1. $R \leq 4\sigma^2$.

This assumption essentially requires that the office benefit is not too large relative to the variance of voter-specific noise term. This ensures that the marginal benefit of re-election from increasing public investment is strictly decreasing. In Lemma 1 in Appendix A, we show that given Assumption A1, $\pi(e)$ is strictly concave in $e \geq 0$, which is sufficient for the existence and uniqueness of pure-strategy equilibrium.

Voters' Pay-offs: Voters E and S both strictly prefer a higher policy outcome and vote to maximize the probability that a *high*-type politician gets elected. This is because politicians will implement their most preferred policy in the second period i.e. $e = 0$ and voter's benefit from having the high-type politician in office. To simplify the voters' decision problem, assume that voters receive a payoff of 1 if a high-type politician is elected and 0 otherwise.

On top of the policy payoff, voter S suffers a psychological cost when *not* choosing an action that they consider qualifying as participation. While this formulation is similar to the assumption of a psychological bonus from the act of voting, as in Riker and Ordeshook (1968), we differ by allowing this cost to vary across abstention and NOTA. Specifically, voter S incurs a psychological cost c is she abstains and a fraction γc if she votes for the NOTA option, where c is uniformly distributed over the interval $[0, 1]$. The parameter $\gamma \in [0, 1]$ is considered to be exogenous but may vary across constituencies and captures the extent to which NOTA is perceived as effective non-participation. A value of $\gamma = 1$ implies that NOTA is considered as equivalent to "non-participation" and therefore inflicts the same psychological cost as abstention. At the other end, a value of $\gamma = 0$ implies that

[10] For a discussion of mixed strategy equilibrium in political accountability model, we refer to Duggan and Martinelli (2020).

NOTA is considered to be as good as "full-participation" and voter S incurs zero cost for choosing the NOTA option.[11]

Denote $\mathbb{P}_i(\theta \,|\, y, a_i)$ voter i's posterior belief that the election winner is of type $\theta \in \{-1, 1\}$ conditional on the observed outcome y and her voting decision a_i. Then we can write the posterior expected payoff of voter E from action $a_E \in \{I, C\}$ given the observed outcome y as

$$V_E(a_E \,|\, y) = \mathbb{P}(\theta = 1 \,|\, y, a_E) \cdot 1 + \mathbb{P}(\theta = -1 \,|\, y, a_E) \cdot 0 = \mathbb{P}(\theta = 1 \,|\, y, a_E).$$

Thus, given the binary choice, voter E bases her own decision on her observed signal y_E and she only votes to re-elect the incumbent if $V_E(a_E = I \,|\, y_E) > V_E(a_E = C \,|\, y_E)$. Similarly, the policy payoff for voter S is simply their posterior belief that the first period election winner is of *high* type. On top of policy payoff, voters S incurs a psychological cost from his voting decision. Specifically, we can write the posterior expected payoff of voter S from an action $a_S \in \{\phi, I, C, N\}$ given the observed outcome y as

$$V_S(a_S \,|\, y) = \mathbb{P}(\theta = 1 \,|\, y, a_S) - \begin{cases} 0 & \text{if } a_S \in \{I, C\}, \\ \gamma c & \text{if } a_S = N, \\ c & \text{if } a_S = \phi. \end{cases} \tag{3}$$

Voter S will choose an action $a_S \in \{\phi, I, C, N\}$ to maximize the expected payoff given her observed outcome y_S and cost of abstention c, that is $a_S(y, c) = \arg\max_{a_S} V_S(a_S \,|\, y_S)$.

Timing: We now summarize the timing of the above election game. At the beginning of the period, the incumbent chooses a level of public investment $e \geq 0$. Nature moves to realize the competence of the incumbent $\theta_I \in \{-1, 1\}$. Given the incumbent's competence θ_I and public investment level e, voter $i \in \{E, S\}$ observes her voter-specific output signal y_i. On the basis of the information available, voters make an assessment of the ability of the incumbent. The incumbent then faces an election against a challenger. Prior to making her voting decision, voter S also realizes a psychological cost of c. During the election, voter E chooses an action $a_E \in \{I, C\}$ while voter S chooses an action $a_S \in \{I, C, \phi, N\}$. Finally, at the end of the period, the election takes place and the politician who obtains more votes is elected to power. Figure 2 illustrates the timing of the game.

We now examine the equilibrium of the election game to show how the introduction of the NOTA option –primarily captured by the parameter γ – influences voters' voting

[11] Under our construction, we can also interpret voter E's voting behaviour as incurring a sufficiently high psychological cost when *not* voting for either candidate.

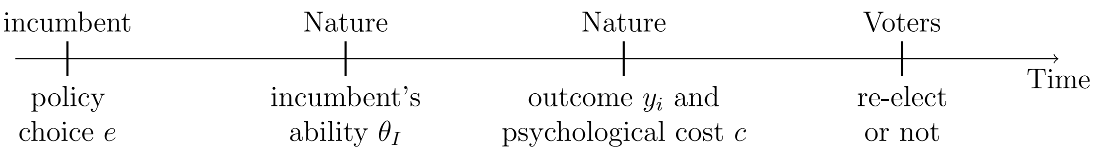

Figure 2: Timeline

decisions and the incumbent's incentives to provide public investment.

4.1.1 Voting Equilibrium

We solve the game through backward induction, starting from the voters' optimal voting behaviours. First, consider the equilibrium strategy of voter E who only has the choice to vote for the incumbent or the challenger. As voter E faces a binary choice, her voting decision depends only on the expectation about the incumbent's type. As a consequence, the representative voter E follows simple cut-off rules given by y^* such that she votes for the incumbent only if $y_E > y^*$. The cut-off y^* is given by the straightforward solution to the equation:

$$\mathbb{P}(\theta_I = 1 | y_E) = \frac{(1/2)f(y_E - e^* - 1)}{(1/2)f(y_E - e^* - 1) + (1/2)f(y_E - e^* + 1)} = \frac{1}{2}, \tag{4}$$

that is, conditional on the cut-off y^*, the probability that the incumbent is of *high*-type is just equal to the prior probability. Given that f is symmetric around 0, solving equation (4) gives:

$$f(y^* - e^* - 1) = f(y^* - e^* + 1) \iff y^* = e^*. \tag{5}$$

Thus, in a pure-strategy electoral equilibrium, the voter E's cut-off is directly pinned down by the policy choice of the incumbent.

We now characterize for voter S's equilibrium voting strategy. First, notice that since $c > 0$ and $\gamma \in [0, 1]$, choosing NOTA always incurs a lower or equal psychological cost compared to abstaining. Moreover, because neither NOTA nor abstention affects the electoral outcome, abstention is now strictly dominated by NOTA under this assumption. This modelling choice captures the spirit of NOTA as a meaningful avenue for voters to express "disapproval of the kind of candidates being put up by the parties." In Section 4.2.1, we relax this assumption and consider the general case where c may be negative, thereby allowing for the possibility that voting itself, rather than abstention, generates psychological costs. In that settings, abstention dominates NOTA in the domain where $c < 0$. For the present analysis, however, this simplifying assumption enables us to concentrate on the trade-offs between voting for one of the candidates and selecting the

NOTA option, conditional on the observed signal y_S and psychological cost c.

While voter E bases her decision solely on her privately observed signal about the public outcome y_E, voter S's equilibrium strategy depends both on her private signal about the public outcome, y_S as well as on the psychological cost c. By observing y_S, voter S forms posterior beliefs regarding the quality of the incumbent and anticipates the voting behaviour of voter E. She then compares the expected utility from voting for a candidate to that of selecting the NOTA option, taking into account the associated psychological cost. Recall the logit function logit $p = \ln[p/(1-p)]$. Then we can characterize voter S's equilibrium voting behavior as follows.

Proposition 1. *The equilibrium voting strategy of voter S is given by:*

$$a_S^* = \begin{cases} I & \text{if } y_S \geq \overline{y} = e^* + \delta(\gamma, c), \\ C & \text{if } y_S < \underline{y} = e^* - \delta(\gamma, c), \\ N & \text{otherwise} \end{cases}$$

where

$$\delta(\gamma, c) = \begin{cases} (\sigma^2/2)\,\text{logit}\,[F(1) - 4\gamma c], & \text{if } c < c^* = \dfrac{F(1) - F(-1)}{8\gamma}, \\ 0, & \text{otherwise.} \end{cases} \tag{6}$$

In other words, when the psychological cost c is relatively small, that is c is below the critical value c^*, voter S's decision depends on the realization of the private signal y_S relative to the two cutoffs, $\bar{y}$ and $\underline{y}$, which are symmetric around the expected incumbent effort e^*. Specifically, voter S chooses the incumbent if $y_S > \bar{y}$, the challenger if $y_S < \underline{y}$, and the NOTA option otherwise. For $c > c^*$, the influence of the NOTA option vanishes and the voter effectively chooses between the two candidates as in the standard model. Note that $F(1)$ and $F(-1)$ represent voter S's prior beliefs that E will support for the incumbent given that the incumbent is of high and low type, respectively. The difference $F(1) - F(-1)$ can thus be interpreted as the ex ante expected payoffs when voter E is the pivotal voter. It also captures the *ex ante value* of the NOTA option to voter S. Intuitively, the larger this difference, the greater the value of NOTA, and the more likely it is that voter S selects this option in equilibrium.

Figure 3 illustrates the equilibrium strategy of voter S for different realization of $(y_S, c) \in \mathbb{R} \times [0, 1]$. The red curve in Figure 3 traces all combinations of (y_S, c) for which voter S is indifferent between voting for NOTA and voting for the incumbent. On the other hand, the blue curve plots all (y_S, c) pairs at which voter S is indifferent between NOTA and the challenger. Finally, the vertical line at $y_S = y^*$ denotes the cut-off level of

y_S at which the conditional probability that the incumbent is of *high*-type equals to that of the challenger.

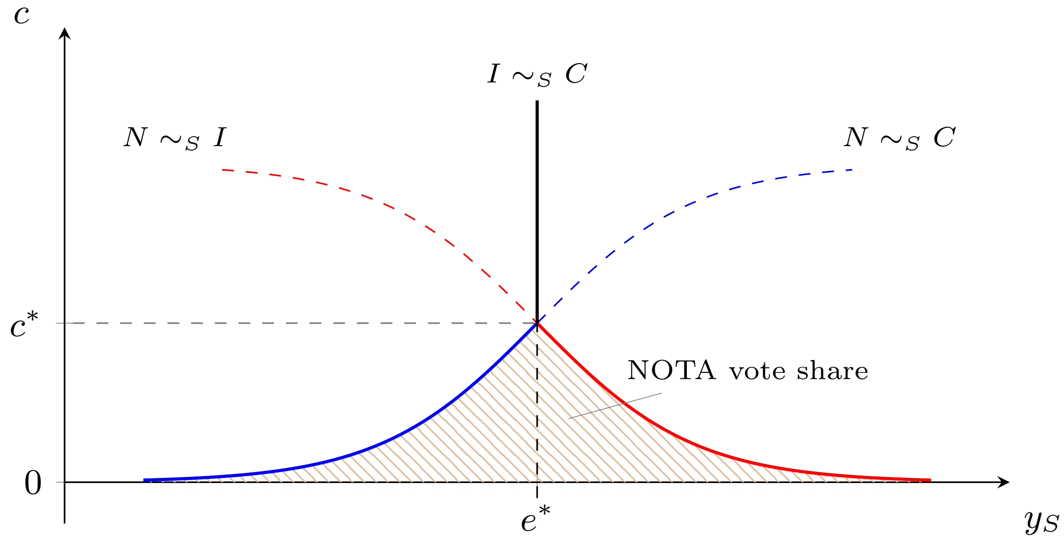

Figure 3: Equilibrium Voting Decision of Voter S.

Together, the red and blue indifference curves and the vertical cut-off line partition the space $\mathbb{R} \times [0, 1]$ into three distinct regions. The region to the top-right corresponds to combinations of (y_S, c) in which voter S strictly prefers the incumbent over both the other options. By contrast, the region to the top-left corresponds to combinations where voter S strictly prefers the challenger. The remaining region (shaded in the figure) depicts (y_S, c) combinations for which choosing NOTA is the dominant strategy for voter S. The intuition is straightforward: when y_S is very high (respectively, very low), voter S strictly prefers the incumbent (respectively, the challenger). However, if y_S lies in an intermediate range – interpreted as a "noisy" signal, $y_S \in (\underline{y}, \overline{y})$ – then S prefers to "delegate" the decision to voter E. The logic of a NOTA vote here is analogous to the strategic abstention principle suggested by Feddersen and Pesendorfer (1996): voter S votes strategically to delegate the pivotal vote that decides the electoral outcome to voter E when the public outcome signal she receives is rather weak. This avoids the wrong outcome from getting selected in equilibrium. Importantly, if the psychological cost c arising from effective non-participation is sufficiently high, the expected benefit of non-participation (that is, delegating the decision to voter E) no longer outweighs its cost. In such case, voter S will cast a decisive vote based on the observed signal (choosing between the incumbent and the challenger accordingly). Thus, voter S exercises the NOTA option only when the observed signal is sufficiently "noisy" relative to the psychological cost of non-participation.

Furthermore, as γ decreases – meaning that voter S perceives NOTA as getting close to fulfilling her civic duty – the psychological cost associated with choosing NOTA diminishes.

This reduction in perceived psychological non-participation cost shifts both the red and blue indifference curves upward in the (y_S, c) space, thereby expanding the region where NOTA is the dominant strategy. Figure 4 illustrates this mechanism and shows that for a given realization of c, the horizontal distance between the red line and the blue line grows as one reduces γ from $\gamma = 1$ to $\gamma < 1$ (bounded below by zero). In other words, a lower γ makes voter S more willing to delegate the decision to voter E across a broader range of signal realizations.

Corollary 1. *The width of the NOTA interval, $\bar{y} - \underline{y}$, is strictly decreasing in γ.*

Another motivation for examining a decrease in γ is that the introduction of the NOTA option itself can be interpreted as a negative shock to the value of γ. In the absence of the NOTA option, voter S can delegate the decision only by abstaining, thereby incurring the full psychological cost c, rather than the attenuated cost γc associated with casting a NOTA vote. Under this interpretation, our framework also sheds light on the identity of voters who choose the NOTA option. As illustrated in Figure 4, the introduction of the NOTA option primarily attracts votes from two groups: voters who would have otherwise abstained and voters who, in the absence of NOTA, would have selected one of the candidates. This result aligns with the empirical findings in Ujhelyi et al. (2021) that without access to a NOTA option, most dissatisfied voters tend to abstain and few that turn out distribute their votes among available candidates.

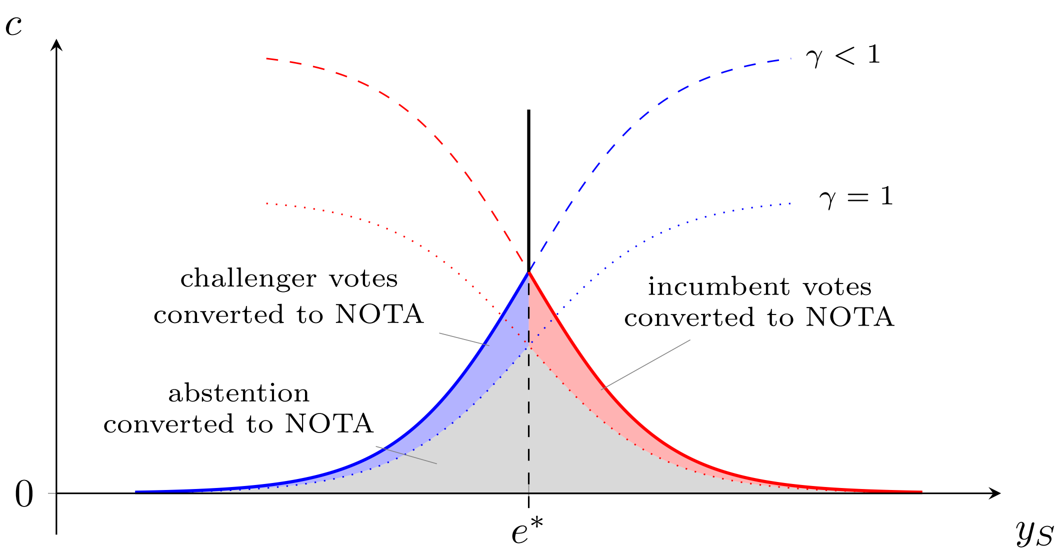

Figure 4: Effect of γ on Voter S's Equilibrium Voting Decision.

4.1.2 Equilibrium Public Policy

Having derived the voters' equilibrium voting decision, we move next to the characterization of the equilibrium public policy, which allows us to derive testable predictions that guide our empirical analysis.

As defined before, let $v(e)$ be the probability of re-election for the incumbent from providing public investment corresponding to e. Then the incumbent implements a policy strategy e^* to maximize his pay-off function as in equation (2). Denote $\gamma c = u$ and define $u^* = [F(1) - F(-1)]/8$. This allows us to can re-write the NOTA interval as $\delta(u) = \text{logit}\,[F(1) - 4u]$. Then, in equilibrium, the marginal increase in re-election probability from an increase in public investment can be written as:

$$v'(e^*) = f(1) + \frac{1}{2\gamma} \underbrace{\int_0^{u^*} \Big[F(1) f[\delta(u) + 1] + F(-1) f[\delta(u) - 1]\Big] du}_{S(\sigma)}$$
$$- \frac{1}{2\gamma} \underbrace{\int_0^{u^*} f(1) \Big[F[-1 - \delta(u)] + F[1 - \delta(u)]\Big] du}_{A(\sigma)} . \tag{7}$$

Notice that $S(\sigma)$ and $A(\sigma)$ depends only on the variance of the noise term, through $f(\cdot)$ and $F(\cdot)$. This leads us to the following proposition.

