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Ties

Abstract

This paper investigates whether the rare occurrence of a local election ending in a tie or being decided by a single vote generates informational spill-overs on nearby localities' subsequent elections. First, based on the pivotal-voter theory, we develop a model of costly instrumental voting in sequential elections with private information, where voters update their beliefs regarding the distribution of political preferences and the probability of their vote being decisive upon observing the outcomes in earlier elections, and decide whether to turn out to vote accordingly. Next, by exploiting over a hundred exact ties or one-vote-difference results in Italian mayoral elections during the past two decades and the quasi-experimental conditions created by the staggered municipal electoral calendar, we test the model's empirical predictions and find a substantial impact on voter turnout rates of exposure for geographical reasons to spill-overs from the localities experiencing those bizarre electoral outcomes.

JEL-Codes: D720, H710.

Keywords: tied elections, voter turnout, information spill-over, salience.

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1 Introduction

Whether the chances of casting the decisive vote in an election play a role in the individual decision to turn out to vote has been a matter of academic research for decades (Riker and Ordeshook, 1968), with recent contributions increasingly casting doubts on the actual importance of pivotality in electoral participation decisions and challenging the hypothesis of the dependence of turnout rates on beliefs about closeness of elections (Coate et al., 2008; Funk, 2010; Enos and Fowler, 2014). In addition, ascertaining the role of pivotality in turnout decisions tends to be hampered by the fact that actual or predicted closeness of an electoral outcome might induce higher participation either by directly influencing voters' perceptions of their chances of casting the decisive vote, or through more intense party campaigning, media coverage, and social pressure (Schachar and Nalebuff, 1999). While profoundly different, the two mechanisms are admittedly difficult to separately identify using observational data on real-world elections (Cancela and Geys, 2016; Gerber et al., 2017). On the other hand, Bursztyn et al. (2018) exploit variation in the existence and dissemination of pre-election polls for high-stakes referenda in Switzerland, and find a significant relationship between ex post referendum closeness and turnout only during the later period of analysis, when pre-election polls were released. Moreover, within the period when polls are released, ex ante closeness and turnout are strongly correlated, and greater cantonal newspaper coverage of close polls is estimated to significantly raise voter turnout. Finally, increasing experimental evidence suggests that a higher subjective probability of being pivotal raises the likelihood that an individual votes, and that voters learn over time to adjust their beliefs to be more consistent with the historical frequency of pivotality (Gerber and Green, 2000; Levine and Palfrey, 2007; Duffy and Tavits, 2008; Großer, Schram, 2010; Agranov et al., 2018).

Indeed, the chances of casting the vote that breaks a tie in large-scale (parliamentary or presidential) elections are extremely small in general (Mulligan and Hunter, 2003; Gelman et al., 2012). However, exact ties or one-vote-difference electoral outcomes have periodically appeared in elections involving somewhat smaller electorates, including races for US state governors and seats in state and national legislatures during the past two centuries. For instance, the 1847 US House of Representatives election saw George G. Dunn gain a seat by defeating David M. Dobson by one vote (7,455-7,454), and similar results occurred in sub-

sequent races with candidates James C. Allen in 1854 (8,452-8,451), Alexander H. Jones in 1868 (10,329-10,328), and Robert M. Mayo in 1882 (10,505-10,504) all gaining their seats in the US House of Representatives by a single vote in pretty large electorates.[1] More recently, Neil C. Fraley defeated challenger Bernard I. Gonder by one vote in the 1950 Maryland Senate elections (3,080–3,079), George Wiggins won the 1982 State Senator election in New Hampshire, District 8, by one vote (5,352-5,351), and Anne Ruwet gained a seat in the Connecticut House of Representatives in 2002 by one vote (3,236–3,235). Tied elections have occurred too. In the 1994 race for the Wyoming House of Representatives, Republican Randall Luthi and independent Larry Call each received 1,941 votes, and the tie was decided by the draw of a ball with Luthi's name out of Wyoming Governor's cowboy hat, while the elections for Virginia House of Delegates saw the occurrences of ties both in 1971, District 19, and in 2017, District 94, where the two candidates got 11,608 votes each. In the former case, the tie was broken by putting the names of the two candidates in sealed envelopes, with the blindfolded Elections Board chairman picking one from a silver loving cup. In the latter case, the names of the candidates were each placed inside a film canister, and one canister was drawn at random from a ceramic bowl by State Board of Elections chairman on January 4, 2018. If the tie had happened in New Mexico, state law would have called for the election to be decided by a game of chance, such as a single hand of poker. In the 2011 election for the Swiss Federal parliament, after two candidates tied at exactly 23,979 votes out of the almost 800,000 votes cast in the Canton Ticino electoral district, the Federal Supreme Court intervened to settle the issue, and ruled against the electoral committee's decision of a computer lottery, ordering a manual lottery instead. In the UK, candidates have to draw straws to find a winner in the event of a tie, as after the May 2017 Northumberland County Council tied election, but more imaginative ways of settling an electoral tie have appeared:

> *"Crawfordsville, Ind., May 8. — On Monday last occurred the city election at Waynetown, Montgomery County. William Simms and Frank Hollowell tied for the office of treasurer, each gentleman receiving 323 votes. To decide the question as to which one should hold the office, a foot race was held Wednesday between the men.*

[1] Congressional Quarterly's Guide to U S Elections, 6th Edition, 2009, Congressional Quarterly Press, Washington.

The race was a 200 yard dash, and several thousand people were on the ground betting for the outcome. Simms seemed a sure winner until he tripped and fell when within three yards from the goal. Hollowell fell over him, but crawling over the line won the race amid the howls and cheers of the crowd. Hollowell was duly sworn in."

(The Pensacola News, 10 May 1891, Sun, p. 5)

As far as Italy - the country that will be the object of our empirical analysis - is concerned, the combination of a highly fragmented local government system and of a first-past-the-post majoritarian electoral system creates frequent conditions for very close mayoral races. The Italian system of local government comprises over 8,000 municipal authorities, about half of which have less than 3,000 residents and a third have less than 1,000, and it exhibits a number of attractive features, including an important role of municipalities in providing public services having an impact on people's lives (e.g., housing benefits and income support to the poor, kindergartens, public transportation, and environmental regulation), strong attachment of people to deeply-rooted municipal institutions, and voter turnout rates averaging over 75%.

Italian municipal elections register the periodic occurrence of ties or one-vote-difference electoral outcomes. In fact, there were over a hundred of them in the elections that took place between 2001 and 2017 (42 ties and 67 one-vote-difference outcomes). It is the informational consequences of these rare events that we aim at studying here, focusing in particular on their impact on voter turnout rates in the elections that were held subsequently in the municipalities that were exposed for geographical reasons to spill-overs from the authorities experiencing those bizarre electoral outcomes. We will focus on whether the information of a tied or one-vote-difference election affects the turnout decisions of voters in subsequent elections taking place in the neighborhood by affecting their perceptions of pivotality of their vote.

In related fields of inquiry that explore the impact of rare events on people's choices in uncertain environments, such as air crashes (Bosch et al., 1998), drug poisoning (Jarrell and Peltzman, 1985), or faulty automobile recalling (Hoffer et al., 1988), the evidence points to market-wise negative spill-over effects. For instance, people are observed to shift to other means of transportation and fly less altogether after an airplane crash, irrespective of the involved airline, and to penalize both producers and competitors of recalled drugs and autos. In order

to clarify the mechanism that in our context could link the rare electoral outcome in a locality with voting behavior in surrounding localities and to derive neat empirical predictions on the spill-over effects of ties and one-vote-difference outcomes, we first develop a theoretical model based on the pivotal-voter theory with voters' private information regarding their political preferences. The elections take place sequentially in two localities. The fact that elections are staggered makes it possible that the outcome of the early election affects the voting behavior in the later election. In particular, upon observing the result of the early election, a share of voters in the other locality (the informed voters) will update their beliefs regarding the distribution of the political preferences in the economy. The model predicts that the information spill-over will be stronger the larger is the difference between the realized candidate vote shares and the anticipated ones and the higher is the turnout rate in the early election. Moreover, the impact of the information spill-over on turnout should be expected to be larger in the localities starting from a more uneven distribution of political preferences.