Proposition 2. *Given Assumption A1, there exists a unique pure-strategy equilibrium level of public investment e^* characterized by:*

$$e^* = \frac{R}{2} \left[f(1) + \frac{1}{2\gamma} (S(\sigma) - A(\sigma)) \right]$$

where $S(\cdot)$, $A(\cdot)$ is defined as in equation (7).

Equation (7) consists of three terms. The first term, $f(1)$, is the probability density that voters observe a public outcome $y_i = e^*$ and are indifferent between the incumbent and challenger. When the NOTA option is unavailable and voters cannot abstain, the marginal gain in re-election probability in equilibrium must be equal to the swing voter density. The next two terms capture the effect on the incumbent's electoral incentive from including the non-participatory options into the career concern model.

The second term, $S(\sigma)$, captures the selection effect, that is, the voters' ability to use private signals about public outcome to infer politicians' unobservable types. In this context, the benefit from the selection effect arises through two channels. First, NOTA allows the strategic voter S to abstain from influencing the electoral outcome when the engaged voter E receives a sufficiently informative signal to make the correct decision – that is, to oust a low-quality incumbent or re-elect a high-quality one. Second, it also strengthens the incumbent's incentive to invest in public goods in order to mobilize voter S, who – depending on her signal and the psychological cost of non-participation – might otherwise choose not to participate. If voter E supports the challenger, inducing voter S to vote for the incumbent instead of NOTA can shift the electoral outcome from a certain loss to a tie-breaker, thereby increasing the incumbent's re-election probability from zero to one-half. Similarly, by marginally increasing public investment, the incumbent can swing voter S's decision from voting for challenger to NOTA which increases the incumbent's re-election probability from one-half to one.

The final term, $A(\sigma)$, captures the disciplining effect , that is, the electorate's ability to hold the incumbent accountable such that once a low-quality incumbent is identified, voters must be able to remove him from office. The term $F[-1-\delta(u)]+F[1-\delta(u)]$ captures the probability that voter S will vote for the incumbent regardless of his type, while $f(1)$ is the probability density that voter E is indifferent between the two candidates. As voter E is equally likely to support either candidate, voter S's tendency to vote for the incumbent will weaken incentives for the incumbent to undertake public investment. As we will show in Section 4.2, this effect is amplified in safe constituencies, where the incumbent enjoys a large electoral advantage.

The interaction between the selection effect, $S(\sigma)$, and the disciplining effect, $A(\sigma)$, will determine whether electoral non-participation leads to an increase or a decrease in the equilibrium level of public investment. When the selection effect outweighs the disciplining effect, electoral non-participation via NOTA or abstention would increase the equilibrium level of public investment. However, when a decisive vote from voter S is required to hold the incumbent accountable, either form of electoral non-participation would lower the pressure on incumbents to perform which, in turn, reduces the equilibrium policy response e^*.

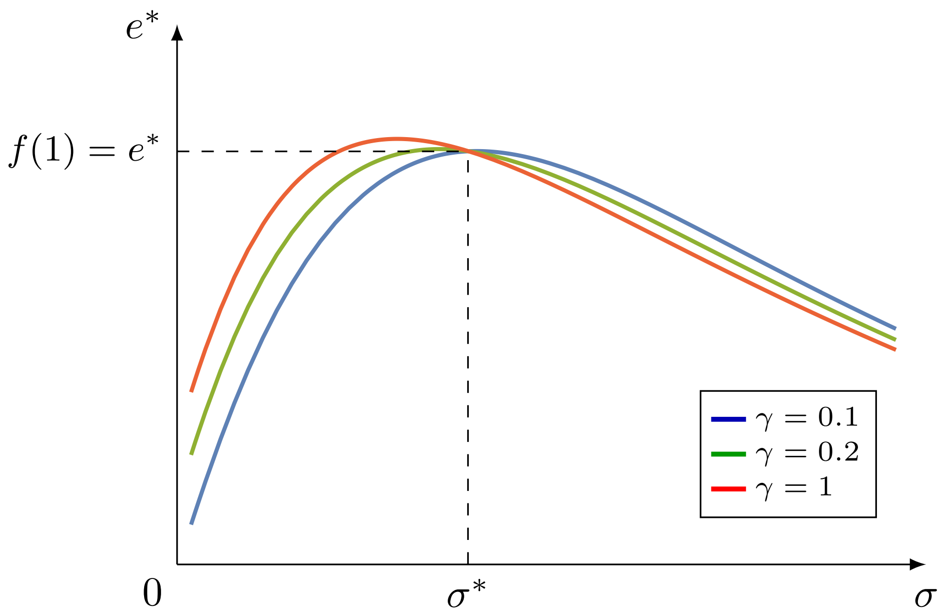

Figure 5: Equilibrium Public Investment as $\sigma \to \infty$.

Figure 5 illustrates the net effect of non-participation on equilibrium public policy, capturing the trade-off between selection and disciplining effects. Recall that the variance of the noise term σ^2 can be interpreted as the electorate's ability to gather information and monitor the incumbent's behavior. When the value of σ^2 is relatively low, the noise term is concentrated around its zero mean which means that the observed public outcome is a relatively precise signal of the incumbent's (unobserved) investment and underlying type. In this scenario, informational gain from improved selection cannot offset the reduction in disciplining effect arising from electoral non-participation. However, as σ^2 increases and the public outcome signal becomes less informative about the incumbent's competence, the electorate places greater value on identifying high-performing incumbents i.e. selection, than on disciplining him. In the extreme, as $\sigma^2 \to \infty$, the observed public outcome is pure noise, voters simply vote according to their priors, both effects dissipate and the net effect converges to 0.

This insight yields our main hypothesis for empirical analysis. Specifically, we propose that for sufficiently large values of σ, a decrease in γ – that is, a wider acceptance of NOTA as a valid form of electoral participation among the electorate – allows the electorate to aggregate information for efficiently, thereby inducing the incumbent to provide a higher level of public goods in equilibrium. Mathematically, an decrease in γ raises the right-hand side of equation (7), and given the incumbent's constant marginal cost of public investment and office rent, this upward shift leads to a higher equilibrium level of public investment. Denote σ^* the solution to the equation $S(\sigma) = A(\sigma)$. This gives us the following result:

Proposition 3. *There exists a threshold σ^*, where σ denotes the standard deviation of the voter-specific noise, such that for $\sigma > \sigma^*$, the NOTA option strictly increases the incumbent's in-office performance, that is,* $\dfrac{\partial e^*}{\partial \gamma} < 0$.

4.2 Extensions

The theoretical framework in Section 4.1 contains a few simplifying assumptions to focus on the main question of interest – the effect of NOTA on public policy. Specifically, the main model does not account for the persistence of abstention with the availability of the NOTA option. In addition, voters believe that both candidates are, on average, equally competent *ex-ante* which rules out the possibility of partisan bias or incumbency advantage. In this section, we relax these assumptions and discuss their implications on the main quantitative results.

4.2.1 NOTA and Abstention

Readers will notice that voter abstention persists even after the implementation of NOTA. To incorporate this regularity in our theoretical framework, we extend the concept of c to encompass both psychological and physical costs of voting. Consistent with Riker and Ordeshook (1968), the decision to vote (or abstain) depends not only on the opportunity costs of voting—such as time and effort—but also on the psychological or civic benefits derived from participation. By redefining c to capture the net of these psychological benefits and physical costs, our model offers a more comprehensive account of voter decision-making and helps explain why abstention persists despite the availability of NOTA.

In terms of theoretical modelling, as c represents the net utility from voting, it may be positive (reflecting civic benefits) or negative (reflecting costs of participation). Suppose c is uniformly distributed over the interval $[-1, 1]$. Recall that the posterior expected payoff of voter S from an action $a_S \in \{\phi, I, C, N\}$ given the observed outcome y is given by

$$V_S(a_S \mid y) = \mathbb{P}(\theta = 1 \mid y, a_S) - \begin{cases} 0 & \text{if } a_S \in \{I, C\}, \\ \gamma c & \text{if } a_S = N, \\ c & \text{if } a_S = \phi. \end{cases}$$

For $c < 0$, the act of voting entails a net cost, and while NOTA allows voters to vote without needing to research, for voters with $c < 0$, abstention is still a dominant strategy. In particular, when voters receive a sufficiently noisy signal of the incumbent's competence, abstaining strictly dominates casting a NOTA vote, with equivalent implications for the electoral outcome. Formally, for $c < 0$ and $e^* - \delta(\gamma = 1, c) \leq y_S \leq e^* + \delta(\gamma = 1, c)$, voter S will strictly prefer to abstain rather than choose the NOTA option. For $c > 0$, the analysis follows the results in Section 4.1.

Figure 6 illustrates the equilibrium voting strategy of voter S when c captures also the cost of voting. The grey shaded area in Figure 6 corresponds to the combination of y_S and $c < 0$ for which abstention is the dominant strategy for voter S. Importantly, the relevant signal interval for abstention is given by $\delta(\gamma = 1, c)$ indicating that the introduction of NOTA does not alter the equilibrium behavior of unengaged voters—those facing a net cost of voting $c < 0$. Instead, the NOTA option is only exercised by voters who would otherwise abstain strategically to avoid the "swing voter curse." It is therefore reasonable to expect that allowing c to take negative values does not meaningfully affect the quantitative results of the original model.

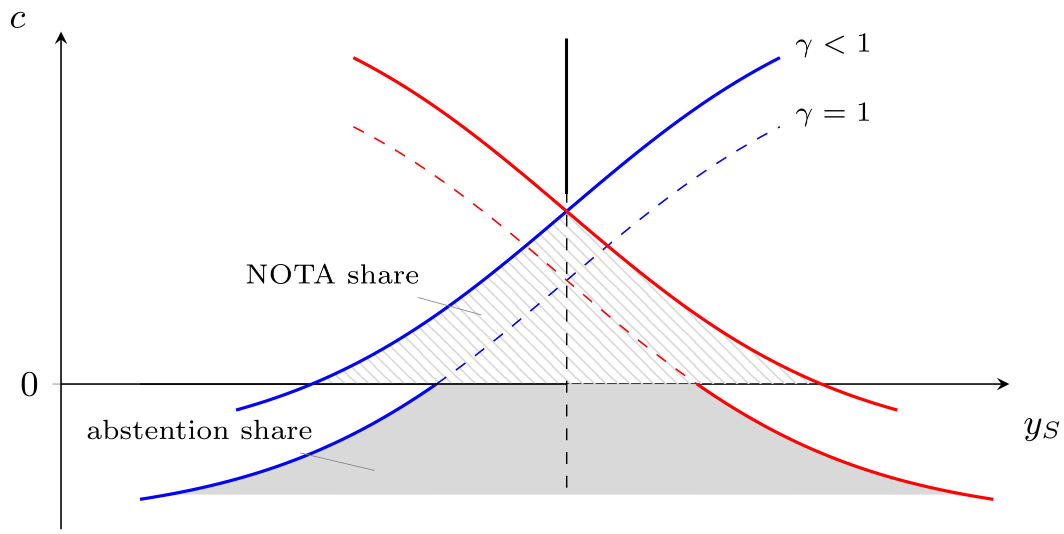

Figure 6: Equilibrium Voting Decision with NOTA and Abstention.

4.2.2 Electoral Advantage

So far, we have not considered the role of electoral advantage and assumed that voters' prior beliefs about the candidates' competence are symmetric and centered at zero. However, this assumption may only apply to a subset of the constituencies. A quick glance at our data shows the presence of several constituencies with lopsided vote margins. For example, the vote margin in Palus-Kadegaon assembly constituency in Sangli district in Maharashtra was 73% in the 2019 elections while Baramati assembly constituency in Pune district in Maharashtra was a close second at 70%. Although only 0.48% of assembly constituencies in our sample produced an absolute majority (a margin exceeding 50%), the average victory margin was about 11.8% with 9.5% of the constituencies securing a victory margin exceeding 25%. Thus, in this section, we introduce *electoral advantage* and examine how it affects the dynamics between political accountability and NOTA.

First, consider the case where the distribution of the challenger's competence differs from the incumbent. This may capture differences between the incumbent and the challenger along non-policy dimensions such as party affiliation, commitment to a social identity, or individual charisma. Specifically, we assume that while the prior belief of the incumbent regarding his own competence remains the same, voters now hold a prior belief that the incumbent is of *high* type with probability $p \in (1/2, 1)$. That is, voters believe ex-ante that the ability of the incumbent is higher than that of the challenger.

Then, the cut-off y^* that characterizes the voting behaviour of voter E is given by the solution to the equation:

$$\mathbb{P}(\theta_I = 1 | y_E) = \frac{1}{2} \iff y_E^* = e^* - \frac{\sigma^2}{2} \text{logit}\,(p).$$

Denote $\kappa = (\sigma^2/2)\,\text{logit}\,(p)$. As $p > 1/2$, it means that $\kappa > 0$ and $y^* < e^*$. That is, the greater the incumbency advantage, the stronger the signal must be in favour of the challenger to induce voter E to vote against the incumbent. Since κ is strictly increasing in p and $\kappa \to \infty$ as $p \to 1$, we can interpret κ as our measure of electoral advantage.

Then we can re-establish the equilibrium voting decision of voter S in the presence of electoral bias:

Proposition 4. *The equilibrium voting strategy of voter S is given by:*

$$a_S^* = \begin{cases} I & \text{if } \; y_S \geq \overline{y} = e^* - \kappa + \delta(-\kappa, \gamma, c), \\ C & \text{if } \; y_S < \underline{y} = e^* - \kappa - \delta(\kappa, \gamma, c), \\ N & \text{otherwise} \end{cases}$$

where

$$\delta(\kappa, \gamma, c) = \begin{cases} (\sigma^2/2)\,\text{logit}\left[\dfrac{F(\kappa+1) - 4\gamma c}{F(\kappa+1) + F(\kappa-1)}\right], & \text{if } \; c < \dfrac{F(\kappa+1) - F(\kappa-1)}{8\gamma}, \\ 0, & \text{otherwise.} \end{cases} \tag{8}$$

Figure 7 illustrates how the NOTA vote share is affected by the presence of an electoral advantage. First, the threshold y^* where both voters are ex post indifferent between the incumbent and challenger is shifted leftward. The reasoning is straightforward: as the electoral advantage of the incumbent increases, voters become more inclined to re-elect the incumbent, and it takes a much stronger signal in favour of the challenger to sway voters' decisions.

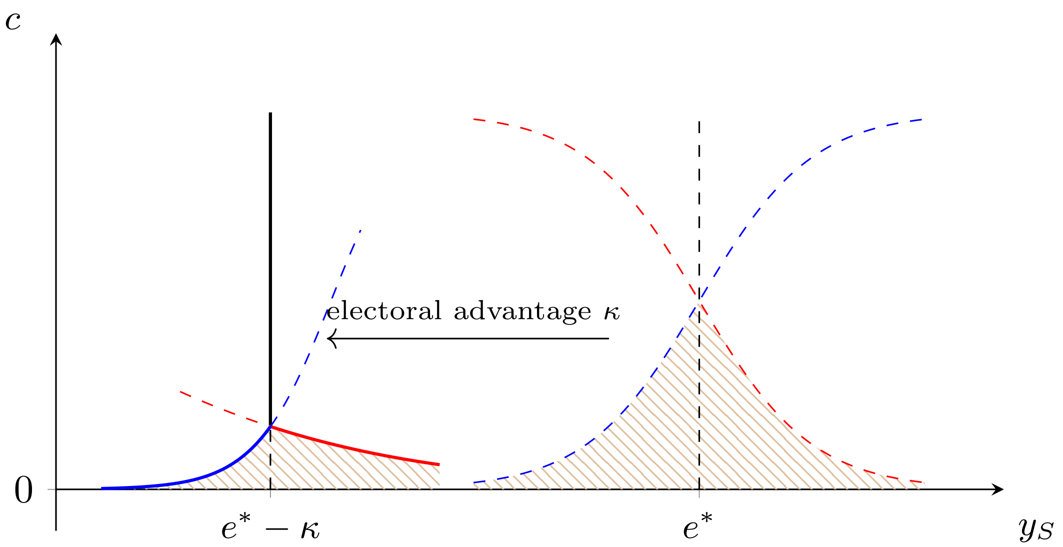

Figure 7: Effect of Electoral Advantage on Voter S's Equilibrium Voting Decision.

Furthermore, for voter S, the signal threshold $\bar{y}$ and $\underline{y}$ is no longer symmetric around y^*. In particular, it is straightforward to verify that for all $c < c^*$, we have $\bar{y} - y^* > y^* - \underline{y}$. That is, when the observed signal slightly favors the incumbent, that is $y_S > y^*$, voter S is now more likely to choose the NOTA option. On the other hand, for an "equally unfavorable" signal ($y_S < y^*$), voter S is more likely to vote for the challenger. The distinction between selecting the NOTA option and voting for the incumbent boils down to the payoff difference when voter E decides to remove the incumbent from office. If the incumbent is of high type, a vote for the incumbent would enable his re-election via the tie-breaking rule. Conversely, if the incumbent is of low type, choosing NOTA and oust the incumbent is the optimal decision. As the electoral advantage increases, the probability that voter S ousts a low-type incumbent outweighs the probability that she removes a high-type from office. Hence, the interval $\bar{y} - y^*$ increases with the electoral advantage κ.

Finally, notice that as the electoral advantage grows arbitrarily large, that is, as $\kappa \to \infty$, then $c^* \to 0$ and the share of NOTA votes will vanish. As the electoral advantage grows, the value of a NOTA option decreases for voter S: as voter E is more likely to vote for the incumbent, the difference in expected payoffs between NOTA and voting for the incumbent decreases. As $\kappa \to \infty$, the probability that voter E votes for the incumbent converges to 1 and the NOTA option is strictly dominated by voting for the incumbent. So we expect that in constituencies where there is large electoral advantage, the introduction of NOTA will not create any additional electoral pressure on the incumbent and there should not be any significant changes to politicians' in-office performance.

Admittedly, there are cases where the NOTA option attracts a substantial share of votes even in constituencies where the incumbent holds a large electoral advantage. A notable example is the 2019 assembly elections in the state of Maharashtra where around 750,000 voters chose the NOTA option. The Latur Rural assembly constituency received the maximum NOTA votes amounting to 13.8% of its voters even though the margin of victory was 53.9%. The assembly constituency of Palus-Kadegaon came second where almost 10% of the electorate voted NOTA and had a vote margin of 73.1%. The high percentage of NOTA votes reflected voters' dissatisfaction with farmer suicides in the arid Latur region along with issues relating to power supply and irrigation. In these cases, we interpret the NOTA vote as primarily driven by *protest motives*, rather than the *strategic abstention* mechanism emphasized in our theoretical model.

The literature offers mixed evidence on the motives behind NOTA voting. Using aggregate data from Nevada, Brown (2011) and Damore et al. (2012) find evidence suggesting that uninformedness is related to NOTA votes. On the other hand, using survey experiments in US and Austria contexts, Ambrus et al. (2025) indicate that

NOTA votes are primarily driven by protest motives but not by the lack of information. These contrasting findings suggest that the factors driving NOTA voting may vary across institutional and electoral contexts. Our paper focuses on the informational channel and argues that in less competitive district, there will be fewer NOTA votes due to strategic abstention, thereby diminishing the impact of the NOTA option on politicians' in-office performance.

5 Data

For our empirical analysis, we combine gridded nighttime luminosity data with assembly election results to construct a constituency-level panel dataset covering eighteen major Indian states from 2012 to 2021. Together, these eighteen states account for more than 91% of India's population and about 84% of its landmass.[12] In this study, we focus on a balanced panel of $2,907$ assembly constituencies across these states which we observe over the ten-year period.[13]

Nighttime Lights: We use gridded annual data at 15-arc-second resolution, which corresponds to approximately 500 meters at the Equator, from the Visible Infrared Imaging Radiometer Suite (VIIRS) onboard the Joint Polar-orbiting Satellite System (JPSS). We obtain the VIIRS-Day Night Band (DNB) annual composites from the Earth Observation Group (EOG), which provides processed nighttime lights (or luminosity) data after filtering out sunlit, moonlit, and cloudy pixels and excludes outliers such as from biomass burning or aurora, which enable better detection of human-lit areas from those lacking detectable lighting (Elvidge et al., 2021).

The use of nighttime lights as a proxy for economic activity follows influential work by Henderson et al. (2012) and others such as Henderson et al. (2011); Elvidge et al. (1997); Doll et al. (2006); Michalopoulos and Papaioannou (2013); Pinkovskiy (2017); Henderson et al. (2017) and, more specifically in the Indian context, by Asher and Novosad (2017); Baskaran et al. (2024); Prakash et al. (2019), among others.[14] These studies utilize

[12]Our sample includes the following states: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal. We exclude states that are governed by special constitutional provisions – the North-Eastern states, the state of Jammu and Kashmir, Delhi National Capital Region and Union Territories – along with other smaller states.

[13]We show that our main results using the full sample are qualitatively similar to the one obtained using a balanced panel that excludes the state of Telangana which was carved out of the state of Andhra Pradesh in 2014. We therefore focus on the balanced panel throughout our analysis to mitigate concerns about compositional changes in our sample.

[14]See Donaldson and Storeygard (2016) for a review of the different applications of nighttime lights in economics.

nightlight data from VIIRS' predecessor, the Operational Linescan Sensor (OLS) on board the Defense Meteorological Satellite Program (DMSP). However, DMSP-OLS was designed to detect clouds for short-term weather forecasts and contains flaws such as blurring, coarse resolution, top-coding, which affects its accuracy (see Nordhaus and Chen, 2015; Gibson et al., 2021). By contrast, data from VIIRS-DNB provide images much clearer in low light, with a dynamic range of seven orders of magnitude compared to DMSP-OLS which only has two. Moreover, the DMSP program has now been discontinued and data is available from 1992 until 2013, that is, preceding the implementation of NOTA which makes it unusable for our study. More recent work such as Chodorow-Reich et al. (2020) use VIIRS-DNB to accurately capture Earth's radiance from outer space as a proxy for economic activity. We build on similar work and use VIIRS-DNB nighttime lights, henceforth NTL, which is more accurate and continuously available since 2012 to construct the main dependent variable for our analysis.

Next, we overlay the gridded NTL data onto a geo-referenced map of assembly constituency boundaries to calculate the average luminosity per constituency-year.[15] This generates a dataset of radiance values at the constituency level where a higher radiance value denotes more economic activity. We then apply a log transformation to this series to reduce the influence of outliers and use it further in our analysis.[16]

Figure 8 plots log NTL averaged across constituencies by first-treated cohort. For example, the line with solid circles plots the evolution of average log NTL for constituencies that implemented NOTA in 2013, the line with solid triangles correspond to the 2014 cohort, and so forth. While the plots show an initial difference in levels across the different cohorts, they exhibit some evidence of convergence around 2019. There are two notable exceptions to this pattern – the line at the top which corresponds to Karnataka, a state that is relatively more prosperous than its counterparts, and the line at the bottom which corresponds to Bihar, a state that lags behind its peers in terms of economic activity.

Election Results and Candidate Characteristics: We obtain data on assembly election results at the constituency level from the Election Commission of India. For this study, we rely on data disseminated by the Trivedi Centre for Political Data (TCPD) which combines election results with information on a subset of candidate characteristics

[15]Assembly constituency boundaries are periodically redrawn to reflect the underlying shifts in demography. The last such delimitation exercise took place in 2008 which altered the boundaries of assembly constituencies within a state according to the population figures in the 2001 Census, but deferred any change in the allocation of parliamentary seats or assembly seats until after the 2026 census. Therefore, we consider the post-2008 assembly constituency boundaries for our analysis.

[16]A limitation of using log-transformed variables, however, is that it drops zero values, which may be meaningful. In Section 7.4.3, we adopt an inverse hyperbolic sine transformation that retains zero values and show that our results remain quite stable.

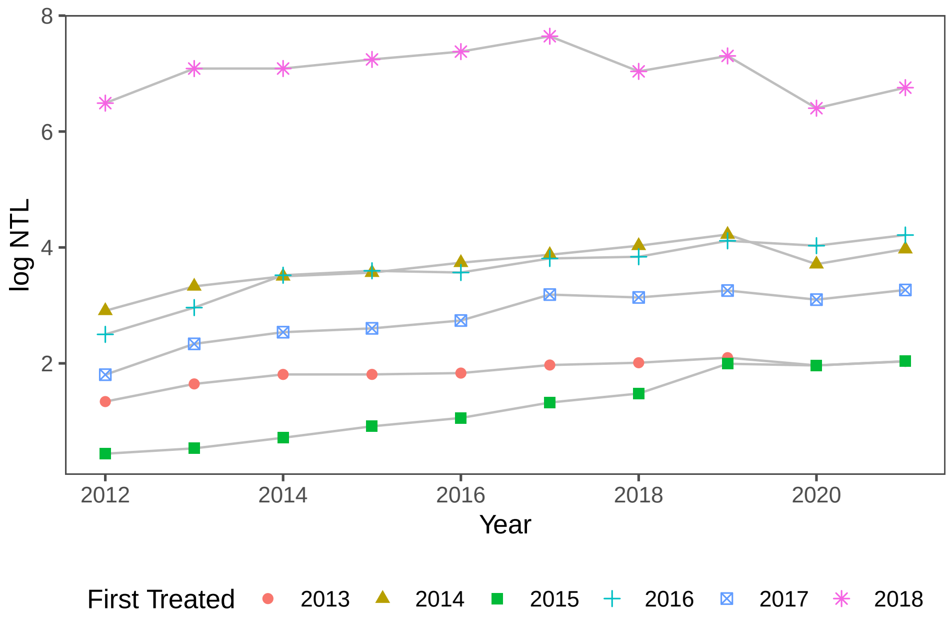

Figure 8: Plot of log NTL over time by first-treated cohort.
The first-treated cohort is the year a state first received NOTA treatment. Data relates to a balanced panel of 2,907 assembly constituencies.

from the digitized affidavits all candidates must furnish to ECI. From this dataset, we use information on the number of votes received by every candidate, the number of NOTA votes, the number of valid votes polled, the percentage of turnout at the constituency, together with candidates' characteristics such as gender, age, and primary profession for every election round held between 2012 and 2021 across the 18 major Indian states that we consider. We then merge election results with geo-referenced constituency boundaries combined with nighttime lights data described in Section 5 above for analysis.

The support for the NOTA option over time is a key component of our analysis. Figure 9, panel (a) plots the cumulative number of NOTA votes since its inception in 2013. Starting with 1.4 million NOTA votes in 2013, it has gathered a cumulative total of more than 10.6 million votes as of 2021. Panel (b) of the same figure plots NOTA votes as a percentage of valid votes by election-year held between 2012-21. While NOTA as a percentage of valid votes was 1.42% in 2013, it reached a peak of 2.46% in the 2015 assembly elections before dropping to 0.87% in 2021. However, it is important to note that the variation in the share of NOTA votes across different election-years reflects in part the staggered timing of assembly elections where groups of states follow distinct electoral cycles.

Cell-tower Coverage: Voter information may complicate the relationship between NOTA and local economic outcomes. To investigate this, we use cell-tower coverage

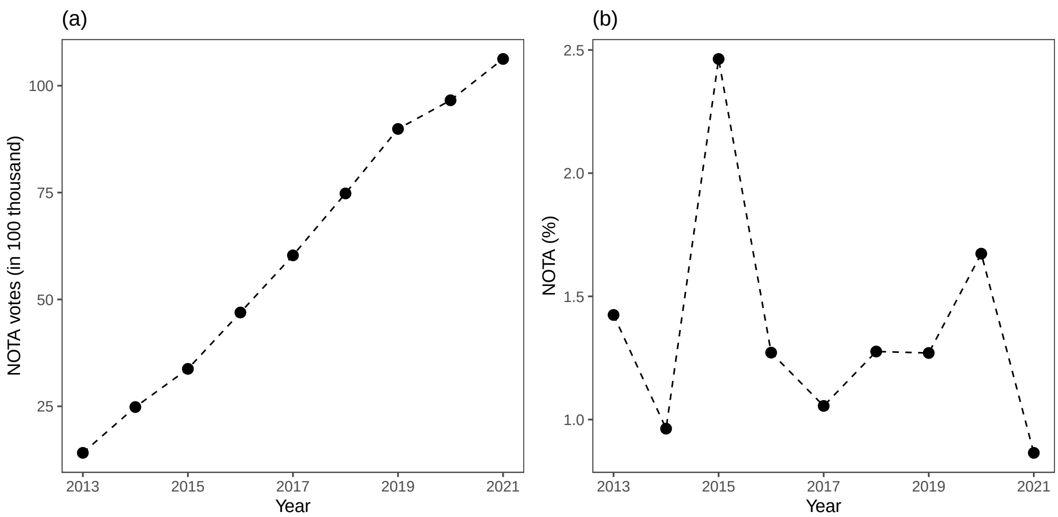

Figure 9: Cumulative NOTA Votes and its Share across Election Years.
Panel (a) shows the cumulative total of NOTA votes across all the constituencies in our sample by election year. Panel (b) shows the percentage of NOTA votes as a fraction of valid votes per constituency aggregated across all constituencies in our sample by election year.

as a proxy for voters' access to information and include this in our regression model. The premise is that voters residing in areas with denser cell-tower coverage are more informed since their information acquisition costs are lower in comparison to voters living in sparser cell-tower coverage areas. The resulting information gap is reflected in their voting decisions. The high density of smartphone users in India coupled with affordable mobile data tariffs makes this an appropriate variable to consider in our analysis.[17]

To achieve this, we obtain mobile tower location data from 'OpenCelliD' – the largest open database of cell towers for the period under study. OpenCelliD collects community contributed GPS positions i.e. the approximate latitude and longitude of cell towers around the world.[18] We obtain data for India corresponding to mobile country codes (MCC) 404 and 405 in the OpenCelliD database and include all types of base transceiver stations (BTS) – GSM, 3G, 4G and 5G – in constructing our measure of cell-tower coverage. We overlay this cell-tower (or BTS) location data onto evenly spaced raster grids of 0.5 degree resolution and extract the cell-tower count per grid-cell by year. Since periodic 'data-dumping' is an issue, we take a 3-year moving average of the cell-tower counts by grid-cell to create a time series from 2012 to 2021 for all grid cells. We then superimpose this raster onto a map of geo-referenced assembly constituency boundaries

[17]The *Comprehensive Modular Survey: Telecom* conducted by the National Sample Survey (NSS) in 2025 estimates that 85.5% of households possessed at least one smartphone. (link). Data from ITU shows that mobile data is relatively affordable in India with a 2 GB of monthly data using at least 3G technology costing 0.92% of GNI per capita [here].

[18]The OpenCelliD database powers the GSMA cellular coverage maps. The World Bank provides a 1 km rasterized map of cell towers map for 2020 [here].

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
log NTL	29,070	−0.289	1.548	−7.673	4.486
NOTA	29,070	0.658	0.474	0	1
NOTA (%)	29,070	0.892	1.024	0.000	13.778
Turnout (%)	29,070	70.835	10.816	7.880	93.330
Fraction Female	29,070	0.090	0.286	0	1
Vote Margin (%)	29,070	11.404	9.496	0.000	81.410

Note: Table shows summary statistics using a balanced panel. log NTL is the log of nighttime lights measured in nW/cm^2/sr (nano watt per steradian per square centimeter). NOTA indicates whether a constituency had NOTA option on the ballot. NOTA (%) is the percentage of NOTA votes polled out of all valid votes. Turnout is the percentage of voters who turned out to vote on the election day; Female takes a value of one if the winner is female and is zero otherwise; Vote margin is the difference in vote share between the winner and the runner-up.

to extract cell-tower count by constituency-year. We normalize this by a constituency's geographic area to obtain the cell-tower density (or coverage) by constituency-year and combine this with data on election results and log NTL. In the Appendix, Figure C4 plots the distribution of cell-tower density per 100 square kilometers, while Figure C5 maps cell-tower density for the year 2021 in our sample.

5.1 Descriptive Statistics

The main outcome variable of interest is the log of nighttime lights calculated as the area-weighted average radiance for a constituency measured in nano watts per steradian per square centimeter and expressed in log scale. Table 1 presents descriptive statistics for the variables of interest. The overall average log NTL was −0.289 with a standard deviation of 1.5, which suggests that constituencies differ widely in their nighttime radiance values or economic output. Figure 10 plots the density of log NTL.

The main covariate of interest, NOTA, is a binary indicator which takes a value of 1 if the constituency held an election with the NOTA option up until that time, which we consider as 'treated', and is zero otherwise. Around 66% of the observations in our sample were already treated. While the variable NOTA denotes treatment status at the extensive margin, that is, whether a constituency is treated or untreated, it misses variation in its intensity of use which may be important for policy. We therefore compute NOTA votes as a percentage of total valid votes in a constituency to capture the effect of NOTA at the intensive margin. From Table 1 we observe that, in percentage terms NOTA votes accounted for around 0.89% of all valid votes. Moreover, the average value masks

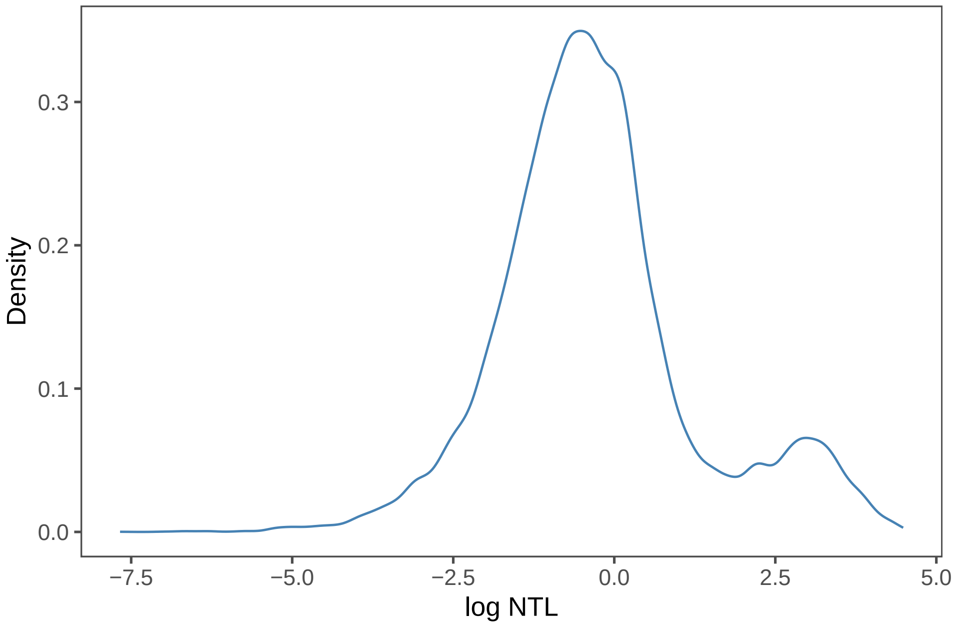

Figure 10: Density plot of log NTL.

significant variation in its intensity of use as the distribution plot in Figure C1 shows. Additionally, the percentage of NOTA votes exhibits large variation across constituencies. Figure C6 maps the percentage of NOTA votes by assembly constituency for the years 2013, 2015 and 2021, respectively, as more states conduct elections with the NOTA option.