In spite of constituting the real world example of the unlikely event of a single vote being decisive, the consequences of the realization of a tied election have not been studied systematically before either by political scientists or economists, with the exception of Enos and Fowler (2014). They test the hypothesis of the role of pivotality in turnout decisions by conducting a field experiment in the aftermath of the November 2010 tied election in District 6 for the Massachusetts State House. Since the Democratic and the Republican candidate each received 6,587 votes, a special election for assigning the seat was scheduled for the following May 2011, making it possible to experimentally manipulate voters' knowledge of closeness of the coming election by placing phone calls to registered voters to remind them about the special election. In particular, only a random subset of them was reminded about the exact tie in the previous election and the unusually high chance that their vote in the special election could be pivotal. However, the results of their field experiment provide no significant evidence that considerations of pivotality spur higher turnout.

In this paper, we take advantage of the features of Italian municipal elections, and in particular of the fact that ties and one-vote-difference results occur randomly across space and that Italian municipalities vote according to a staggered schedule, allowing us to test a number of distinct empirical predictions. The main results of our analysis can be summarized as follows. First, the turnout

rate in the municipalities that are first-order (border-sharing) neighbors of localities experiencing a close outcome and that vote in the subsequent year is estimated to be higher by between two and three percentage points than in authorities that are not exposed. The spill-over on first-order neighbors remains positive and significant (about one percentage point of additional turnout) two years after the tied election, but it tends to vanish over time in the sense that no effect is found if the elections are held more than two years apart. As for geographic distance, second-order neighbors (neighbors' neighbors) experience a significant increase in the rate of turnout of almost one percentage point only if they hold an election the year immediately after a close election, but the effect becomes nil in the subsequent years. Second, we find some evidence that, as predicted by our model, the impact of the information spill-over on turnout is larger on the authorities having a more uneven distribution of preferences among the two main parties, while the rate of turnout and the prior party lead in the localities experiencing the close outcomes are not estimated to exert any additional influence on turnout rates in the surrounding localities.

Finally, we consider a number of potential alternative channels that might be responsible for the transmission of the effect of a tie in a locality on the rate of turnout in nearby localities and that have to do with the endogeneity of local political competition, the response of incumbents to increased uncertainty by means of local tax policy setting, and the role of political parties' campaigning. First, with reference to the issue of endogenous mayoral candidacy, we find that the number of mayoral candidates is not affected by whether a close outcome occurred in the neighborhood in the preceding years. Second, we find some evidence that incumbents that are exposed to close outcomes in the neighborhood in the years before they are up for re-election tend to set lower local income tax rates, compatibly with the hypothesis that income tax manoeuvring is used as a vote-buying policy when the electoral race is perceived as increasingly uncertain. However, there remains a large independent impact of exposure to a tie on turnout (over two percentage points) when controlling for the level of the local income tax rate in the turnout determination equation. On the other hand, since data on campaigning are not available at the local level, we are unable to test the hypothesis that a tie or a one-vote-difference outcome stimulates turnout through more intense get-out-the-vote party efforts. It should be taken into account, though, that in most instances the electorate is very small and the race is between independent, non-partisan candidates, virtually ruling out the

campaigning role of political parties.

The rest of the paper is structured as follows. Section **2** presents a theoretical model of voting based on Taylor and Yildirim (2010) that allows for an informational spill-over from electoral outcomes in the neighborhood, and derives a number of empirical predictions. Section **3** illustrates the panel dataset of Italian municipalities, while section **4** introduces the econometric model and discusses the estimation results. Section **5** conducts a number of tests of potential alternative channels of interaction among localities, and section **6** concludes.

2 A theoretical model of elections and information spill-overs

In this section, we construct a theoretical model that is based on the pivotal-voter theory, developed by Ledyard (1984) and Palfrey and Rosenthal (1983, 1985), which assumes that voters rationally anticipate the probability of their votes being pivotal and that they will cast their votes if the expected benefit of voting outweighs the cost of voting. Although it is widely believed that the pivotal-voter models tend to underestimate the turnout rates in large elections, they can still offer reasonable predictions to the outcomes in small-scale elections. Along this line of consideration, Börgers (2004) proposes a model of a small electorate with *ex ante* symmetric citizens where each voter has his personal political preference which is his private information, and shows that voluntary majority voting may lead to a too high turnout from the social viewpoint. Taylor and Yildirim (2010) further generalize Börgers (2004) and allow for asymmetric political preferences where there are two groups of supporters of different alternatives. They highlight an "underdog effect" in small-scale elections in that the minority group has a higher turnout rate than the majority group does.

To formalize the idea of the information spill-overs between different elections, we extend the model of Taylor and Yildirim (2010) into one with two elections that take place sequentially. There are two localities in an economy, 1 and 2, where locality $j = 1, 2$ contains n_j voters. An election is held in locality j at time $t = 1, 2$, in each of which there are two candidates running for the election. Candidates may not be the same ones in different elections; however, we assume that they belong to either party L or party R (which can be broadly interpreted as one of the left-wing parties and one of the right-wing parties).

Each voter is either one of two types, $\theta = L, R$, i.e., he either prefers party L or prefers party R. The type θ is private information to each voter; however, before the election at period t takes place, there is a common knowledge that a voter is of type $\theta = L$ with probability $\lambda \in (0, 1)$ and of type $\theta = R$ with probability $1 - \lambda$.

Following Enos and Fowler (2014), we distinguish two situations: one where the voters in the later election are aware of the electoral outcome in the early election, referred to as the "informed voters," and one where the voters are unaware of the outcome, referred to as the "uninformed voters." When observing the outcome in the previous election, the informed voters will update their belief regarding the distribution of the political preferences in this economy. In this case, there is an information spill-over of the early election that will affect the voting behavior in the later election. By contrast, the uninformed voters do not have that information in mind and still use their prior belief.[2]

In each election, voters simultaneously decide whether to vote for their preferred party or to abstain. The winner is the candidate who wins a majority of votes, and when there is a tie, it is determined by a fair coin toss. A voter receives a payoff normalized to 1 if his preferred candidate wins, and 0 if the other one is elected. Moreover, voting incurs a cost $c \in [0, \bar{c}]$, which is also private information to each voter. However, it is common knowledge that c is randomly drawn from a differentiable distribution $F_j(c)$ with $\frac{\mathrm{d}F_j}{\mathrm{d}c} > 0$. For simplicity, we assume that F_1 and F_2 are independent and $F_1 = F_2 = F$.

As is typical in the literature, we focus on the type-symmetric Bayesian Nash equilibrium, where all voters of the same type adopt the same equilibrium strategy. A voter will cast his vote if the expected benefit of voting is greater than the cost of voting. It can be easily shown that a voter of types (θ, c) will use the following strategy in equilibrium: he votes if and only if $c \leq c^*_\theta$, where c^*_θ is some critical level of cost for type θ.

The sequence of events can be summarized as follows. (1) Each voter in locality 1 observes his types of (θ, c). (2) Voters in locality 1 decide whether to vote or not. Then the electoral outcome is realized. (3) After the outcome

[2] This can be considered as an application of "availability heuristic," proposed by Tversky and Kahneman (1973), which is a proclivity that people often take a mental shortcut that relies on the past occurrences that can be remembered immediately and estimate the probability of an event by using them. Since we focus on the spill-overs among localities rather than voters, for simplicity, we assume that voters in the same locality share the same information and belief, where they are either informed or uninformed about the outcome in the previous election.

in locality 1 is revealed, the informed voters in locality 2 update their belief regarding the share of voters who prefer party L from λ to λ', while the uninformed voters still use the prior belief λ. (4) Each voter in locality 2 observes his types (θ, c). (5) Voters in locality 2 decide whether to vote or not. Then the electoral outcome is realized.

We first analyze the electoral equilibrium in locality 1. In order to decide whether to vote or not, a voter needs to compute the probability of his vote being "pivotal," in that his vote either creates a tie or breaks a tie, in both of which cases he makes a difference to the outcome. According to Taylor and Yildirim (2010), the pivotal probability for an L-type voter is

$$\begin{aligned}
&\Pi_{1L}(\tau_{1L}, \tau_{1R}) \\
=& \sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k, n_1-1-2k} (\lambda\tau_{1L})^k \left[(1-\lambda)\tau_{1R}\right]^k \left[1-\lambda\tau_{1L}-(1-\lambda)\tau_{1R}\right]^{n_1-1-2k} \\
+& \sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k+1, n_1-2-2k} (\lambda\tau_{1L})^k \left[(1-\lambda)\tau_{1R}\right]^{k+1} \left[1-\lambda\tau_{1L}-(1-\lambda)\tau_{1R}\right]^{n_1-2-2k},
\end{aligned} \tag{1}$$

where $\lfloor \cdot \rfloor$ is the integer part of a number, and $\tau_{1\theta}$ is the *ex ante* probability that a voter of type θ turns out and casts his vote. The first term after the equality in (1) represents the event where there is a tie, and the second term represents the event where the L-type candidate would lose by one vote without his vote.

Similarly, the pivotal probability for an R-type voter is

$$\begin{aligned}
&\Pi_{1R}(\tau_{1L}, \tau_{1R}) \\
=& \sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k, n_1-1-2k} (\lambda\tau_{1L})^k \left[(1-\lambda)\tau_{1R}\right]^k \left[1-\lambda\tau_{1L}-(1-\lambda)\tau_{1R}\right]^{n_1-1-2k} \\
+& \sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k+1, n_1-2-2k} (\lambda\tau_{1L})^{k+1} \left[(1-\lambda)\tau_{1R}\right]^k \left[1-\lambda\tau_{1L}-(1-\lambda)\tau_{1R}\right]^{n_1-2-2k}.
\end{aligned} \tag{2}$$

For a voter of type θ, the expected benefit of voting is $\frac{1}{2}\Pi_{1\theta}$, because when his vote is pivotal, the difference in the payoff between his preferred candidate and the other one is 1 and a tie is broken by a fair coin toss. Therefore, a voter will cast his vote if

$$\frac{1}{2}\Pi_{1\theta}(\tau_{1L}, \tau_{1R}) \geq c. \tag{3}$$

Since $c \geq 0$, there exists some $\tau_{1L} > 0$ and $\tau_{1R} > 0$ such that $\frac{1}{2}\Pi_{1\theta}(\tau_{1L}, \tau_{1R}) = c^*_\theta > 0$ in equilibrium. Therefore, a voter will cast his vote if and only if $c \leq c^*_\theta$, and so the equilibrium turnout rate will satisfy $\tau^*_{1\theta} = F(c^*_\theta)$. It follows that in the type-symmetric Bayesian Nash equilibrium, the equilibrium $(\tau^*_{1L}, \tau^*_{1R})$ will

satisfy:

$$\tau_{1L}^* = F\left(\frac{1}{2}\Pi_{1L}(\tau_{1L}^*, \tau_{1R}^*)\right) \quad \text{and} \quad \tau_{1R}^* = F\left(\frac{1}{2}\Pi_{1R}(\tau_{1L}^*, \tau_{1R}^*)\right). \tag{4}$$

According to Proposition 1 of Taylor and Yildirim (2010), we have the following result:

Lemma 1 (Taylor and Yildirim, 2010)**.** *In the type-symmetric Bayesian Nash equilibrium,* $\tau_{1L}^* < \tau_{1R}^*$ *and* $\lambda\tau_{1L}^* > (1-\lambda)\tau_{1R}^*$ *if and only if* $\lambda > \frac{1}{2}$.

That is, the supporters of the *ex ante* underdog candidate are more likely to turn out to vote compared to the supporters of the *ex ante* leading candidate. This is because the pivotal probability is larger for a voter in the minority group: if $\lambda > \frac{1}{2}$, so that candidate L has larger support, a vote for candidate R narrows the expected lead of candidate L, while a vote for candidate L widens it. As a result, supporters of candidate R have a higher incentive to vote. However, the higher turnout rate cannot make up for the initial disadvantage, so the expected winning probability for the *ex ante* leading candidate is still higher than that for the underdog candidate.

Now we consider the election held in locality 2. Basically, elections held in different localities are not directly related to each other because they have different candidates and voters. However, as long as voters are informed about the electoral outcome in the early period, it can still have an information spillover that can affect the voting behavior in the later period. After the numbers of votes for both parties in locality 1 are revealed, the informed voters will realize the difference between the data and the prior belief, and then update their belief regarding the population share of each party, which further determines whether they want to cast their vote or not.

Suppose that n_{1L} and n_{1R} are the numbers of voters who vote for the candidates from party L and party R in period 1, respectively. The posterior belief regarding the population share for party L, denoted by λ', is

$$\lambda' = \frac{n_{1L} + \lambda(n_1 - n_{1L} - n_{1R})}{n_1}. \tag{5}$$

The numerator of (5) represents the expected number of supporters of the L party, where the informed voters in locality 2 still use the prior belief λ to be the share of the L-type supporters among those who did not turn out to vote in period 1. (5) can be rewritten as

$$\lambda' = \hat{\tau}_1\hat{\lambda}_1 + (1-\hat{\tau}_1)\lambda, \tag{6}$$

or equivalently,

$$\lambda' - \lambda = \hat{\tau}_1(\hat{\lambda}_1 - \lambda), \tag{7}$$

where $\hat{\tau}_1 \equiv \frac{n_{1L}+n_{1R}}{n_1}$ is the actual turnout rate and $\hat{\lambda}_1 \equiv \frac{n_{1L}}{n_{1L}+n_{1R}}$ is the realized vote share for the L-type candidate in period 1. Note that if a tie occurs in period 1, $\hat{\lambda}_1 = \frac{1}{2}$.

(7) has some interesting implications. The difference between the posterior and prior beliefs, $|\lambda' - \lambda|$, can be regarded as the magnitude of the information spill-over from the previous electoral outcome. For the uninformed voter, this value is zero because there is no information spill-over. For the informed voters, the larger the difference is, the more the belief will be adjusted, which then has a greater impact on their turnout decision in the later election.

Importantly, there are two factors that can determine the level of an information spill-over. First, if the realized turnout rate $\hat{\tau}_1$ is higher, given the same difference $\hat{\lambda}_1 - \lambda$, voters will adjust their belief to a greater deal. Intuitively, when more voters turn out to reveal their preferences, the informed voters in the later election will put a larger weight on that information in the posterior belief according to (6). Second, the difference between the realized vote share and the anticipated one, $\hat{\lambda}_1 - \lambda$, is a "shock" to the belief. If this difference is large, then given the same turnout rate, voters should adjust their belief to reflect the realized data more. In particular, when $\hat{\lambda}_1 > (<)\lambda$, the voters will make a upward (downward) adjustment to the prior belief. For example, suppose that the prior belief is one that the candidate from party L is leading ($\lambda > 1/2$), but a tie happens in the election of locality 1. Then the voters in locality 2 will believe that $\lambda' < \lambda$, which means that the advantage of the L party shrinks. Moreover, if this tie event happens in an election with a high turnout rate, the advantage will be further narrowed compared to one with a low turnout rate.