The variable turnout (%) in Table 1 is the percentage of electors who turned out to vote on the election day. The average turnout in our sample is around 70% which points toward a relatively engaged electorate. Female is the fraction of winning candidates who are female and is around 9%. The vote margin is the difference in the vote share between the winner and the runner-up in a constituency and captures the competitiveness of elections. Lower vote margins indicate greater competitiveness, whereas higher margins reflect one-sided contests. On average, the vote margin was around 11% in our sample. We now move on to discussing our identification strategy.

6 Identification Strategy

The main objective of this paper is to understand whether including the NOTA option on the electoral ballot encourages politicians to promote economic activity. Proposition 2 in Section 4.1.2 predicts positive welfare gains from NOTA compared to a counterfactual without it.

To test our prediction, we bring the model to the data. Using annual data on nighttime luminosity combined with detailed assembly constituency-level electoral results from 2012 to 2021, we estimate the following baseline regression model:

$$\log(\text{NTL})_{it} = \beta\, \mathbb{1}[\text{NOTA}_{it}] + \boldsymbol{\delta}\mathbf{X}_{it} + \alpha_i + \psi_t + u_{it} \tag{9}$$

where the dependent variable, log (NTL), is a measure of local economic activity. i indexes assembly constituency and t denotes year. $\mathbb{1}[\text{NOTA}_{it}]$ is an indicator variable which denotes post-treatment status i.e. it takes a value of 1 for the i^{th} constituency once it has been exposed to NOTA treatment on or before time t and is zero otherwise. The main parameter of interest is the coefficient β which captures the post-treatment effect of NOTA on log (NTL). The vector $\mathbf{X}_{it}$ includes potential confounding factors such as voter turnout, winner gender, and the constituency's pre-treatment log (NTL) interacted with time. We include assembly constituency and year fixed effects to help ensure conditional exogeneity. u_{it} is an error term clustered at the constituency level to allow for within-constituency correlation over time.

Our empirical strategy relies on the plausibly exogenous variation in the timing of NOTA adoption across states, conditional on the full set of controls, for identification. Since constituencies incorporate the NOTA option in the election immediately following the Supreme Court's October 2013 order, our analysis is unlikely to be affected by manipulation of treatment timing. Table B1 in the Appendix displays the timeline of NOTA adoption across the states in our sample. We observe that the states of Chhattisgarh, Madhya Pradesh, and Rajasthan were among the first to receive NOTA treatment, with other states following suit depending on their respective pre-determined election cycles, and constituencies across all states in our sample had been treated by 2018.

We complement this approach with results from a regression discontinuity design (RDD) (Imbens and Lemieux, 2008) where we estimate local linear regressions in a narrow window on either side of a constituency's NOTA implementation date for identification.[19] Specifically, we estimate the following regression discontinuity (RD) model:

$$\log(\text{NTL})_{it} = \alpha_i + \beta^h\, \mathbb{1}[\text{NOTA}_{it}] + f(\text{Relative Time}_{it}) + \boldsymbol{\delta}\mathbf{X}_{it} + \varepsilon_{it} \tag{10}$$

where $\mathbb{1}[\text{NOTA}_{it}]$ equals 1 after the first NOTA election in the i^{th} constituency and is zero before that. 'Relative Time' is the forcing variable, normalized to zero on the year an election with NOTA option is first held in that constituency, while $f(.)$ denotes a flexible function. α_i represents assembly fixed effects. In equation (11), we specify

[19] Hausman and Rapson (2018) reviews the literature on regression discontinuity in time. Anderson (2014) provides an excellent application that exploits variation from the 2003 Los Angeles transit workers' strikes to estimate its effect on traffic delays and congestion.

$f(\text{Relative Time}_{it})$ as a linear function $\beta\,\text{NOTA}_{it} + \gamma_1\,\text{Relative Time}_{it}$ which gives:

$$\log(\text{NTL})_{it} = \alpha_i + \beta^h\,\mathbb{1}[\text{NOTA}_{it}] + \gamma_1\,\text{Relative Time}_{it} + \gamma_2\,(\mathbb{1}[\text{NOTA}_{it}] \times \text{Relative Time}_{it}) + \boldsymbol{\delta}\mathbf{X}_{it} + \varepsilon_{it} \tag{11}$$

We select a uniform kernel and vary the bandwidth across different models. The least squares estimate of β^h represents the causal effect of NOTA treatment for assembly constituencies in a narrow time window around the NOTA implementation cut-off. h is a parameter that specifies the time window or bandwidth in estimation. ε_{it} is an error term clustered at the assembly constituency.[20]

While the within-constituency variation in log (NTL) following the implementation of NOTA sheds interesting insight, it masks significant variation in the intensity of NOTA use across constituencies. This is because the percentage of NOTA votes as a fraction of valid votes varies widely across constituencies as shown in Figure C6. Therefore, understanding the intensive-margin impact of NOTA is important. To examine this, we regress log (NTL) on the share of NOTA votes, denoted by NOTA_{it}, along with the entire set of controls as follows:

$$\log(\text{NTL})_{it} = \beta\,\text{NOTA}_{it} + \boldsymbol{\delta}\mathbf{X}_{it} + \alpha_i + \psi_t + \varepsilon_{it} \tag{12}$$

One issue with this, however, is that, whereas the NOTA treatment indicator in equation (9) is arguably exogenous, the percentage of NOTA votes in equation (12) is likely to be affected by local socio-economic conditions or underlying political cleavages, rendering it endogenous and potentially biasing estimates. To address this concern, we use an instrumental variable approach where we instrument the percentage of NOTA votes with a dummy variable – 'SC Order' – which takes a value of 1 for all elections held after the October 2013 Supreme court judgement and is zero before that date.[21] The idea is that the NOTA judgment caused a discontinuous jump in NOTA votes from zero, allowing us to isolate its impact on log (NTL).

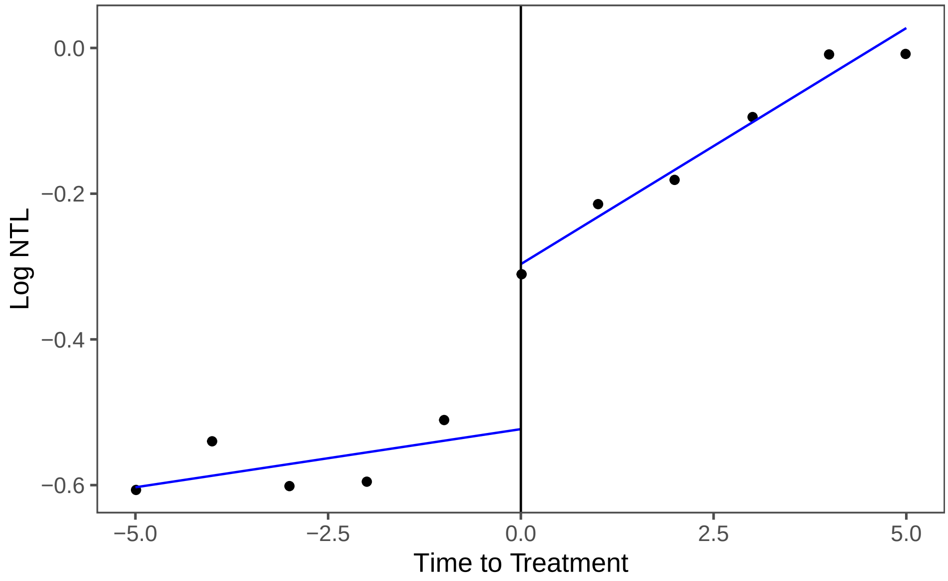

Figure 11: RD Plot: Effect of NOTA on log NTL.
Figure plots average log NTL against Relative Time to treatment using a five year bandwidth. The vertical line denotes the first-treated year.

7 Empirical Results

7.1 NOTA and Economic Activity

7.1.1 RDD Results

Figure 11 plots average log of NTL against relative time to treatment (or 'Relative Time') which is centered at zero and uses a five-year bandwidth on either side of the cut-off. Negative values of 'Relative Time' denote treatment leads, whereas positive values denote treatment lags. The solid vertical line at zero corresponds to the year the first post-NOTA election is held in that constituency. The discontinuous jump at the cut-off as one moves from left to right is compelling and suggests clearly an increase in economic activity following the implementation of NOTA.

Table B3 presents RD estimates. Column (1) reports results from regresses log NTL on NOTA and a linear function of Relative Time, f(Relative Time), using the full sample, controlling for assembly fixed effects. It shows that NOTA increases nighttime lights by 14.3% (s.e. = 0.008). Columns (2) and (3) vary the bandwidth around the cut-off date

[20] Additionally, we cluster the standard error by the forcing variable ('Relative Time') and jointly by assembly constituency and 'Relative Time' (Cameron and Miller, 2015), obtaining similar results.

[21] The idea is similar to that in Blakeslee (2018), who uses the date of Rajiv Gandhi's assassination – a prominent Congress politician and a former Prime Minister of India – as an instrument for the share of Congress votes.

and consider a bandwidth size of 3 years and 5 years, respectively. The estimates increase from 6.3% (s.e. = 0.007) to 12.1% (s.e. = 0.007) as the bandwidth increases, suggesting a persistent effect. Columns (4) to (6) include political controls and an interaction term – pre-NOTA log NTL times year – to the respective models in columns (1) to (3) to absorb the effect of potential confounding factors. While the effect remains positive across these models, the effect is no longer statistically significant for the three-year bandwidth in column (5). Moreover, to mitigate any bias due to bunching near the cut-off, column (7) considers a *donut* sample which excludes one year before and one year after the NOTA implementation date and finds estimates that are much larger at 23.6% (s.e. = 0.016). We next present results from OLS and instrumental variable (IV) models.

7.1.2 OLS and IV2SLS Results

Table 2 presents results from estimating equation (9). Column (1) estimates a baseline model, regressing log NTL on NOTA × Post using the full sample and includes assembly and year fixed effects. $\hat{\beta}_{OLS}$ is estimated to be 8% (s.e. = 0.008). Column (2) controls for additional political factors such as turnout and candidate's gender which might affect estimates, along with the pre-treatment average log NTL interacted with time to account for differences in baseline conditions. This increases the value of $\hat{\beta}_{OLS}$ to 10.2% (s.e. = 0.008). Column (3) re-estimates the model on a balanced sample to ensure that our results are not driven by compositional effects and obtains an estimate of 10.4% (s.e. = 0.008). Column (4) is similar to the specification in column (3), except that it regresses log NTL on the percentage of NOTA votes and obtains an estimate of 7.5% (s.e. = 0.007). In column (5), we instrument the percentage of NOTA votes with 'SC order', an indicator that takes a value of 1 if the election is held after October 2013 and is zero otherwise. The first-stage effects are large, positive and significant at the 1% level (Kleibergen-Paap F-statistics = 3746.71). The IV2SLS estimate of the coefficient on NOTA percent, $\hat{\beta}_{IV}$, is 7.6% and precisely estimated with a standard error of 0.006.

The recent literature on treatment effect estimation with staggered adoption suggests that two-way fixed effects estimates, such as in equation (9), may be potentially biased due to 'forbidden' comparisons, that is, when early-treated units act as controls for later-treated units (Goodman-Bacon, 2021). This problem is much more severe when the treatment effect varies across units or over time, which may even reverse signs due to 'negative weighting' (Roth et al., 2022). Thus, to ensure the credibility of our estimates, we use alternative estimators that avoid 'forbidden' comparisons and rely on 'clean' controls that compare treated and not-yet-treated units. Specifically, we use the doubly-robust estimator by Sant'Anna and Zhao (2020), the efficient estimator proposed by Roth and Sant'Anna (2023), and the stacked estimator by Cengiz et al. (2019). This yields precisely

Table 2: Effect of NOTA on log NTL

	log NTL				
	(1)	(2)	(3)	(4)	(5)
𝟙[NOTA]	0.080***	0.102***	0.104***		
	(0.008)	(0.008)	(0.008)		
NOTA percent				0.075***	0.076***
				(0.007)	(0.006)
log NTL (pre-mean) × Year		✓	✓	✓	✓
Political controls		✓	✓	✓	✓
Sub-sample	Full	Full	Balanced	Balanced	Balanced
Estimator	OLS	OLS	OLS	OLS	IV
Observations	30,614	29,439	29,070	29,070	29,070
Adjusted R^2	0.960	0.968	0.968	0.968	0.968
Assembly fixed effects	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓

Note: Dependent variable is log NTL for all columns. 𝟙[NOTA] denotes NOTA treatment dummy whereas, NOTA percent is the NOTA votes polled as a percentage of total valid votes. Column (1) reports a least squares estimates of log NTL on NOTA, controlling for assembly and year fixed effects, using the full sample. Column (2) adds controls for the pre-treatment average of constituency-level log NTL interacted with year along with political controls. Column (3) has the same specification as Column (2) but is estimated on a balanced panel. Column (4) uses the percentage of NOTA votes as the main explanatory variable. Column (5) presents IV estimates, instrumenting NOTA with "SC Order," an indicator equal to 1 after October 2013, when the Supreme Court mandated adding NOTA as an option in all assembly elections, and 0 before. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

estimated coefficients between 4.9%–7.3% (see Table B10) which are smaller in magnitude than the least squares results and closer to the IV2SLS estimates (see Table 2). A more detailed discussion of the validity of our least squares estimates is provided in Section 7.4.5.

7.2 Role of Political Competition

One of the predictions from our theoretical model is that NOTA is more likely to be effective in increasing incumbents' in-office performance in constituencies that are not considered "safe" seats (see Section 4.2.2). To test this prediction, we classify constituencies into three bins of political competitiveness, measured by margin of victory.: high (vote margin $\leq$ 10%), moderate (vote margin between 10%-25%) and low (vote margin $\geq$ 25%). Figure C2 plots the distribution of vote margin in our sample. It is positively skewed, which indicates that the probability of observing a moderately or highly competitive constituency is greater than that of observing an overwhelmingly one-sided race. However, the percentage of NOTA votes does not vary significantly across competition bins (see Figure C3).[22]

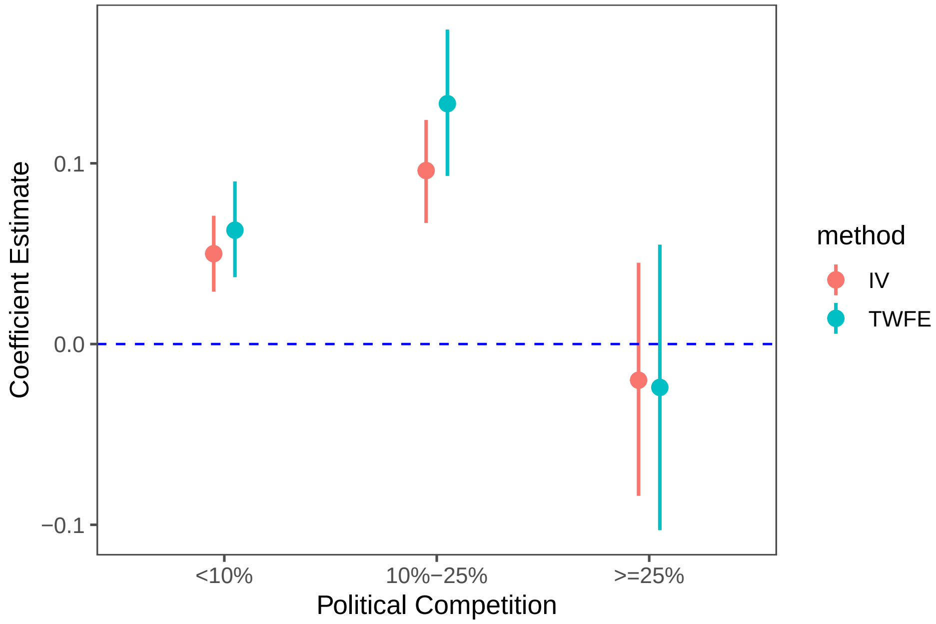

Figure 12: Effect of NOTA on log NTL by Political Competition Bins. Figure plots the coefficients on the NOTA dummy for distinct sub-samples corresponding to different levels of political competition, measured by the winner's victory margin. A smaller victory margin indicates higher levels of political competition. Coefficients are obtained from a regression of log NTL on NOTA dummy, assembly fixed effects and time fixed effects and the full set of controls. TWFE and IV estimates, using 2013 Supreme Court judgement as instrument, are presented.

Table B4 shows that, consistent with theory, NOTA is most effective in constituencies with a moderate level of political competition ($\hat{\beta} = 13.3\%$ with a standard error of 0.021); the effect is positive but smaller ($\hat{\beta} = 6.4\%$ with a standard error of 0.014) in highly competitive constituencies; and importantly, the effect becomes negative but statistically insignificant in 'safe' seats ($\hat{\beta} = -2.4\%$ with a standard error of 0.040). Figure 12 summarizes these results. The estimates labeled TWFE are the least squares estimates, while the results labeled IV are their instrumental variable counterparts which regress log NTL on the percentage of NOTA votes instrumented by 'SC order', including the full set of controls. The error bars in the figure represent the 95% confidence interval for each of the estimates.

The findings are supported by wider literature on electoral competition and economic outcome, which suggests that elections are most effective when incumbents face credible

[22] In addition, Ujhelyi et al. (2021) provides reduced-form evidence that NOTA has no effect on political competition in India.

re-election threats. Using panel data for the US states, Besley et al. (2010) find evidence that areas with higher political competition experienced better economic outcomes and adopted more growth-enhancing policies. In an influential study in Brazil, Ferraz and Finan (2011) use random audit data on local governments to show that mayors who faced re-election pressure engaged in significantly less corruption than those who did not. Svaleryd and Vlachos (2009) demonstrate both theoretically and empirically that increasing competition (and voter information) in Swedish municipalities reduced rents extracted by officials. Since the effect of NOTA operates through the electoral mechanism, it follows that when the effectiveness of elections is weak, the presence of NOTA has little impact on in-office performance or on economic outcome.

7.3 Role of Information

The existing literature on the role of information suggests that better-informed voters influence electoral behavior to select better politicians (see Pande 2011 for a review). Information weakens the effect of ethnic ties and increases electoral accountability and redistribution (Casey, 2015). More recently, studies show that increasing mobile internet coverage – a proxy for information – reduces government approval (Guriev et al., 2021) and increases mass mobilisation through increased coordination (Manacorda and Tesei, 2020) among others (see Zhuravskaya et al. 2020 for a review of the political effects of the internet and social media).

In our model, NOTA's success lies in its ability to aggregate information about the incumbent's quality that is dispersed among the electorate. The model formalizes this mechanism, predicting that NOTA is likely to be more effective when voters face a relatively noisy signal of incumbent's performance in comparison to a scenario where voters observe an unambiguous signal (see Proposition 3 in Section 4.1.2). That is, when voters receive information that is quite precise, NOTA is likely to be less effective at the margin, and may even be counter-productive when electoral accountability is sufficiently weak. In other words, NOTA may be a substitute for information. How large is this effect? Does accounting for information overturn NOTA's effectiveness?

To test this empirically, we use cell coverage at the constituency level – a widely accepted proxy for information in the literature – where a higher value indicates a constituency with a denser mobile network i.e. where voters have access to more precise information and vice-versa. We then include this variable in levels along with its interaction with NOTA $\times$ Post into equation (9). Table 3 presents regression results where our interest lies in the joint test $\delta = 0$, where the parameter $\delta =$ NOTA + NOTA $\times$ Cell coverage. Column (1), Table 3, estimates this extended model on the full sample. Columns (2)-(4) focus on the high, moderate, and low political competition sub-samples, respectively.

Table 3: NOTA, Cell Coverage and log NTL

	log NTL			
	(1)	(2)	(3)	(4)
𝟙[NOTA]	0.110***	0.069***	0.144***	-0.022
	(0.008)	(0.014)	(0.022)	(0.043)
Cell coverage	0.005***	0.012**	0.010***	0.004
	(0.0010)	(0.005)	(0.002)	(0.005)
𝟙[NOTA] × Cell coverage	-0.014***	-0.018***	-0.019***	-0.002
	(0.001)	(0.006)	(0.003)	(0.006)
Joint test : $\delta = 0$	0.096***	0.051***	0.125***	-0.024
	(0.000)	(0.000)	(0.000)	(0.549)
NTL (pre-mean) × Year	✓	✓	✓	✓
Political controls	✓	✓	✓	✓
Electoral Comp.	Balanced Sample	$< 10\%$	$10\% - 25\%$	$\geq 25\%$
Observations	29,070	15,573	10,971	2,526
Adjusted R^2	0.968	0.969	0.979	0.992
Assembly fixed effects	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓

Note: Table shows the effect of NOTA conditional on cell tower coverage. $\delta = 0$ is the joint hypothesis that 𝟙[NOTA] + 𝟙[NOTA] × Cell coverage equals zero, that is, the marginal effect of NOTA accounting for the interactive term is zero. Column (1) considers the full sample, while cols.(2–4) relate to sub-samples where the victory margin is $< 10\%$, 10%-25%, and $> 25\%$, respectively. All regressions control for assembly constituency and year fixed effects along with the full set of controls. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

We find that, firstly, increasing cell coverage is associated with an increase in economic activity; secondly, the interaction with cell coverage is negative which implies that NOTA becomes less effective as information becomes more precise at the margin; and finally, even after controlling for information in this way, the effect of NOTA on log NTL remains positive except for one-sided elections where the effect is not statistically significant. Specifically, the overall impact of NOTA on log NTL in the balanced sample is estimated to be 9.6% (s.e. = 0.008) which is close to the results obtained in Table 2, column (3). Additionally, the results from columns (2)-(4) mirror those in Table B4, and we observe that NOTA is most effective is moderately competitive constituencies, it's effect is positive but somewhat less effective in highly competitive constituencies, and the effect becomes negative but imprecisely estimated in one-sided elections. Thus, we find evidence of an association between NOTA, information and log NTL which is consistent with theory.

Next, we discuss robustness checks.

7.4 Robustness

7.4.1 Persistence of Impact

We construct three-year and five-year leads of log NTL to examine whether the effect of NOTA persists over time. Table B5 shows that across the different models, NOTA has a positive impact on log NTL, although the effect is relatively smaller in magnitude.

7.4.2 Political Budget Cycles

A careful reader might be concerned that political budget cycles may bias the estimated impact of NOTA on log NTL. This is the idea that voters tend to be myopic which drives incumbents to increase public spending near election-years (Rogoff, 1990). Following Besley and Burgess (2002), who study government responsiveness as post-calamity relief in India, we construct an indicator for an election and pre-election year and include this as a control in our regression model. Table B6 shows that our main results are robust to including this variable in our model.

7.4.3 Alternative Dependent Variable

We log transform the radiance values of nighttime lights and use this as our dependent variable. A limitation of the log transformation is its undefined nature for zero values. This is not a problem if the occurrence of zero-values is non-systematic. However, to guard against this, we use an inverse hyperbolic sine (IHS) transformation of NTL and re-estimate our models using it as our dependent variable. Table B7 shows that our results remain qualitatively unchanged although the effect becomes smaller in magnitude.

7.4.4 Election Year Sub-Sample

While we observe log NTL annually, assembly elections are typically held once in five years. Hence, in order to construct our panel dataset, we use repeated measures of election results in the years intervening the election years. Table B8 presents estimates that consider only observations that relate to election years. The estimated effects are similar in magnitude and sign which increases our confidence in the main results with the full sample.

7.4.5 Staggered Adoption

As mentioned before, recent literature on treatment effect estimation shows that two-way fixed effects estimators may be misleading when there is staggered treatment adoption

Goodman-Bacon (2021). The main reason is 'forbidden' comparisons where already treated units serve as controls for later treated units. To understand how this affects our results, we first conduct a Goodman-Bacon decomposition which provides the weights and estimates for all possible 2×2 designs (Goodman-Bacon, 2021). Figure C8 shows that while there are some problematic comparisons, those with more weights are centred around zero.

To investigate this further, first we split our sample into *early* treated units i.e. those units that were treated during 2013 to 2015 and *later* treated units i.e. units treated during 2016 to 2018 and estimate separate regressions on the respective sub-samples. Table B9, Column (1) shows that the coefficient on the interaction term with the indicator for the *early* in the full sample is positive and statistically significant. Moreover, columns (2) and (3) of the same table which consider the *late* and *early* sub-samples, respectively, confirm the heterogeneity in impacts.

Since heterogeneity in impact is a problem in staggered designs, we use alternative estimators that yield robust estimates. Specifically, we use three different estimators which avoid 'forbidden' comparisons and rely on 'clean' controls that compare treated and not-yet-treated units. Specifically, we use the doubly-robust estimator by Sant'Anna and Zhao (2020), the efficient estimator proposed by Roth and Sant'Anna (2023), and the stacked estimator by Cengiz et al. (2019). Table B10 shows that the estimated coefficients are between 4.9%–7.3% and they are all statistically significant at the conventional levels.

7.4.6 TSLS and LATE

Recent work has pointed out that the common interpretation of linear IV as estimating a local average treatment effect (LATE) is valid only for saturated models. Blandhol et al. (2022) show that the treatment effect in linear IV with covariates is affected by both compliers and always takers, with some always takers being negatively weighted. To avoid this, we introduce flexible specifications of our covariates following the double-debiased machine learning (DDML) estimation approach Chernozhukov et al. (2018). Table B11 presents regression results from a linear IV model with the full set of controls where the covariates are flexibly specified and estimated using the random forest learner. We find that a marginal increase in the percentage of NOTA votes increases log NTL by approximately 0.30 log points.

8 Conclusion

In this paper, we examine the relationship between nil voting via the None-of-the-Above (NOTA) option and the responsiveness of policy-making. We build a career concerns model with an incumbent and a challenger and two types of voters – *engaged* and *strategic*. The NOTA option incurs a psychological cost which captures the degree of acceptance of a NOTA vote as a valid form of electoral participation and is considered an exogenous parameter in our model. Our model suggests that NOTA leads to an increase in public goods outcome only when the signal regarding the public goods outcome is not too precise since, under such circumstances, the selection effect due to NOTA outweighs the disciplining effect. While the main model excludes abstention as an option to simplify presentation, we show that the main results remain the same even with abstention. Furthermore, we allow partisan bias in our model and show that NOTA is more effective when the seats are not considered as *safe* that is, when the electoral advantage is not too one-sided reinforcing the need for electoral accountability.

We take predictions from our theoretical model to real-world elections. Using panel data at the assembly constituency level from India during 2012 to 2021, we find that, in line with predictions from theory, the exogenous introduction of NOTA in October 2013 through a Supreme Court judgement led to an increase of 8%-10% in log nighttime luminosity (log NTL), our measure of economic activity. We use an instrumental variable approach to address endogeneity in the percentage of NOTA votes. Furthermore, we examine heterogeneity in the impact of NOTA by political competition and find that NOTA is more effective when the seats are not *safe* reinforcing the need for electoral accountability. Additionally, we find suggestive evidence that voter information, measured as the density of cell-tower coverage, does not meaningfully alter our main results.

We conduct several robustness checks. Firstly, we examine the impact of NOTA on log NTL 3-year and 5-years down the line and find the effect to be persistent. Second, we control for the effect of political budget cycles as a potential confounding factor and find our results to be stable. Thirdly, we use an inverse hyperbolic sine (IHS) transformation of nighttime lights and use this as our dependent variable. This does not alter our main results in any meaningful way. Fourthly, we re-estimate our results on an election-year sub-sample and again find results that are qualitatively similar. Since the roll-out of NOTA is staggered across states depending on their pre-determined electoral cycle, we estimate the main model using alternative estimators that use 'clean' comparisons to avoid the issue of 'forbidden' comparisons where early treated units serve as a control for later treated units. The results from this suggest effects that are comparable to our IV2SLS estimates suggesting that our results are robust. Finally, to ensure that the results from our linear IV estimates with covariates can be correctly interpreted, we adopt a double-debiased machine learning estimator with a random forest learner which includes flexible specification of the covariates in the model. The results are much larger but do not qualitatively change our main conclusions.

Overall, our study provides strong evidence that NOTA can be a potent instrument to strengthen democratic accountability. The findings clearly challenge the notion that NOTA is a "failed idea" simply because it lacks direct legal consequences for the election result. On the contrary, even without voiding elections or mandating a re-poll when NOTA votes are high, the presence of a NOTA option induces politicians to be more responsive to citizens. By giving dissatisfied voters a voice (short of staying home or casting a random vote), NOTA creates an implicit threat that incentivizes better performance from incumbents and parties. Our results complement the emerging literature on protest voting and electoral outcomes – for example, recent studies have shown that introducing a NOTA-like option can increase voter participation and alter vote shares – by demonstrating a clear link between protest voting and tangible improvements in economic governance. In sum, the NOTA option serves as a meaningful democratic tool: it not only allows voters to express disapproval, but also translates that expression into better subsequent policy performance.

While our analysis has focused on the Indian context and one measure of policy outcome, it opens up several avenues for further inquiry. First, it would be useful to examine whether the accountability-enhancing effects of NOTA generalize to other settings. Different countries or subnational elections (possibly with varying rules for NOTA) could provide fertile ground to test the external validity of our findings. Investigating contexts where a NOTA vote might carry formal consequences – for instance, jurisdictions that consider a re-election if NOTA wins a plurality – would be particularly insightful to understand how institutional design influences the effectiveness of protest voting. Second, future research could delve deeper into the micro-level mechanisms behind our results. For example, researchers might study how political parties and candidates respond strategically to the introduction of NOTA: Do parties field higher-quality candidates or adjust their policy platforms when voters have the option to reject all candidates? Does the threat of NOTA lead incumbents to change their campaigning strategy or undertake more visible projects during their term? Detailed case studies or surveys around elections could shed light on how politicians anticipate and react to protest voting behavior. Third, it would be valuable to explore the long-run implications of NOTA on political selection and voter attitudes. Over multiple election cycles, does the presence of a NOTA option lead to a sustained improvement in the average quality of elected officials, as low-performing incumbents are consistently filtered out? Or might there be diminishing returns as political actors adapt to the new equilibrium? Additionally, understanding whether habitual use of NOTA influences voter engagement or trust in the political process over time could inform debates about the overall welfare impact of such electoral reforms. By pursuing these questions, future research can build on our findings to more fully understand the conditions under which protest voting instruments like NOTA enhance democracyand to identify potential refinements that maximize their positive impact.

Appendix A Theory

Proof of Proposition 1. In order to determine the equilibrium strategy of voter S, we first need to express S's expected payoffs of each action $\{C, I, N\}$ as a function of the observed outcome y_S and the psychological cost c_S. As abstention is strictly dominated by NOTA for any value of c, we can focus on voter S's expected payoffs from choosing $a_S \in \{N, I, C\}$.

Given the incumbent's equilibrium strategy e^*, the conditional probability that voter E will vote for the incumbent given that the incumbent is of High type is given by

$$\mathbb{P}(a_E = I \mid \theta_I = 1) = \mathbb{P}(e^* + 1 + \varepsilon_E \geq y^*) = \mathbb{P}(\varepsilon_E \geq -1) = F(1). \tag{13}$$

Similarly, we have the conditional probability that voter E will vote for the incumbent given that the incumbent is of Low type:

$$\mathbb{P}(a_E = I \mid \theta_I = -1) = \mathbb{P}(e^* - 1 + \varepsilon_E \geq y^*) = \mathbb{P}(\varepsilon_E \geq 1) = F(-1). \tag{14}$$

If voter S votes for the incumbent, that is $a_S = I$, then a High type politician is elected if and only if:

(i) the incumbent is of High type and voter E votes for the incumbent;

(ii) the incumbent is of High type, voter E votes for the challenger, and the incumbent wins by tie-breaker;

(iii) the incumbent is of High type, voter E votes for the challenger, the challenger is also of High type, and the challenger wins by tie-breaker;

(iv) the incumbent is of Low type, voter E votes for the challenger, the challenger is of High type, and the challenger wins by tie-breaker.

Then we can write:

$$\begin{aligned}\mathbb{P}(\theta = 1 \mid y_S, a_S = I) = {} & F(1)\,\mathbb{P}(\theta_I = 1 \mid y_S) + \frac{1}{2}F(-1)\,\mathbb{P}(\theta_I = 1 \mid y_S) \\ & + \frac{1}{4}F(-1)\,\mathbb{P}(\theta_I = 1 \mid y_S) + \frac{1}{4}F(1)\,\mathbb{P}(\theta_I = -1 \mid y_S).\end{aligned} \tag{15}$$

Similarly, if voter S votes for the challenger, that is $a_S = C$, then a High type politician is elected if and only if:

(i) the incumbent is of High type, voter E votes for the incumbent, the challenger is of Low type, and the incumbent wins by tie-breaker;

(ii) the incumbent is of High type, voter E votes for the incumbent, the challenger is also of High type, and the challenger wins by tie-breaker;

(iii) the incumbent is of High type, voter E votes for the challenger, and the challenger is also of High type;

(iv) the incumbent is of Low type, voter E votes for the incumbent, the challenger is of High type and wins by tie-breaker;

(v) the incumbent is of Low type, voter E votes for the challenger, the challenger is of High type.