We summarize the above result in the following lemma:

Lemma 2. *For the informed voters, the magnitude of the information spill-over, $|\lambda' - \lambda|$, will be larger if the actual turnout rate in the previous election is higher or the shock to the belief is stronger.*

We now analyze the effect of the information spill-over of the early electoral outcome on voters' turnout in the later election. Without loss of generality, we assume that $\lambda > 1/2$, i.e., the candidate from party L is the *ex ante* leading party. In the following analysis which relies on the comparative statics, we consider the situation where the belief change is not drastic, in that $|\lambda' - \lambda|$ is

relatively small and it is still believed that the L party remains leading after the first election. In this case, we can obtain a more clearly predictable pattern on voters' turnout rates by focusing on some special cases as described in the following proposition:

Proposition 1. *In the case of informed voters, suppose that $\lambda > 1/2$ and $|\lambda' - \lambda|$ is relatively small. Then in a close election where λ is close to $1/2$, $\tau^*_{2L} > \tau^*_{1L}$ and $\tau^*_{2R} < \tau^*_{1R}$ if $\lambda' < \lambda$. By contrast, in a lopsided election where λ is close to 1, $\tau^*_{2L} > \tau^*_{1L}$ and $\tau^*_{2R} > \tau^*_{1R}$ if $\lambda' < \lambda$.*

Proof. By taking the derivatives of the pivotal probabilities in (1) and (2) with respect to λ, and fixing at the equilibrium $(\tau^*_{1L}, \tau^*_{1R})$, we have:

$$\begin{aligned}
&\frac{\partial \Pi_{1L}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda} = \\
&\sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k, n_1-2-2k} \lambda^{k-1}(\tau^*_{1L})^k (1-\lambda)^{k-1}(\tau^*_{1R})^k \left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]^{n_1-2-2k} \\
&\times \Bigg\{ \underbrace{\frac{k(1-2\lambda)\left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]}{(n_1-1-2k)}}_{(-)} + \underbrace{\frac{k(1-2\lambda)(1-\lambda)\tau^*_{1R}}{(k+1)}}_{(-)} - \underbrace{\frac{\lambda(1-\lambda)\tau^*_{1R}}{(k+1)}}_{(-)} \\
&\quad + \lambda(1-\lambda)(\tau^*_{1R}-\tau^*_{1L}) \Bigg[1 + \underbrace{\frac{(n_1-2-2k)(1-\lambda)\tau^*_{1R}}{(k+1)\left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]}}_{(+)} \Bigg] \Bigg\}, \qquad (8)
\end{aligned}$$

$$\begin{aligned}
\text{and } &\frac{\partial \Pi_{1R}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda} = \\
&\sum_{k=0}^{\lfloor \frac{n_1-1}{2} \rfloor} \binom{n_1-1}{k, k, n_1-2-2k} \lambda^{k-1}(\tau^*_{1L})^k (1-\lambda)^{k-1}(\tau^*_{1R})^k \left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]^{n_1-2-2k} \\
&\times \Bigg\{ \underbrace{\frac{k(1-2\lambda)\left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]}{(n_1-1-2k)}}_{(-)} + \underbrace{\frac{k(1-2\lambda)\lambda\tau^*_{1L}}{(k+1)}}_{(-)} + \underbrace{\frac{\lambda(1-\lambda)\tau^*_{1L}}{(k+1)}}_{(+)} \\
&\quad + \lambda(1-\lambda)(\tau^*_{1R}-\tau^*_{1L}) \Bigg[1 + \underbrace{\frac{(n_1-2-2k)\lambda\tau^*_{1L}}{(k+1)\left[1-\lambda\tau^*_{1L}-(1-\lambda)\tau^*_{1R}\right]}}_{(+)} \Bigg] \Bigg\}. \qquad (9)
\end{aligned}$$

There are no definite signs in general. We then focus on some special cases to see the effect of λ. Consider a very close election where $\lambda \to 1/2$. In this case, we have $\tau^*_{1R} \to \tau^*_{1L}$, according to Börgers (2004), who deals with the symmetric

case $\lambda = 1/2$. Therefore, the terms in the braces in (8) and (9) approach to zero except the third one. Therefore,

$$\frac{\partial \Pi_{1L}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda}|_{\lambda \to 1/2} < 0 \quad \text{and} \quad \frac{\partial \Pi_{1R}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda}|_{\lambda \to 1/2} > 0.$$

Consider a new λ' which is close to λ and $\lambda' < \lambda$. Then under this λ', since $\frac{\mathrm{d}F}{\mathrm{d}c} > 0$, we know

$$\tau^*_{1L} < F\left(\frac{1}{2}\Pi_{1L}(\tau^*_{1L}, \tau^*_{1R})\right) \quad \text{and} \quad \tau^*_{1R} > F\left(\frac{1}{2}\Pi_{1R}(\tau^*_{1L}, \tau^*_{1R})\right). \tag{10}$$

Thus, in order to maintain the equality, the new equilibrium $(\tau^*_{2L}, \tau^*_{2R})$ under λ' must be the case where

$$\tau^*_{2L} > \tau^*_{1L} \quad \text{and} \quad \tau^*_{2R} < \tau^*_{1R}. \tag{11}$$

That is, when a very close election becomes even closer, the pivotal probability for a supporter of the leading (underdog) candidate will be larger (smaller), so that it is more (less) likely for that voter to turn out and vote in the later election.

Another extreme case is $\lambda \to 1$, where the election is dominated by the leading party. Similar to the previous case, we have

$$\frac{\partial \Pi_{1L}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda}|_{\lambda \to 1} < 0 \quad \text{and} \quad \frac{\partial \Pi_{1R}(\tau^*_{1L}, \tau^*_{1R})}{\partial \lambda}|_{\lambda \to 1} < 0.$$

Consider a new λ' which is close to λ and $\lambda' < \lambda$. Then under this λ',

$$\tau^*_{1L} < F\left(\frac{1}{2}\Pi_{1L}(\tau^*_{1L}, \tau^*_{1R})\right) \quad \text{and} \quad \tau^*_{1R} < F\left(\frac{1}{2}\Pi_{1R}(\tau^*_{1L}, \tau^*_{1R})\right). \tag{12}$$

Thus, in order to maintain the equality, the new equilibrium $(\tau^*_{2L}, \tau^*_{2R})$ under λ' is such that

$$\tau^*_{2L} > \tau^*_{1L} \quad \text{and} \quad \tau^*_{2R} > \tau^*_{1R}. \tag{13}$$

That is, when the election becomes less lopsided, the pivotal probability for a supporter of either party increases, so that it is more likely for a voter to vote. Thus, the total turnout rate increases. □

To understand this result, we can decompose the comparative statics in (8) and (9) into three effects: the competition effect, the underdog effect, and the externality effect of voting. The first two effects have been mentioned by Levine

and Palfrey (2007), and the third one is similar to the argument made by Börgers (2004). We discuss each effect as follows.

The first two terms of (8) and (9) are negative, which can be considered as the "competition effect," in the sense that when the election is expected to be closer (i.e., when λ becomes smaller), the pivotal probability for a voter is larger, which then has a positive effect on turnout.[3]

The third term can be viewed as the "underdog effect," which means that it is more likely for a voter to support the less popular party. For the leading party, this term is negative, which means that when the election becomes closer, the pivotal probability for its supporter will be larger because the disadvantage of the underdog party is narrowed, which has a further positive effect on the turnout rate of the leading party. On the contrary, this term is positive for a supporter of the underdog party, which means that when the election becomes closer, the pivotal probability for its supporter will be smaller, and so it has a negative impact on the turnout rate of the underdog party.[4]

Finally, we interpret the last term as the "externality effect" of voting. Basically, this term captures the change in the probability of voters' abstention when λ changes. As argued by Börgers (2004), there is a negative externality arising from voting, in that a vote will make it less likely that other voters are pivotal. Therefore, if a voter anticipates that it is more likely that the other voters will abstain from voting, the pivotal probability of his vote increases. Since $\tau_{1R}^* > \tau_{1L}^*$ by Lemma 1, when the election becomes closer, the probability that a voter abstains from voting decreases,[5] and so it reduces the pivotal probability. Therefore, this term is positive.

The three above effects provide the intuition to understand Proposition 1. In a very close election, the competition effect of an extra closedness is negligible.