Then we can write:

$$\begin{aligned}\mathbb{P}_S(\theta = 1 \,|\, y_S, a_S = C) = &\frac{1}{2}F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{4}F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) \\ &+ \frac{1}{2}F(-1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{4}F(-1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S) \\ &+ \frac{1}{2}F(1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S).\end{aligned} \tag{16}$$

Finally, if voter S votes for the NOTA option, that is $a_S = N$, then a High type politician is elected if and only if:

(i) the incumbent is of High type, voter E votes for the incumbent;

(ii) the incumbent is of High type, voter E votes for the challenger, and the challenger is also of High type;

(iii) the incumbent is of Low type, voter E votes for the challenger, and the challenger is of High type.

Then we can write:

$$\begin{aligned}\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) = &F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{2}F(-1)\,\mathbb{P}_S(\theta_I = 1 \,|\, y_S) \\ &+ \frac{1}{2}F(1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S).\end{aligned} \tag{17}$$

Voter S chooses NOTA over voting for the challenger if and only if the difference between the expected policy payoffs of NOTA and voting for the challenger exceeds the psychological cost of NOTA. Formally, voter S chooses NOTA over voting for the challenger only if:

$$\begin{aligned}&\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) - \mathbb{P}(\theta = 1 \,|\, y_S, a_S = C) \geq \gamma c \\ \Longleftrightarrow\ &\frac{1}{4}[F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S)] \geq \gamma c.\end{aligned} \tag{18}$$

Notice that given the incumbent's strategy e^*, $\mathbb{P}(\theta_I = 1 \,|\, y_S)$ is strictly increasing and $\mathbb{P}(\theta_I = -1 \,|\, y_S)$ is strictly decreasing in y_S. It implies that the LHS of (18) is also strictly increasing in the observed outcome y_S. Furthermore, as $\lim_{y_S \to -\infty} \mathbb{P}(\theta_I = 1 \,|\, y_S) = 0$ and $\lim_{y_S \to +\infty} \mathbb{P}(\theta_I = 1 \,|\, y_S) = 1$, we have:

$$\lim_{y_S \to -\infty} \Big[F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S)\Big] = -F(-1) < 0,$$
$$\text{and} \quad \lim_{y_S \to \infty} \Big[F(1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S)\Big] = F(1) \in (0,1).$$

As the LHS of (18) is continuous in y_S, for any $0 < c < c^*$. we can define the cut-off $\underline{y}(c)$ as the unique solution of the equation:

$$[F(1) - 4\gamma c]\, f(y_S - e^* - 1) - [F(-1) + 4\gamma c]\, f(y_S - e^* + 1) = 0. \tag{19}$$

Then, for a given value of the psychological cost c, voter S strictly prefers to vote for NOTA over voting for the challenger only if $y_S > \underline{y}$.

Similarly, voter S chooses to NOTA over voting for the incumbent if and only if the difference between the expected policy payoffs of the NOTA option and voting for the incumbent exceeds the psychological cost of NOTA. Formally, voter S chooses NOTA over voting for the incumbent only if:

$$\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) - \mathbb{P}(\theta = 1 \,|\, y_S, a_S = I) \geq \gamma c$$
$$\iff \frac{1}{4}[F(1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S)] \geq \gamma c. \tag{20}$$

Applying the same arguments as above, we have the LHS of (20) is strictly decreasing in the observed outcome y_S. Furthermore, we have:

$$\lim_{y_S \to -\infty} [F(1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S)] = F(1) \in (0,1),$$
$$\text{and} \quad \lim_{y_S \to +\infty} [F(1)\,\mathbb{P}(\theta_I = -1 \,|\, y_S) - F(-1)\,\mathbb{P}(\theta_I = 1 \,|\, y_S)] = -F(-1) < 0. \tag{21}$$

Denote $c^* = [F(1) - F(-1)]/(8\gamma)$. As the LHS of (20) is continuous in y_S, for any $0 < c < c^*$, we can define the cut-off $\bar{y}(c)$ as the unique solution of the equation:

$$[F(1) - 4\gamma c]\, f(y_S - e^* + 1) - [F(-1) + 4\gamma c]\, f(y_S - e^* - 1) = 0. \tag{22}$$

Then, for a given value of c, voter S strictly prefers to vote for NOTA over voting for the incumbent only if $y_S < \bar{y}$.

As the density function of the noise term $f(\cdot)$ is symmetric around its zero mean, we can re-write the equation (19) that characterizes the lower cut-off $\underline{y}(c)$ as

$$[F(1) - 4\gamma c]\, f[-(y_S - y^*) + 1] - [F(-1) + 4\gamma c]\, f[-(y_S - y^*) - 1] = 0,$$

which, in turn, implies that for any c, $\bar{y}(c)$ and $\underline{y}(c)$ is equidistant to y^*. Let $\delta(\gamma, c) = \bar{y}(c) - y^* = y^* - \underline{y}(c)$. Then we can rewrite both equation (19) and (22) as

$$\begin{aligned}
& [F(1) - 4\gamma c]\, f(\delta + 1) - [F(-1) + 4\gamma c]\, f(-\delta + 1) = 0 \\
\iff & \frac{f(-\delta + 1)}{f(\delta + 1)} = \frac{F(1) - 4\gamma c}{F(-1) + 4\gamma c} \\
\iff & \exp\Big(\frac{2\delta}{\sigma^2}\Big) = \frac{F(1) - 4\gamma c}{1 - [F(1) - 4\gamma c]} \\
\iff & \delta(\gamma, c) = \frac{\sigma^2}{2} \operatorname{logit}\, [F(1) - 4\gamma c].
\end{aligned}$$

Hence, for any realization of c, voter S strictly prefers incumbent if $y_S > \bar{y}(c) = y^* + \delta(\gamma, c)$; she strictly prefers the challenger if $y_S < \underline{y}(c) = y^* - \delta(\gamma, c)$; and she strictly prefers the NOTA option if $\underline{y}(c) < y_S < \bar{y}(c)$. □

Proof of Proposition 2. We need first to compute the probability of winning the elections, as perceived by the incumbent when choosing investment e. By assumption, he does not yet know his own competence. His probability of re-election for a given level of public investment can be written as:

$$v(e) = \mathbb{P}(\theta_I = 1) v(e \,|\, \theta_I = 1) + \mathbb{P}(\theta_I = -1) v(e \,|\, \theta_I = -1).$$

where $v(e \,|\, \theta_I)$ is the probability of reelection as a function of public policy e given his level of competence θ_I. Then the derivative of $v(e)$ with respect to e is simply:

$$v'(e) = \frac{1}{2} v'(e \,|\, \theta_I = 1) + \frac{1}{2} v'(e \,|\, \theta_I = -1). \tag{23}$$

Given voter E and S's equilibrium voting decisions, we can write:

$$v(e \,|\, \theta_I) = \mathbb{P}(a_E = I \,|\, \theta_I) - \frac{1}{2}\mathbb{P}(a_E = I \,|\, \theta_I)\mathbb{P}(a_S = C \,|\, \theta_I) + \frac{1}{2}\mathbb{P}(a_E = C \,|\, \theta_I)\mathbb{P}(a_S = I \,|\, \theta_I) \tag{24}$$

with

$$
\begin{aligned}
\mathbb{P}(a_E = I \,|\, \theta_I) &= \mathbb{P}(\varepsilon \geq y^* - e - \theta_I) = F(\theta_I + e - y^*), \\
\mathbb{P}(a_E = C \,|\, \theta_I) &= \mathbb{P}(\varepsilon \leq y^* - e - \theta_I) = F(y^* - e - \theta_I), \\
\mathbb{P}(a_S = I \,|\, \theta_I) &= \mathbb{P}(c \geq c^*) \cdot \mathbb{P}(\varepsilon \geq y^* - e - \theta_I) + \int_0^{c^*} \mathbb{P}(\varepsilon \geq \bar{y}(c) - e - \theta_I) dc, \\
\mathbb{P}(a_S = C \,|\, \theta_I) &= \mathbb{P}(c \geq c^*) \cdot \mathbb{P}(\varepsilon \leq y^* - e - \theta_I) + \int_0^{c^*} \mathbb{P}(\varepsilon \leq \underline{y}(c) - e - \theta_I) dc.
\end{aligned}
$$

Taking derivative of these probability terms with respect to e gives us:

$$
\begin{aligned}
\frac{\partial \mathbb{P}(a_E = I \,|\, \theta_I)}{\partial e} &= f(\theta_I + e - y^*), \\
\frac{\partial \mathbb{P}(a_E = C \,|\, \theta_I)}{\partial e} &= -f(y^* - e - \theta_I), \\
\frac{\partial \mathbb{P}(a_S = I \,|\, \theta_I)}{\partial e} &= (1 - c^*) f(\theta_I + e - y^*) + \int_0^{c^*} f[e + \theta_I - \bar{y}(c)] dc, \\
\frac{\partial \mathbb{P}(a_S = C \,|\, \theta_I)}{\partial e} &= -(1 - c^*) f(y^* - e - \theta_I) - \int_0^{c^*} f[\underline{y}(c) - e - \theta_I] dc.
\end{aligned}
$$

Then we can write compute the derivative of $v(e \,|\, \theta_I)$ as follows:

$$
\begin{aligned}
v'(e \,|\, \theta_I) = {} & f(\theta_I + e - y^*)(1 - \frac{1}{2}c^*) \\
& + \frac{1}{2} F(\theta_I + e - y^*) \int_0^{c^*} f[\underline{y}(c) - e - \theta_I] dc \\
& + \frac{1}{2} F(y^* - e - \theta_I) \int_0^{c^*} f[e + \theta_I - \bar{y}(c)] dc \\
& + \frac{1}{2} f(\theta_I + e - y^*) \int_0^{c^*} \Big[F(\bar{y}(c) - e - \theta_I) - F(\underline{y}(c) - e - \theta_I) \Big] dc. \qquad (25)
\end{aligned}
$$

In equilibrium, voters should have correct belief about the effort of the incumbent and hence, $y^* = e^*$. Then we can rewrite equation (25) as:

$$
\begin{aligned}
v'(e^* \,|\, \theta_I) = {} & (1 - \frac{1}{2}c^*) f(\theta_I) + \frac{1}{2} F(\theta_I) \int_0^{c^*} f[-\delta(\gamma, c) - \theta_I] dc + \frac{1}{2} F(-\theta_I) \int_0^{c^*} f[\theta_I - \delta(\gamma, c)] dc \\
& + \frac{1}{2} f(\theta_I) \int_0^{c^*} \Big[F(\delta(\gamma, c) - \theta_I) - F(-\delta(\gamma, c) - \theta_I) \Big] dc. \qquad (26)
\end{aligned}
$$

Substituting equation (26) into (23) gives us:

$$v'(e^*) = (1-\frac{1}{2}c^*)f(1) + \frac{1}{2}F(1)\int_0^{c^*} f[\delta(\gamma,c)+1]dc + \frac{1}{2}F(-1)\int_0^{c^*} f[\delta(\gamma,c)-1]dc$$
$$+\frac{1}{2}f(1)\underbrace{\int_0^{c^*}\Big\{F[1+\delta(\gamma,c)]-F[1-\delta(\gamma,c)]\Big\}dc}_{\text{prob. of a NOTA vote}}, \tag{27}$$

Next, we need to establish that the incumbent's effort e^* characterized by the first-order condition above is indeed payoff-maximizing given voters' equilibrium strategies. We will do so by proving the following result:

Lemma 1. *Under Assumption A1, the payoff function $\pi(e)$ is strictly concave in e.*

Proof. Recall that

$$\pi''(e) = \frac{R}{2}\Big[v''(e\,|\,\theta_I=1)+v''(e\,|\,\theta_I=-1)\Big]-2.$$

Taking derivative of equation (25) gives:

$$\begin{aligned}
v''(e|\theta_I) &= f'(\theta_I+e-y^*)[1-\frac{1}{2}c^*]\\
&+\frac{1}{2}f'(\theta_I+e-y^*)\int_0^{c^*}[F(\bar{y}(c)-e-\theta_I)-F(\underline{y}(c)-e-\theta_I)]dc\\
&-f(\theta_I+e-y^*)\int_0^{c^*}[f(\bar{y}(c)-e-\theta_I)-f(\underline{y}(c)-e-\theta_I)]dc\\
&+\frac{1}{2}\int_0^{c^*}[F(y^*-e-\theta_I)f'(\bar{y}(c)-e-\theta_I)-F(\theta_I+e-y^*)f(\bar{y}(c)-e-\theta_I)]dc.
\end{aligned}$$

Recall that $f'(\cdot)$ is bounded between $-(2\pi\sigma^4 e)^{-1/2}$ and $(2\pi\sigma^4 e)^{-1/2}$ and $f(\cdot)$ is bounded above by $(2\pi\sigma^2)^{-1/2}$. Then we can write the bound on $v''(e|\theta_I)$ as:

$$v''(e|\theta_I) < \frac{1}{\sigma^2}\Big(\frac{3}{2\sqrt{2\pi e}}+\frac{1}{2\pi}\Big).$$

Then the second derivative of the incumbent's payoff function must be bounded above by:

$$\pi''(e) < \frac{R}{\sigma^2}\Big(\frac{3}{2\sqrt{2\pi e}}+\frac{1}{2\pi}\Big)-2 \approx \frac{R}{\sigma^2}\cdot(0.522)-2,$$

which is strictly negative by Assumption 1. Hence, the incumbent's payoff function is strictly concave. □

As the incumbent's payoff function is strictly concave, the public investment e^* and voters' voting strategy characterized above determine an unique pure-strategy equilibrium of the election game. □

Proof of Proposition 3. It is straightforward to verify that $\sigma^* \approx 1.15$. Denote $\delta^* = \delta(u^*) = \text{logit}\,[F(1)]$ and let

$$\Delta(\delta;\sigma) = F(1)f(1+\delta) + F(-1)f(1-\delta) - f(1)[F(1-\delta) + F(-1-\delta)] \tag{28}$$

Then we can write

$$S(\sigma) - A(\sigma) = \int_0^{\delta^*} \Delta(\delta;\sigma)d\delta.$$

Notice that $\Delta(\delta = 0, \sigma) = 0$. So if we can show that $\Delta(\delta, \sigma)$ is strictly increasing in $\delta \in (0, \delta^*)$ for all $\sigma > \sigma^*$, then the proof is complete.

First, we will establish the bounds on δ^*. Recall that the logit function is increasing in its input and $F(1)$ is strictly decreasing in σ. Hence, for $\sigma \geq 2$, we have

$$\delta^* = \text{logit}\,[F(1)] < 1.$$

Taking derivative of equation (28) with respect to δ gives

$$\Delta'(\delta;\sigma) \;=\; F(1)f'(1+\delta) \;-\; \underbrace{F(-1)f'(1-\delta)}_{>0 \text{ as } \delta<1} \;+\; \underbrace{f(1)f(1-\delta)}_{>0} + f(1)f(1+\delta).$$

Hence, for $\Delta(\delta;\sigma)$ to be strictly increasing in δ, it is sufficient to show that

$$F(1)f'(1+\delta) + f(1)f(1+\delta) = f(1+\delta)\left[f(1) - \frac{1+\delta}{\sigma^2}F(1)\right] > 0.$$

As $f(1+\delta) > 0$ and $\delta < 1$, it suffices to prove that for large σ

$$f(1) - \frac{2}{\sigma^2} > \frac{1}{\sqrt{2\pi}\sigma}(1 - \frac{1}{2\sigma^2}) - \frac{2}{\sigma^2} > 0,$$

which is true for $\sigma \geq 6$. Hence, $S(\sigma) - A(\sigma) > 0$ for $\sigma \geq 6$. Lastly, by computation, we can verify that $S(\sigma) - A(\sigma) > 0$ for all $\sigma^* < \sigma \leq 6$, which completes the proof. □

Proof of Proposition 4. The proof of Proposition 4 follows similar steps to those of Proposition 1. Given the incumbent's equilibrium strategy e^*, the conditional probability that voter E will vote for the incumbent given that the incumbent is of High type is given by

$$\mathbb{P}(a_E = I \,|\, \theta_I = 1) = \mathbb{P}(e^* + 1 + \varepsilon_E \geq y^*) = \mathbb{P}(\varepsilon_E \geq -\kappa - 1) = F(\kappa + 1).$$

Similarly, we have the conditional probability that voter E will vote for the incumbent given that the incumbent is of Low type:

$$\mathbb{P}(a_E = I \,|\, \theta_I = -1) = \mathbb{P}(e^* - 1 + \varepsilon_E \geq y^*) = \mathbb{P}(\varepsilon_E \geq -\kappa + 1) = F(\kappa - 1).$$

Then we can write the expected payoffs of the voter S from choosing an action $a_S \in \{I, C, N\}$.