[3] Mathematically, the competition effect is captured by the change in the probability of a tie event caused by the belief update, i.e., $(\lambda\tau_{1L})^k [(1-\lambda)\tau_{1R}]^k$ in the pivotal probabilities (1) and (2), fixing the voters' abstention probability. Thus, the term $(1-2\lambda)$ appears in the derivatives (8) and (9), which means that the effect is maximal at $\lambda = 1$ and minimal at $\lambda = 1/2$. That is, when the election is already very close, the effect of an additional closedness is very small in terms of creating a tie event, so that the competition effect is very small.

[4] In (8) and (9), the underdog effect is basically captured by the change in the probability of a party losing by one vote given that a voter casts his vote, i.e., $(\lambda\tau_{1L})^k [(1-\lambda)\tau_{1R}]^{k+1}$ for the L party and $(\lambda\tau_{1L})^{k+1} [(1-\lambda)\tau_{1R}]^k$ for the R party, relative to that of the tie event. Since by Lemma 1, $\lambda\tau_{1L} > (1-\lambda)\tau_{1R}$ in equilibrium, the probability of an extra vote for it opponent is larger for the R party, which means that it is more worthwhile to support the underdog since it is more likely to be pivotal, and vice versa for the L party. Thus, when λ is lower, the effect of this extra vote increases for the L party and decreases for the R party.

[5] Recall that the probability of abstention by a voter in the first period is $1 - \lambda\tau_{1L}^* - (1-\lambda)\tau_{1R}^*$.

The externality effect is also very small because the probability of abstention is not much affected by an extra closedness. Therefore, the underdog effect dominates, so that when a very close election is expected to be getting even closer, it is more (less) likely for that a supporter of the leading (underdog) candidate to turn out and vote in the later election. On the other hand, in a very lopsided election, the underdog effect is negligible because the difference in popularity between these two candidates is so overwhelming that an extra closedness does not make too much change. The externality effect is also very small because the probability of abstention is again not much affected. Therefore, the competition effect dominates, so that when a very lopsided election is expected to be closer, the supporters of both parties will turn out and vote in the later election.

According to Proposition 1, we can draw out some implications and see the effect of ties which cause a minor change in the belief. Note that when a tie event occurs, $\lambda' < \lambda$ since $\hat{\lambda} = 1/2$. Therefore, ties occurred in the last election cause a downward updating in the belief. Therefore, we have the following prediction:

Corollary 1. *In the presence of an even distribution of preferences between party R and party L (λ close to $1/2$), a tie occurring in the early election will induce a higher (lower) turnout rate of supporters of the leading (underdog) party in the later election. By contrast, in the presence of a lopsided distribution of preferences between party R and party L (λ close to 1), a tie occurring in the early election will induce higher turnout rates of supporters of both parties in the later election.*

Corollary 1 provides a testable hypothesis: the impact of a tie on the total turnout in the later election will be stronger where there is a very lopsided distribution of preferences. In this case, the turnout rates unambiguously increase for all supporters. On the contrary, since in a close election the underdog effects go in opposite directions for the two parties, they tend to cancel out so that the overall turnout impact may be weaker.

The above prediction is based on the case where $|\lambda' - \lambda|$ is relatively small, which occurs when relatively fewer voters cast their votes in the early election (according to (7)). If $|\lambda' - \lambda|$ is relatively large, the effect of the information spill-overs can be more drastic. To see this more clearly, we provide a numerical example with various n_1 and λ, and compute the equilibrium turnout rate for each party. We assume that the voting cost is uniformly distributed on [0, 0.5].[6]

[6] Since the expected benefit of voting is $\frac{1}{2}\Pi_{1\theta}$, we let $\bar{c} = 1/2$.

The result is summarized in table 1.

The result basically confirms the predictions in Proposition 1 and Corollary 1. In a close election where λ is relative small, say, 0.51 or 0.55, the underdog effect appears: as the election is expected to be even closer, the turnout rate for the leading party increases, while that for the underdog party decreases, at least for a relatively small electorate when $n_1 = 101$ and $n_1 = 1001$. On the other hand, in a more lopsided election where $\lambda \geq 0.6$, we see a dominating competition effect: the turnout rates for both parties increase when the election gets closer.

Another observation is the "size effect," also argued by Levine and Palfrey (2007), which means that when the electorate becomes larger, the turnout rates for both parties decrease, clearly because the pivotal probability is smaller. In particular, the competition effect dominates and the underdog effect (almost) disappears when the size is over 5000.[7] In other words, the underdog effect is stronger in a closer election with a smaller electorate.

Table 1 The equilibrium turnout rates with various sizes and beliefs

	$n_1 = 101$			$n_1 = 1001$			$n_1 = 5001$		
λ	τ^*_{1L}	τ^*_{1R}	τ^*_1	τ^*_{1L}	τ^*_{1R}	τ^*_1	τ^*_{1L}	τ^*_{1R}	τ^*_1
0.5	0.1840	0.1840	0.1840	0.0859	0.0859	0.0859	0.0503	0.0503	0.0503
0.51	0.1826	0.1851	0.1838	0.0849	0.0861	0.0855	0.0492	0.0499	0.0495
0.55	0.1736	0.1855	0.1790	0.0743	0.0794	0.0766	0.0367	0.0393	0.0379
0.6	0.1567	0.1791	0.1657	0.0564	0.0645	0.0596	0.0228	0.0261	0.0241
0.7	0.1179	0.1558	0.1293	0.0315	0.0481	0.0365	0.0104	0.0138	0.0114
0.8	0.0848	0.1334	0.0945	0.0188	0.0297	0.0210	0.0056	0.0089	0.0063
0.9	0.0589	0.1195	0.0650	0.0114	0.0234	0.0126	0.0032	0.0066	0.0035
1	0.0334	0.1489	0.0334	0.0052	0.0328	0.0052	0.0013	0.0101	0.0013

Notes: Figures obtained based on the assumption that c is uniformly distributed on [0, 0.5]. Moreover, τ^*_1 is the total turnout rate, where $\tau^*_1 = \lambda\tau^*_{IL} + (1-\lambda)\tau^*_{IR}$.

3 Institutional framework and dataset

We perform the empirical analysis on a panel dataset of Italian municipal elections spanning through almost twenty years (2001 to 2017). While the total number of Italian municipalities exceeds 8,000, we focus on the around 7,000 localities that are situated in the fifteen "state law" continental Italy's regions

[7] That is, to find the underdog effect, it requires a λ even smaller than 0.51.

(83 provinces). We thus exclude the five regions (the two islands *Sardegna* and *Sicilia*, and the three small alpine regions *Valle d'Aosta*, *Trentino-Alto-Adige,* and *Friuli-Venezia-Giulia*) that are entitled to larger autonomy and establish own limits and rules on the municipal governments that are located within their boundaries ("home rule").

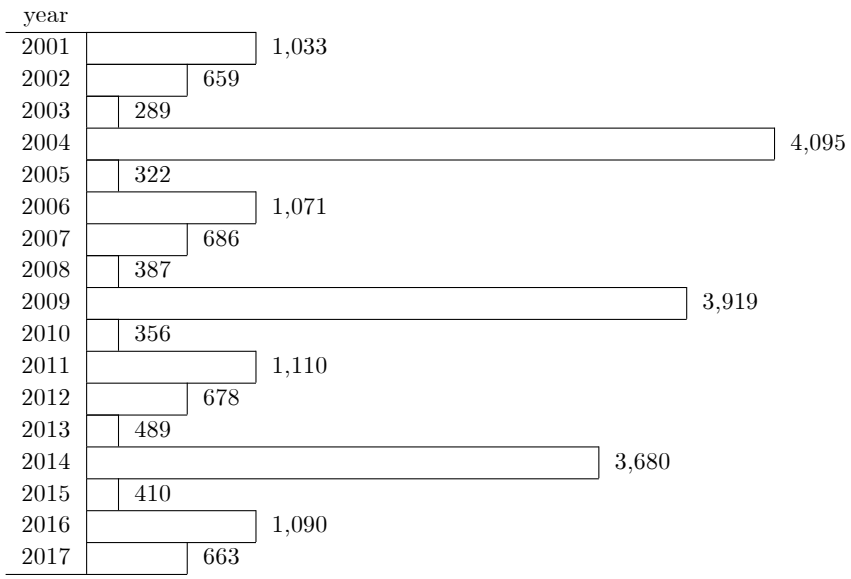
The municipal level of government is characterized by considerable fragmentation, with average population size of around 7,000 inhabitants and more than half the localities having less than 3,000 residents. Irrespective of their size, though, all municipal authorities are statutorily responsible for the provision of public services in two main areas.[8] The first area concerns environment-related services, and includes urban public transportation systems, road maintenance and cleaning, waste collection and management, water and sewer services, parks and green spaces, environmental monitoring, regulation and protection, urban planning and zoning (including the location of new productive plants), and management of industrial, agricultural and touristic infrastructures located within the municipal boundaries. The second area concerns personal social services including social care to the elderly and disabled, organization and management of pre-school services (kindergartens), cultural services (libraries, museums, sports infrastructures), and local police.