$$\begin{aligned}
\mathbb{P}(\theta = 1 \,|\, y_S, a_S = I) &= F(\kappa+1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{2}F(-\kappa-1)\mathbb{P}(\theta_I = 1 \,|\, y_S) \\
&\quad + \frac{1}{4}F(-\kappa-1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{4}F(-\kappa+1)\mathbb{P}(\theta_I = -1 \,|\, y_S), \\
\mathbb{P}(\theta = 1 \,|\, y_S, a_S = C) &= \frac{1}{2}F(\kappa+1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{4}F(\kappa+1)\mathbb{P}(\theta_I = 1 \,|\, y_S) \\
&\quad + \frac{1}{2}F(-\kappa-1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{4}F(\kappa-1)\mathbb{P}(\theta_I = -1 \,|\, y_S) \\
&\quad + \frac{1}{2}F(-\kappa+1)\mathbb{P}(\theta_I = -1 \,|\, y_S), \\
\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) &= F(\kappa+1)\mathbb{P}(\theta_I = 1 \,|\, y_S) + \frac{1}{2}F(-\kappa-1)\mathbb{P}(\theta_I = 1 \,|\, y_S) \\
&\quad + \frac{1}{2}F(-\kappa+1)\mathbb{P}(\theta_I = -1 \,|\, y_S).
\end{aligned}$$

Voter S chooses NOTA over voting for the challenger if and only if the difference between the expected policy payoffs of NOTA and voting for the challenger exceeds the psychological cost of NOTA. Formally, we have

$$\begin{aligned}
&\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) - \mathbb{P}(\theta = 1 \,|\, y_S, a_S = C) \geq \gamma c \\
\iff &\frac{1}{4}[F(\kappa+1)\mathbb{P}(\theta_I = 1 \,|\, y_S) - F(\kappa-1)\mathbb{P}(\theta_I = -1 \,|\, y_S)] \geq \gamma c.
\end{aligned}$$

By solving the above equation, we derive the threshold $\underline{y}$ (as a function of c) at which voter S is indifferent between the NOTA option and voting for the challenger:

$$\underline{y} = y^* - \frac{\sigma^2}{2}\,\mathrm{logit}\left[\frac{F(\kappa+1) - 4\gamma c}{F(\kappa+1) + F(\kappa-1)}\right].$$

Similarly, voter S chooses NOTA over voting for the incumbent if and only if the difference between the expected policy payoffs of NOTA and voting for the incumbent exceeds the psychological cost of NOTA. Formally, we have

$$\begin{aligned}
&\mathbb{P}(\theta = 1 \,|\, y_S, a_S = N) - \mathbb{P}(\theta = 1 \,|\, y_S, a_S = I) \geq \gamma c \\
\iff &\frac{1}{4}[F(-\kappa+1)\mathbb{P}(\theta_I = -1 \,|\, y_S) - F(-\kappa-1)\mathbb{P}(\theta_I = 1 \,|\, y_S)] \geq \gamma c.
\end{aligned}$$

By solving the above equation, we derive the threshold $\bar{y}$ (as a function of c) at which voter S is indifferent between the NOTA option and voting for the incumbent:

$$\bar{y} = y^* + \frac{\sigma^2}{2} \operatorname{logit}\left[\frac{F(-\kappa+1) - 4\gamma c}{F(-\kappa+1) + F(-\kappa-1)}\right].$$

Finally, we have $\underline{y}(c) < y^* < \bar{y}(c)$ for all $c < c^*$ where

$$c^* = \frac{F(-\kappa+1) - F(-\kappa-1)}{8\gamma} = \frac{F(\kappa+1) - F(\kappa-1)}{8\gamma},$$

and for $c \geq c^*$, we have $y^* = \bar{y} = \underline{y}$. □

Appendix B Tables

Table B1: Timing of NOTA Implementation, Balanced Sample

Year	States
2013	Chhattisgarh, Madhya Pradesh, Rajasthan
2014	Andhra Pradesh, Jharkhand, Maharashtra, Odisha
2015	Bihar
2016	Kerala, Tamil Nadu, West Bengal
2017	Gujarat, Himachal Pradesh, Punjab Uttar Pradesh Uttarakhand
2018	Karnataka

Table B2: Percentage of Constituencies where NOTA exceeded Vote Margin

State Name	Year	Constituencies (%)	NOTA (%)	Vote Margin (%)
Andhra Pradesh	2014	1.75	0.55	8.39
Andhra Pradesh	2019	2.92	1.31	12.55
Bihar	2015	9.09	2.50	11.13
Bihar	2020	12.12	1.68	9.60
Chhattisgarh	2013	13.41	3.06	9.39
Chhattisgarh	2018	7.32	1.96	13.41
Gujarat	2017	18.18	1.85	13.28
Himachal Pradesh	2017	5.97	0.89	10.00
Jharkhand	2014	14.29	1.73	11.22
Jharkhand	2019	4.29	1.42	10.63
Karnataka	2018	3.17	0.88	11.33
Kerala	2016	2.44	0.52	11.14
Kerala	2021	1.63	0.47	11.03
Madhya Pradesh	2013	10.70	1.82	11.46
Madhya Pradesh	2018	9.63	1.39	9.92
Maharashtra	2014	7.22	0.96	12.72
Maharashtra	2019	3.25	1.44	15.37
Odisha	2014	6.62	1.27	13.81
Odisha	2019	6.62	1.03	10.90
Punjab	2017	2.61	0.71	12.21
Rajasthan	2013	5.38	1.92	13.42
Rajasthan	2018	8.06	1.32	9.53
Tamil Nadu	2016	11.76	1.28	8.13
Tamil Nadu	2021	5.35	0.73	11.15
Uttar Pradesh	2017	2.78	0.89	13.71
Uttarakhand	2017	6.06	1.15	12.55
West Bengal	2016	8.03	1.54	11.59
West Bengal	2021	4.74	1.09	13.58

Table B3: RD Estimates: Effect of NOTA on log NTL

	log NTL						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RD Estimates	0.143***	0.063***	0.121***	0.114***	0.005	0.062***	0.236***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.009)	(0.007)	(0.016)
NTL (pre-mean) × Year				✓	✓	✓	✓
Political controls				✓	✓	✓	✓
Bandwidth Size	All years	3 years	5 years	All years	3 years	5 years	Donut
Observations	29,070	18,785	25,945	29,070	18,785	25,945	20,349
Adjusted R^2	0.956	0.964	0.957	0.966	0.971	0.966	0.960
Assembly fixed effects	✓	✓	✓	✓	✓	✓	✓

Note: Table presents regression discontinuity estimates where the dependent variable log NTL is regressed on NOTA and a linear function f(Relative time). Cols(1)-(3) controls for assembly fixed effects, whereas cols.(4)-(7) political controls and the average pre-NOTA log NTL interacted with time. Col.(1) considers the full sample, cols.(2) and (5) focus on a bandwidth of 3 years, while col.(3) and (6) focus on a bandwidth of 5 years. Col.(7) considers a *donut* sample which excludes one year before and one year after the NOTA implementation date. All regressions include assembly fixed effects. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B4: Effect of NOTA on log NTL by Electoral Competitiveness

	log NTL					
	(1)	(2)	(3)	(4)	(5)	(6)
𝟙[NOTA]	0.064***	0.133***	-0.024			
	(0.014)	(0.021)	(0.040)			
NOTA percent				0.050***	0.096***	-0.020
				(0.011)	(0.015)	(0.033)
log NTL (pre-mean) × Year	✓	✓	✓	✓	✓	✓
Political controls	✓	✓	✓	✓	✓	✓
Electoral Comp.	$< 10\%$	$10\% - 25\%$	$\geq 25\%$	$< 10\%$	$10\% - 25\%$	$\geq 25\%$
Estimator	OLS	OLS	OLS	IV	IV	IV
Observations	15,573	10,971	2,526	15,573	10,971	2,526
Adjusted R^2	0.969	0.979	0.992	0.969	0.979	0.992
Assembly fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓

Note: Dependent variable is log NTL for all columns. Cols(1-3) show OLS results from regressing log NTL on NOTA and a full set of controls. Col.(1) considers constituencies with a vote margin $< 10\%$, col.(3) relates to constituencies with a vote margin between 10%-25% while col.(4) considers constituencies where the vote margin is $\geq 25\%$. Cols.(4-6) show IV2SLS results where the percentage of NOTA votes are instrumented by the SC judgment but are otherwise similar to cols.(1-3). All regressions use the entire set of controls. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B5: Effect of NOTA on Leads of log NTL

	log $NTL_{T=T+3}$			log $NTL_{T=T+5}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$[NOTA]	0.015***			0.063***		
	(0.005)			(0.004)		
NOTA percent		0.013***	0.011***		0.011***	0.045***
		(0.004)	(0.004)		(0.002)	(0.003)
log NTL (pre-mean) × Year	✓	✓	✓	✓	✓	✓
Political controls	✓	✓	✓	✓	✓	✓
Estimator	OLS	OLS	IV	OLS	OLS	IV
Observations	20,349	20,349	20,349	14,535	14,535	14,535
Adjusted R^2	0.984	0.985	0.985	0.991	0.991	0.991
Assembly fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓

Note: Table shows the effect of NOTA on leads of log NTL. Cols.(1)-(3) consider a 3 year lead of log NTL while cols.(4)-(6) consider a 5 year lead. All regressions include the full set of controls and focus on the balanced sample. Cols(1) and (4) regress three and five year lead of log NTL, respectively, on a NOTA dummy and full set of controls and estimate them using least squares. Cols.(2) and (5) use the percentage of NOTA votes, while cols.(3) and (6) estimate an IV regression where the percent of NOTA votes is instrumented by 'SC order'. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B6: Effect of NOTA on log NTL controlling for PBC.

	log NTL				
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}$[NOTA]	0.085***	0.107***	0.109***		
	(0.008)	(0.008)	(0.008)		
NOTA percent				0.076***	0.080***
				(0.007)	(0.006)
Political Budget Cycle	0.077***	0.079***	0.079***	0.079***	0.079***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
log NTL (pre-mean) × Year		✓	✓	✓	✓
Political controls		✓	✓	✓	✓
Sub-sample	Full	Full	Balanced	Balanced	Balanced
Estimator	OLS	OLS	OLS	OLS	IV
Observations	30,614	29,439	29,070	29,070	29,070
Adjusted R^2	0.961	0.969	0.968	0.969	0.969
Assembly fixed effects	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓

Note: Table shows regression results on the effect of NOTA on log NTL after controlling for political budget cycles (PBC). Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B7: Effect of NOTA on NTL-IHS

	NTL-IHS				
	(1)	(2)	(3)	(4)	(5)
$\mathbb{1}$[NOTA]	0.047***	0.045***	0.046***		
	(0.003)	(0.003)	(0.003)		
NOTA percent				0.017***	0.034***
				(0.002)	(0.003)
NTL-IHS (pre-mean) × Year		✓	✓	✓	✓
Political controls		✓	✓	✓	✓
Sub-sample	Full	Full	Balanced	Balanced	Balanced
Estimator	OLS	OLS	OLS	OLS	IV
Observations	30,614	29,439	29,070	29,070	29,070
Adjusted R^2	0.987	0.986	0.986	0.986	0.986
Assembly fixed effects	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓

Note: Dependent variable is the inverse hyperbolic sine of nighttime lights for all columns. NOTA denotes $\mathbb{1}$[NOTA] treatment dummy × Post whereas, NOTA percent is NOTA votes as a percentage of total valid votes. Col.(1) is a least squares regression of NTL-IHS on NOTA after controlling for assembly fixed effects and time fixed effects on the full sample. Col.(2) adds controls for the pre-treatment average of constituency-level IHS NTL interacted with time along with political controls. Col.(3) has the same specification as col.(2) but is estimated on a balanced panel. In col.(4), the main covariate is the percentage of NOTA votes polled. Col.(5) presents IV estimates where NOTA is instrumented by a dummy variable that takes a value of 1 after October 2013 when the Supreme court mandated adding NOTA as an option on the ballot in all assembly elections, and is zero prior to that. All regressions include assembly fixed effects and year fixed effects. Standard errors clustered at the constituency level in parentheses. *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B8: Effect of NOTA on log NTL, Election Year Sub-Sample

	log NTL		
	(1)	(2)	(3)
$\mathbb{1}$[NOTA]	0.071***		
	(0.021)		
NOTA percent		0.016**	0.044***
		(0.008)	(0.013)
log NTL (pre-mean) × Year	✓	✓	✓
Political controls	✓	✓	✓
Estimator	OLS	OLS	IV
Observations	5,814	5,814	5,814
Adjusted R^2	0.967	0.967	0.967
Assembly fixed effects	✓	✓	✓
Year fixed effects	✓	✓	✓

Note: *p-values: ***: 0.01, **: 0.05, *: 0.1*

Table B9: Effect of NOTA on log NTL, Early/Late

	log NTL		
	(1)	(2)	(3)
𝟙[NOTA]	0.052***	0.066***	0.454***
	(0.009)	(0.007)	(0.022)
𝟙[NOTA] × Early	0.204***		
	(0.023)		
NTL (pre-mean) × Year	✓	✓	✓
Political controls	✓	✓	✓
Sub-sample	Full	Late	Early
Observations	29,070	15,670	13,400
Adjusted R^2	0.968	0.977	0.959
Assembly fixed effects	✓	✓	✓
Year fixed effects	✓	✓	✓

Note: Dependent variable is log NTL for all columns. *Early* takes a value of one if the constituency implemented NOTA during 2013-15 while it takes a value of zero if it implemented NOTA between 2016-18. Col(1) considers the full sample and interacts Early with NOTA, whereas cols.(2) and (3) consider the sub-sample of Late and Early implementers, respectively. All regressions include assembly constituency and year fixed effects and the full set of controls. *p-values:* ***: 0.01, **: 0.05, *: 0.1

Table B10: Accounting for Staggered Treatment Timing

	log NTL		
	(1)	(2)	(3)
Estimate	0.073	0.049	0.072
SE	0.0091	0.0063	0.006
CI	(0.055, 0.091)	(0.006, 0.007)	(0.059, 0.084)
Estimator	SAZ	RSA	CD
Observations	29,070	29,070	99,280

Note: Table shows the effect of NOTA on log NTL using estimators robust to staggered treatment adoption. Column (1) presents estimates from the doubly robust ATT estimator by Sant'Anna and Zhao (2020) (SAZ), column (2) from the efficient estimator by Roth and Sant'Anna (2023) (RSA), while column (2) shows results from the stacked estimator with clean controls by Cengiz et al. (2019) (CD). SE = standard errors; CI = 95% confidence interval.

Table B11: Effect of NOTA on log NTL, DDML

	log NTL	
	(1)	(2)
NOTA percent	0.297	0.30
	(0.015)	(0.018)

Note: Table shows the effect of NOTA percent on log NTL in both columns. The results are from an instrumental variable model where log NTL is regressed on NOTA percent and includes the full set of controls along with assembly and year fixed effects. Estimates are based on DDML approach (Chernozhukov et al., 2018) which introduces flexible covariates using a Random Forest learner. Col.(1) assumes independence whereas, col.(2) clusters standard errors at the constituency level. *p-values:* ***: 0.01, **: 0.05, *: 0.1

Appendix C Figures

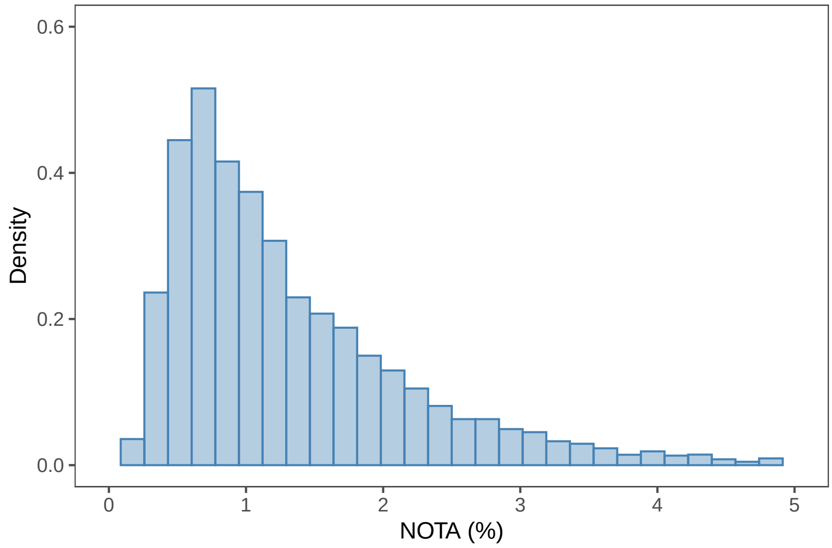

Figure C1: Distribution of NOTA votes as a percentage of valid votes.

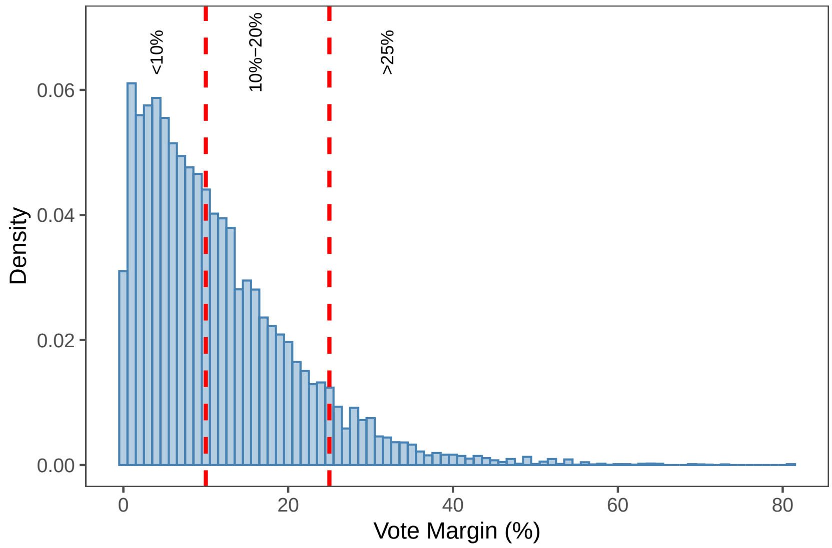

Figure C2: Distribution of vote margin. The vertical lines denote thresholds for classifying political competition into discrete bins.