As for local elections, all Italian municipalities have direct election of the mayor every fifth year in a single or dual ballot depending on resident population size, with larger localities (>15,000 inhabitants) having a runoff stage among the two most voted candidates if no candidate gets more than 50% of the votes in the first stage. The list supporting the winner of the run-off stage enjoys a seat majority premium, in the sense that at least 60% of the council seats are assigned to the councillor candidates (frequently grouped in one or more political parties) supporting the mayor that is elected. The rest of the council seats are assigned on a proportional representation basis. Voters express a vote for a mayor candidate as well as for a councillor candidate if they wish. Voting is formally mandatory for all aged above 18, though no sanctions exist for abstainers.

Elections take place according to a staggered schedule that is reported in table 2 for the years 2001 to 2017. During the 2001 to 2017 period there were more than 20,000 mayoral elections.

[8] The sole exception is the possibility (or obligation in some instances) for small-sized municipalities to set up an intermunicipal cooperation agreement or formal institution for the provision of public services that require a minimum scale of production.

Table 2 Schedule of municipal elections



Notes: Source: Ministero dell'Interno, Governo Italiano (www.interno.gov.it).

Table 3 Ties

municipality	region	year	votes
Valmala	Piemonte	2004	28
Acceglio	Piemonte	2006	47
Oldenico	Veneto	2014	92
Margno	Lombardia	2009	96
Colleretto castelnuovo	Piemonte	2014	97
Cortanze	Piemonte	2006	101
Aisone	Piemonte	2009	101
Serravalle Langhe	Piemonte	2004	121
Piazzatorre	Lombardia	2004	132
Roatto	Piemonte	2001	139
Vizzola Ticino	Lombardia	2004	163
Cerano d'Intelvi	Lombardia	2004	170
Fraine	Abruzzo	2011	194
Borbona	Lazio	2004	196
San Giovanni in Galdo	Molise	2009	241
Corrido	Lombardia	2004	251
Proserpio	Lombardia	2014	294
Miglierina	Calabria	2004	298
Spadola	Calabria	2007	300
Terravecchia	Calabria	2008	314
Civita d'Antino	Abruzzo	2016	351
Cellere	Lazio	2014	372
Quingentole	Lombardia	2004	378
Roseto Valfortore	Puglia	2010	434
Cazzano di Tramigna	Veneto	2004	450
Montorfano	Lombardia	2013	465
Rignano garganico	Puglia	2012	531
Cerchiara di Calabria	Calabria	2009	593
Revine Lago	Veneto	2014	613
Scanno	Abruzzo	2003	625
Ortucchio	Abruzzo	2016	636
Calvagese della Riviera	Lombardia	2002	706
Orsara di Puglia	Puglia	2002	877
Sant'Angelo di Alife	Campania	2005	878
Ardenno	Lombardia	2016	922
Menaggio	Lombardia	2014	953
San Benedetto dei Marsi	Abruzzo	2008	968
Narzole	Piemonte	2016	997
Casina	Emilia R.	2016	1,164
Cannobio	Piemonte	2004	1,227
Arcene	Lombardia	2009	1,492
Monte San Vito	Marche	2009	1,653

Table 4 Elections decided by one vote

municipality	region	year	votes	municipality	region	year	votes
Briga Alta	Piemonte	2006	22-21	Cleto	Calabria	2009	366-365
Igliano	Piemonte	2004	30-29	Campiglia	Veneto	2004	371-370
Spriana	Lombardia	2004	37-36	Camburzano	Piemonte	2004	391-390
Castelverrino	Molise	2004	49-48	Guardistallo	Toscana	2014	391-390
Canevino	Lombardia	2009	49-48	Lauriano	Piemonte	2001	443-442
Sueglio	Lombardia	2011	55-54	Lanzo d'Intelvi	Lombardia	2005	447-446
Calascio	Abruzzo	2011	61-60	Torre Nocelle	Campania	2013	496-495
Crissolo	Piemonte	2016	72-71	San Donato	Molise	2011	519-518
Testico	Liguria	2011	78-77	Premosello	Piemonte	2011	530-529
Valvestino	Lombardia	2014	82-81	Verzino	Calabria	2004	544-543
Levice	Piemonte	2004	89-88	Valbrembo	Lombardia	2004	552-551
Collegiove	Lazio	2009	106-105	San Mango	Campania	2012	577-576
Cornalba	Lombardia	2006	112-111	Castelpagano	Campania	2001	626-625
Vallinfreda	Lazio	2011	122-121	Campoli App.	Lazio	2002	638-637
Gambasca	Piemonte	2009	136-135	Castiglione	Toscana	2012	647-646
S. Giacomo F.	Lombardia	2015	139-138	Angolo terme	Lombardia	2009	667-666
Pozzaglia S.	Lazio	2014	151-150	Gaglianico	Piemonte	2014	675-674
Osiglia	Liguria	2014	155-154	Mergozzo	Piemonte	2004	678-677
Pettoranello	Molise	2009	173-172	Moricone	Lazio	2014	690-689
Acquaviva	Molise	2005	175-174	Grotteria	Calabria	2012	752-751
Castel Castagna	Abruzzo	2015	191-190	Berzo inferiore	Lombardia	2003	760-759
Salisano	Lazio	2017	181-180	Castel S.Elia	Lazio	2007	841-840
Prasco	Piemonte	2004	195-194	Ronco Freddo	Emilia R.	2004	888-887
Salle	Abruzzo	2004	196-195	Gissi	Abruzzo	2014	921-920
Vesime	Piemonte	2017	196-195	Occhiepo	Piemonte	2009	986-985
Angrogna	Piemonte	2007	252-251	Spirano	Lombardia	2004	987-986
Mello	Lombardia	2001	253-252	Corte Franca	Lombardia	2011	1311-1310
Cortino	Abruzzo	2016	259-258	Travacò	Lombardia	2014	1385-1384
Casal Cermelli	Piemonte	2016	266-265	Grottaferrata	Lazio	2017	1930-1929
Zaccanopoli	Calabria	2004	281-280	Montecompatri	Lazio	2003	2047-2046
Gaiba	Veneto	2009	284-283	Curti	Campania	2014	2251-2250
Fabbrica C.	Piemonte	2004	292-291	Meda	Lombardia	2012	3867-3866
Breme	Lombardia	2006	307-306	Monselice	Veneto	2004	4251-4250
Palermiti	Calabria	2010	355-354				

The number of mayor candidates varies from a single candidate running unopposed (about 6% of the elections) to as many as 19 candidates. Most elections (over 70% of them) have 2 to 3 candidates. Table 3 reports the 42 cases of elections ending in a tie during the same period (municipality name, region, and number of votes got by each of the two most voted candidates). When a tie happens, an extra electoral round needs to be called after two weeks. Ties happen even in reasonably large electorates, in the order of the thousands of registered voters. The largest tie saw two candidates get 1,653 votes. Table 4 reports instead the results of the 67 elections that were decided by one vote, that is elections where an abstainer could have changed the outcome of the race if only he had chosen to turn out. In a few instances, one-vote-difference outcomes occurred in localities counting several thousands of registered voters.

4 Estimation results

4.1 The internal impact of a tie

First of all, given that the Italian electoral rules require a tied election to be settled by calling a second ballot between the evenly-voted candidates two weeks after the tied election, we can investigate the behavior of voters in such supplementary elections. Interestingly, we can compare the behavior of voters in the ballotage following the tied election to the behavior of voters in runoff elections in larger authorities (population exceeding 15,000), that are statutorily obliged to hold a second round between the two most voted candidates whenever a candidate does not get at least 50% of the votes in the first round. In both instances, the second round takes place on the second Sunday following the first round.

In particular, in order to identify the impact of the increased perception of pivotality that should follow the tied election on the decision to turn out to vote, we test whether turnout rates in the supplementary elections that are called after a tied election are significantly higher than turnout rates in ordinary run-off elections that need to be held in the authorities that do not have a winner in the first round. The latter circumstances are observed in 898 elections that took place during the 2001-2017 period. The average first-round vote share of the most voted candidate in those jurisdictions is below 40%, and the average vote share gap relative to the most voted opponent is about ten percentage points. This suggests that, even if a winner did not emerge in the first round,

those elections should not be perceived as particularly close.

To remove differences between the authorities that experience ties (that tend to be small) and the authorities that vote according to the two-round electoral system (localities hosting a population of at least 15,000, otherwise a single-round electoral system applies), we regress the *change* in turnout in percentage points between the two electoral rounds Δy_{jt} on a vector of year dummies h_t ($t = 2001, ..., 2017$) and on a dummy variable $D(\text{tie})$ equaling 1 if the second round election in locality j had to be called because of a tie in the first round:[9]

$$\Delta y_{jt} = \theta D(\text{tie}) + h_t + u_{jt} \tag{14}$$

The estimated θ coefficient from equation (14) takes a large and highly significant value of around 12 (standard error ≈ 0.8). This means that the rate of turnout in the second round is higher by over 12 percentage points if the extra round was called because of an exact tie in the first electoral round than if the second round occurs in two-round election authorities where no candidate has got 50% of the votes in the first round. This provides strong prima facie evidence that the rare event of a tied election indeed raises the electorate's participation in subsequent races. The next section tests whether such large internal effect of a tied election has an influence onto voting behavior in neighboring localities too.

4.2 Information spill-overs

We test here the hypothesis that ties or one-vote-difference outcomes have an impact on subsequent elections taking place in neighboring localities. We use a geographic definition of neighborhood and rely on a standard border-sharing criterion, in the sense that two localities are considered first-order neighbors if they share a common border, and are considered second-order neighbors if they do not share a common border, but they have a common first-order neighbor.

The results of estimation of an equation that allows for information spill-overs from close electoral outcomes in the neighborhood are reported in tables 5 and 6. First, table 5 reports the results of estimation of equation (15) below, where the dependent variable y_{it} is in this case the rate of voter turnout that is registered in municipality i at an election held at time t (first round), and j indexes the locality where the rare electoral outcome occurs:

$$y_{it} = \rho_{1l} n_1(i,j) D(\text{tie}_{j,t-l}) + \rho_{2l} n_2(i,j) D(\text{tie}_{j,t-l}) + m_i + g_t + \varepsilon_{it} \tag{15}$$

[9] The average electorate size of localities having a tie is about 1,600.

$n_1(i,j)$ and $n_2(i,j)$ contain the binary spatial information on the location of authorities holding elections relative to the authorities where ties occurred, with $n_1(i,j) = 1$ ($n_2(i,j) = 1$) if i is a first-order (second-order) neighbor of j, 0 otherwise, while $D(\text{tie}_{j,t-l}) = 1$ if a tie occurred in j at an election held during the time intervaal $(t, t-l)$, with l taking values $l = 1, ..., 5$ in different specifications of equation (15).[10] ρ_{1l} and ρ_{2l} are the parameters of interest, m_i and g_t are municipality and year fixed effects, and ε_{it} is an error term that is assumed i.i.d.

Table 5 Spillovers: turnout

	years from tie to election in neighborhood				
	1 year	2 years	3 years	4 years	5 years
	turnout				
	first-order neighbors				
D(tie)	2.544***	0.926**	0.388	0.430	0.381*
	(0.629)	(0.390)	(0.298)	(0.274)	(0.226)
	first-order & second-order neighbors				
D(tie) (1^{st}-order)	2.495***	0.927**	0.390	0.434	0.383*
	(0.630)	(0.390)	(0.298)	(0.274)	(0.226)
D(tie) (2^{nd}-order)	0.895**	-0.116	0.111	0.182	0.101
	(0.422)	(0.263)	(0.203)	(0.191)	(0.152)
obs.	20,937				

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote.

The results in table 5 show that the turnout rate in the authorities that are first-order neighbors of localities experiencing a tie and that hold elections in the subsequent year (parameter ρ_{11}) is higher by between two and three percentage points, with the effect declining but still remaining sizeable and statistically significant in the next year ($\rho_{12} \approx 1$). The spill-over vanishes over time, though, in the sense that no effect is found if the elections are held more than two years apart. The lower panel of table 5 shows evidence of a non-negligible spill-over on second-order neighbors holding elections right in the subsequent year too ($\rho_{21} \approx 0.9$), with the spill-over effect turning nil in the following years though. Interestingly, the results are robust when we include a number of controls (table

[10] We group all ties and one-vote-difference outcomes in a single variable that we refer to as 'ties' for convenience from now on.

6), namely the size of the electorate (in thousands of eligible voters), the number of mayoral candidates, and the win margin of the mayor, defined as the difference in votes between the elected mayor and its most voted opponent as a percentage of the total votes cast for those two candidates.

Table 6 Spillovers: turnout, with controls

	years from tie to election in neighborhood				
	1 year	2 years	3 years	4 years	5 years
	turnout				
	first-order neighbors				
D(tie)	2.319***	0.901***	0.339	0.377	0.496**
	(0.564)	(0.349)	(0.267)	(0.246)	(0.202)
electorate	-0.076***	-0.075***	-0.076***	-0.075***	-0.075***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
candidates	0.320***	0.322***	0.321***	0.321***	0.321***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
vote margin	-0.071***	-0.071***	-0.071***	-0.071***	-0.071***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	first-order & second-order neighbors				
D(tie) (1^{st}-order)	2.299***	0.904***	0.339	0.378	0.496**
	(0.564)	(0.349)	(0.267)	(0.246)	(0.202)
D(tie) (2^{nd}-order)	0.354	-0.280	-0.014	0.075	0.021
	(0.378)	(0.236)	(0.182)	(0.171)	(0.136)
electorate	-0.076***	-0.075***	-0.075***	-0.076***	-0.075***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
candidates	0.320***	0.321***	0.321***	0.321***	0.321***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
vote margin	-0.071***	-0.071***	-0.071***	-0.071***	-0.071***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
obs.	20,937				

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote.

All variables have the expected sign, and are precisely estimated. Larger electorates and wider win margins tend to be associated with lower rates of turnout, in line with the comparative static effects of the rational choice theory of voter turnout (Levine and Palfrey, 2007), while a higher number of candidates is associated with higher turnout.[11] Finally, it is interesting to notice that the

[11] We should not stress these results too much, though, because, with the exception of the size of the electorate in the short run, the other two controls (number of candidates and win margin) can be suspect of endogeneity or reverse causality.

spillover effect turns significant again five years after the occurrence of the tie, when the localities that voted at the same time as when the tie occurred and are first-order neighbors of the locality that experienced the tie are back to the polls.

4.3 Test of corollary 1

Next, we test the hypothesis that the impact of the informational shock on turnout depends on the degree of lopsidedness of party affiliation in the locality that receives the spill-over (Corollary 1). We experiment with a number of win margin thresholds - average percentage vote difference between the two most voted candidates across the elections observed during the whole period of observation - to proxy the distribution of political consensus (30%, 40%, 50%, 60%, 70%), and estimate equation (15) both on the two distinct subsamples (low and high win margin authorities, according to the various thresholds) and on the full sample by means of an interaction term (information spill-over dummy multiplied by the lopsidedness proxy dummy).