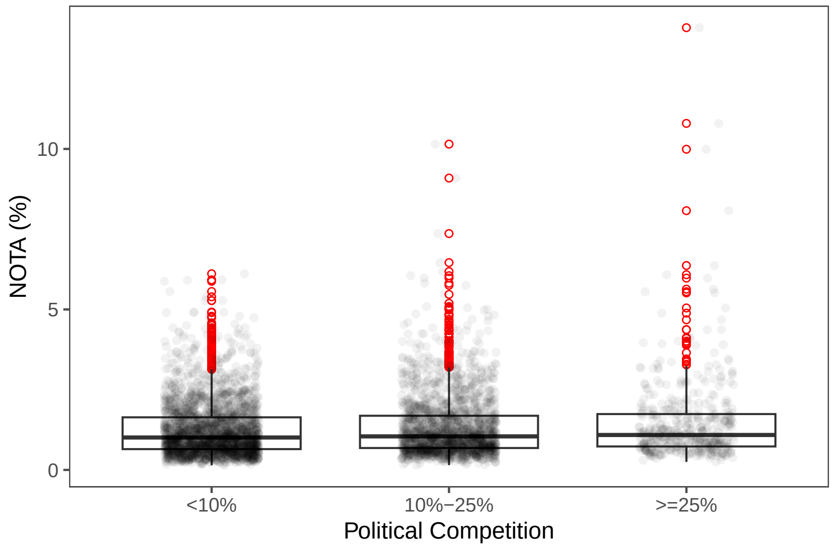

Figure C3: Distribution of NOTA votes (in percent) by Political Competition Bins.

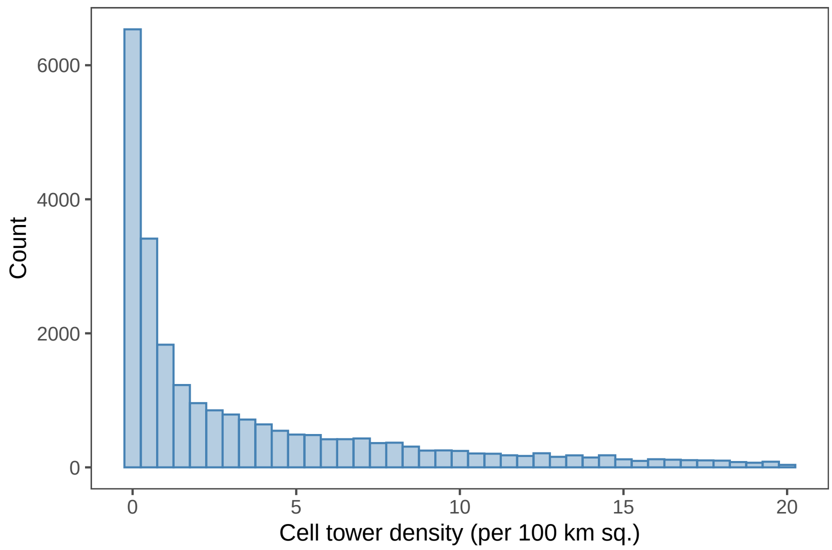

Figure C4: Distribution of cell tower density measured as the density of cell towers per 10 sq. km across state assemblies in the sample. Cell tower density is top-coded at 20 in this figure.

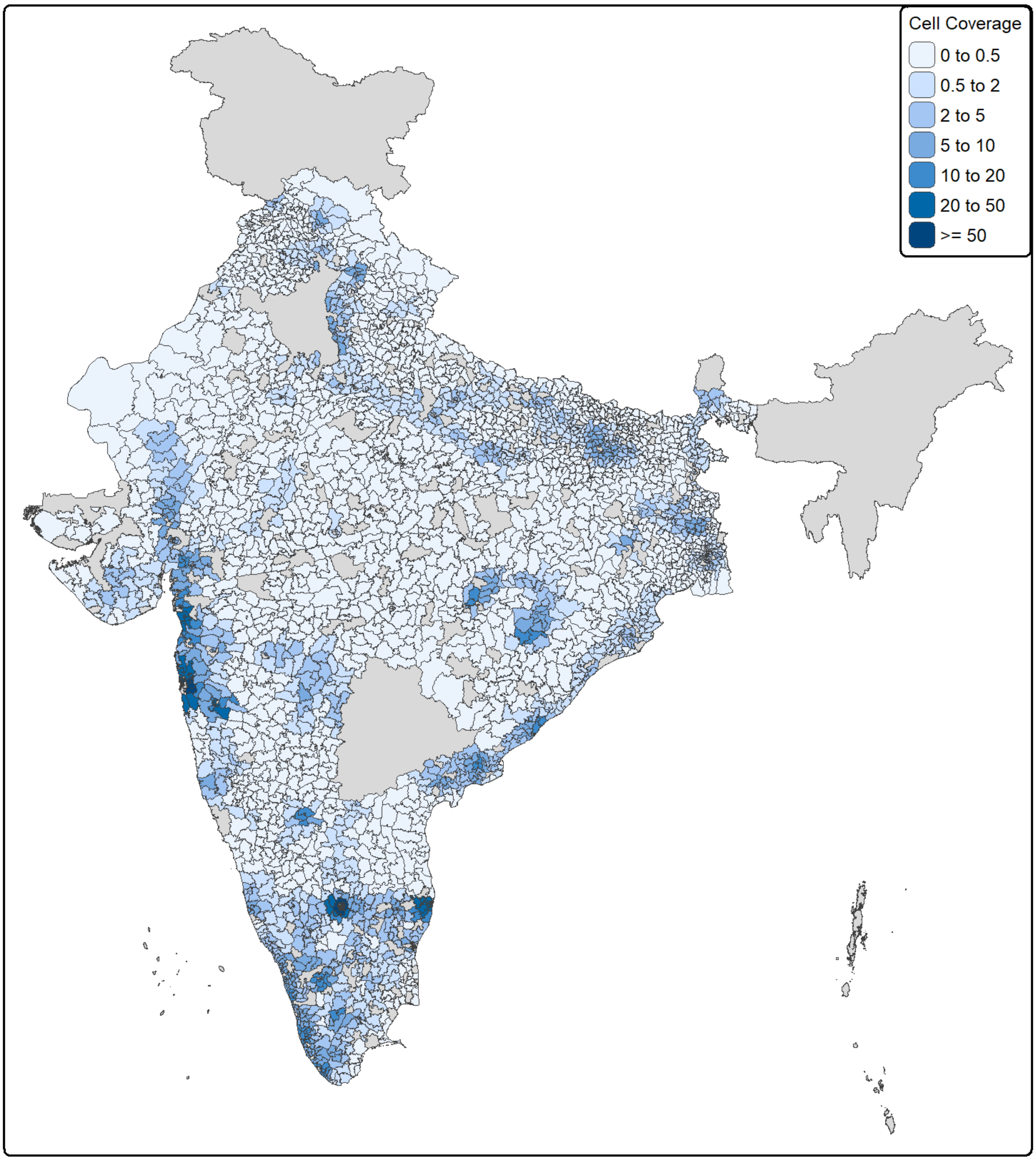

Figure C5: Map of cell tower density per 100 sq. km. in 2021 for the balanced sample.

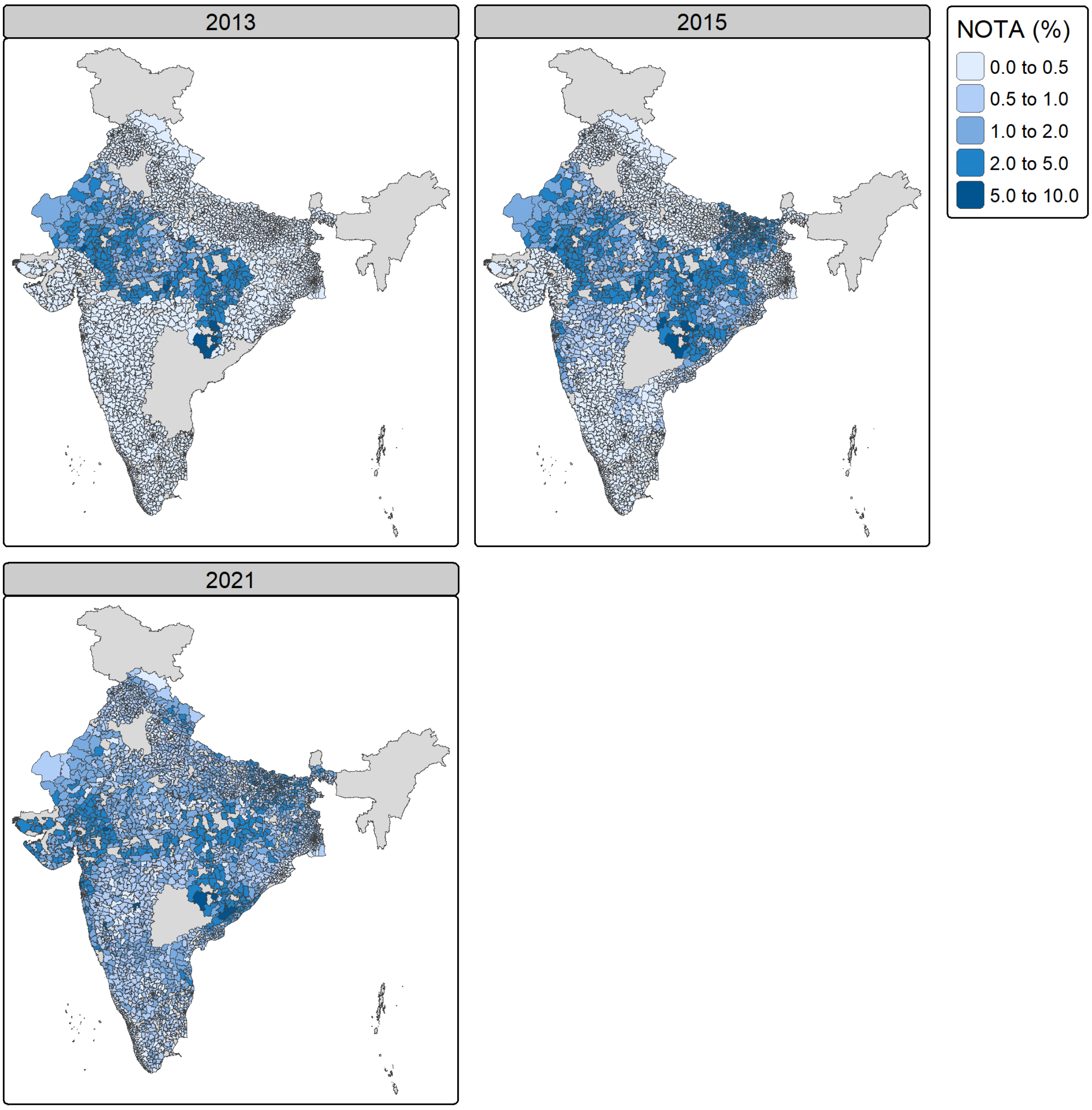

Figure C6: Map of NOTA votes as a percentage of valid votes in 2013, 2015 and 2021.

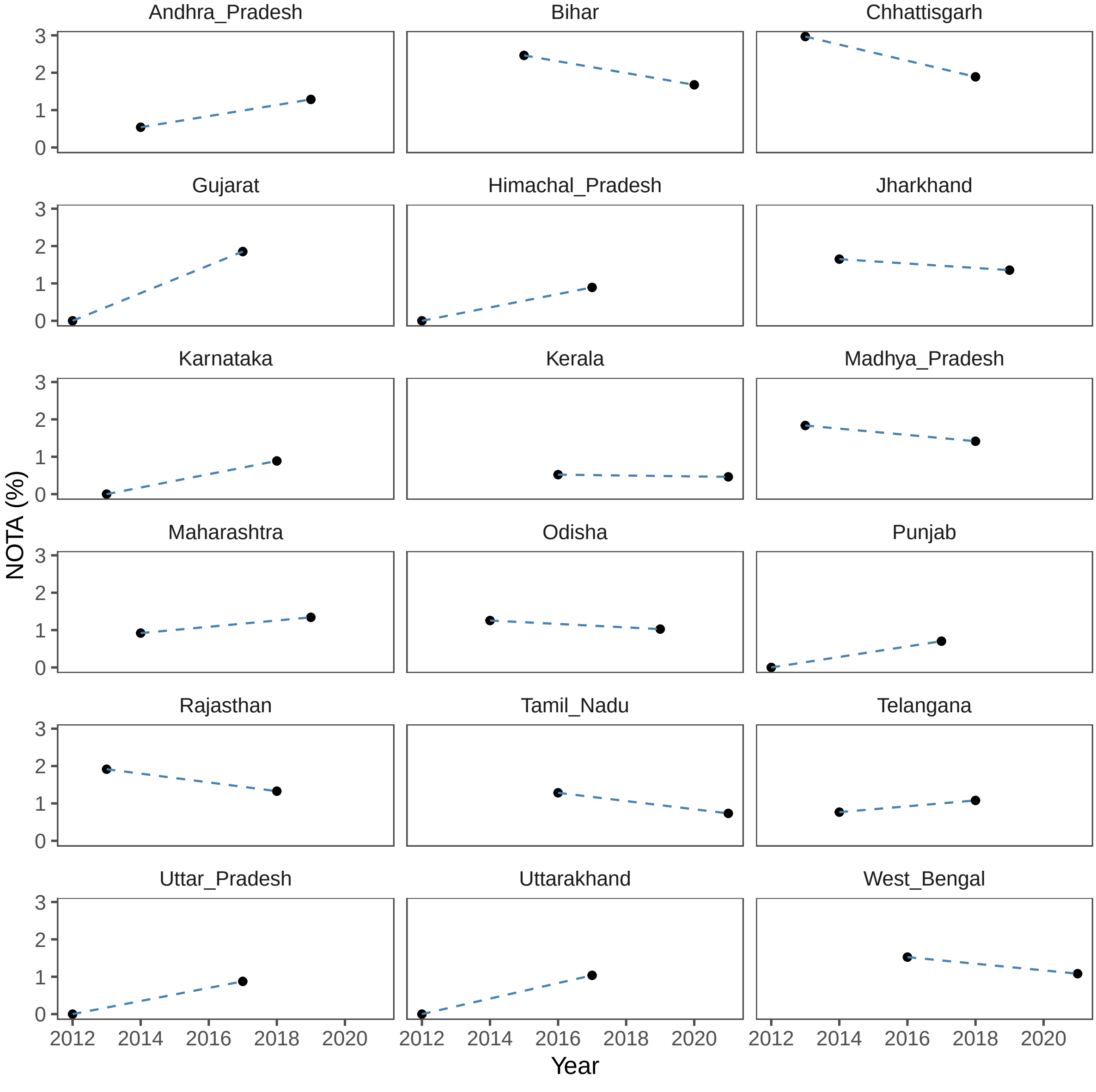

Figure C7: NOTA vote share by State and Election Round.

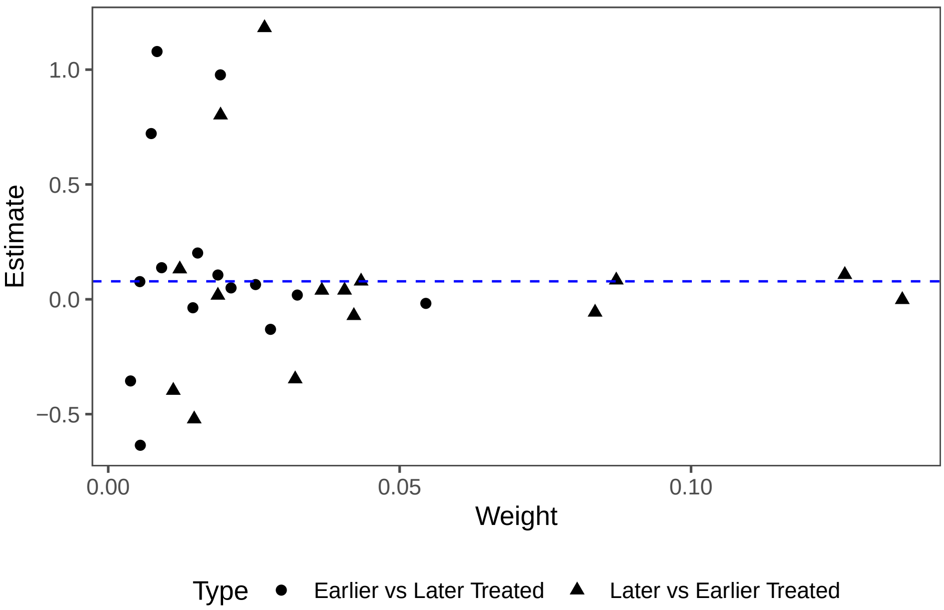

Figure C8: Goodman-Bacon Decomposition. Each point represents an estimate-weight pair from all possible 2×2 designs. The horizontal dotted line is the OLS estimate.

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