Table 7 Spillovers: turnout, lopsidedness

	30%	40%	50%	60%	70%
D(tie)	2.631***	2.224***	2.273***	2.180***	2.309***
	(0.815)	(0.700)	(0.665)	(0.646)	(0.641)
D(tie)×D(lop)	-0.214	1.674	2.618	7.037**	6.660**
	(1.282)	(1.599)	(2.062)	(2.837)	(3.407)
			D(lop)=0		
D(tie)	2.413***	2.112***	2.217***	2.152***	2.299***
	(0.662)	(0.627)	(0.628)	(0.628)	(0.630)
obs.	13,065	15,964	18,247	19,530	20,145
			D(lop)=1		
D(tie)	2.538**	3.861**	4.432*	9.451**	10.012**
	(1.227)	(1.819)	(2.546)	(3.813)	(4.426)
obs.	7,872	4,973	2,690	1,407	792

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote, and held an election in the subsequent year; D(lop) = dummy variable equal to 1 if the mean vote difference between the two most voted candidates in the elections having taken place in a locality during the period of observation exceeds the predetermined threshold in line 1.

Table 7 reports the results for the elections that were held in the neighborhood in the year following the tied elections and for first order neighbors only (ρ_{11}): all other specifications are available on request. The results reported in table 7 are compatible with the hypothesis that the impact on turnout is larger on jurisdictions that have a more lopsided distribution of preferences in the electorate. When focusing on the elections with a progressively more uneven distribution between the two main candidates, the impact of the information spill-over increases up to a turnout impact of about ten percentage points. While the coefficients are not estimated with precision because of the shrinking sample of lopsided elections when raising the threshold, the results are statistically significant at conventional levels, and amount to a remarkable additional impact on the authorities with lopsided preferences relative to authorities with evenly distributed ones.

4.4 Test of lemma 2

Finally, we test if the magnitude of the information spillover (as reflected in the change in turnout in the later elections) is correlated with: a) the rate of turnout that was observed in the tied election; b) the shock to the belief, proxied by the party lead that was observed in the election preceding the tied election. As for hypothesis a), it is based on the idea that a higher turnout in the tied election - the first term on the right-hand side of equation (7) - should induce the informed voters in the later elections in the neighborhood to put a larger weight on the information contained in the tie in the posterior belief (first part of Lemma 2). As for hypothesis b), the last term of equation (7) suggests that the larger is the difference between realized and anticipated vote shares, the stronger is the shock to the belief, and the bigger should be the impact on turnout.

We first try with a number of turnout thresholds (65%, 70%, 75%), and build a dummy variable that equals 1 if the turnout rate in the tied election exceeds the threshold, and interact it with the exposure to the informational spill-over dummy (elections in the subsequent year). As shown in table 8, no significant result emerges in this case. In fact, while it is plausible that the news of a tie or one-vote-difference outcome spread to neighboring localities via local media and social interactions, it is likely much less so in practice as far as knowledge of the degree of participation of voters to the elections that ended up with those unusual outcomes is concerned. Consider next the effect of the shock to the belief. We set four thresholds for the party lead in the election

that preceded the tied election (30%, 40%, 50%, 60%), and interact the dummy variables for exceeding those thresholds with the dummy variables for exposure to the informational spillover. Likely for the same reasons as above, though, the results reported in table 9 do not return any evidence in support of an effect of the party lead in the previous election.

Table 8 Spillovers: high/low turnout in tied election

	65%	70%	75%
D(tie)	2.542***	2.707***	3.028***
	(1.146)	(0.989)	(0.853)
D(tie)×D(high)	0.004	-0.273	-1.062
	(1.371)	(1.282)	(1.264)

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote, and held an election in the subsequent year; D(high) = dummy variable equal to 1 if the rate of turnout in the tied election exceeded the predetermined threshold in line 1.

Table 9 Spillovers: prior party lead in tied election

	30%	40%	50%	60%
D(tie)	2.543***	2.656***	2.504***	2.561***
	(0.788)	(0.723)	(0.707)	(0.700)
D(tie)×D(lead)	0.003	-0.462	0.193	-0.087
	(1.310)	(1.471)	(1.551)	(1.601)

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote, and held an election in the subsequent year; D(lead) = dummy variable equal to 1 if the vote share difference in the election preceding the tied election exceeded the predetermined threshold in line 1.

5 Alternative mechanisms

In this section we test whether other mechanisms might be at work that can explain the observed spill-over effect on turnout. The mechanism that is built in the theoretical model of section **2** can be seen as a direct one: the idea is that a tie in a locality induces people living in nearby localities (and therefore learning about the tie through local media, commuting, or social networks) to update their beliefs about the distribution of preferences between the main parties and, as a result, their own chances of casting the decisive vote. Under the circumstances discussed in section **2**, such cross-locality informational spill-over might make people living in those communities more likely to vote in subsequent elections, keeping everything else constant. As we documented, the effect is stronger the closer in space and time is the election in i following the tied election in j.

However, one could think of indirect mechanisms linking the political outcome in a locality to the political process in the neighboring localities that can in turn take three distinct forms. First, the tie in locality j might induce more people to run as mayor candidates in locality i in so far as potential candidates perceive the incumbent in i to be weaker and the coming election to be a closer one, where they have higher than usual chances to win. In turn, the larger number of candidates in locality i should be expected to stimulate turnout.

Second, and relatedly, the tie in locality j might make the incumbent government in nearby locality i anticipate that the next race will be more uncertain, that its vote share will be lower, and that a larger number of people will vote in the next election than it was the case in the previous one. This could induce the incumbent to try to 'buy' votes to foster its chances of re-election. One way of doing so is by manoeuvring local taxes and expenditures before the elections to produce a short-term boost in popularity. We will test this hypothesis by using the local income tax rate as the key dependent variable, and verify in particular if holding elections after a tie in a neighboring jurisdiction has the effect of inducing a decrease in the local income tax rate as a vote-buying strategy, and if that strategy has an impact on voter turnout rates.

Third, the tie in locality j might make mayor candidates in locality i (or the political parties supporting them) expend a larger effort in mobilizing their own supporters to the polls. This would mean that the higher turnout in the neighborhood of a tied election is not a direct psychological effect on voters, but

it is mediated by the increased campaigning effort of parties and candidates. In fact, we will not be able to test this hypothesis because no data are available on political parties' mayoral campaigns. However, this does not seem to be a major issue in practice: in most Italian municipal races the electorate is pretty small and the competition is between non-partisan candidates, ruling out in the majority of cases the presence of structural campaigning by political parties.

5.1 Results

We first test whether a tie in a given jurisdiction has an effect on the number of mayoral candidates in neighboring authorities in subsequent elections, so we estimate equation (15) with the number of candidates as the dependent variable. The results in table 10 show that the number of mayoral candidates is not affected by the fact that a close outcome occurred in the neighborhood in any of the preceding years.

Second, we take the local income tax rate as the dependent variable in equation (15). The local income tax rate data are available for the years 2001-2015. Table 11 (columns 1 to 5) shows some evidence that incumbents that are exposed to close outcomes in the neighborhood (first-order neighbors only, with no effect on second-order ones) and that hold elections during the next one to three years tend to set lower income tax rates, compatibly with the hypothesis that a tie having occurred in the neighborhood raises uncertainty about own electoral outcomes, and tends to stimulate vote-buying fiscal policies on the part of incumbents. In order to verify if the effect of tied elections on neighbors' turnout rates takes place through the response of incumbents' fiscal policies in the neighborhood, we re-estimate the turnout determination equation while controlling for the level of the local income tax rates (column 6 of table 11). While the local income tax rate is estimated to have a significant negative impact on the rate of turnout, there remains a large independent impact of exposure to a tie on turnout (over two percentage points) when controlling for the level of the local income tax rate in the turnout determination equation.

Table 10 Spillovers: candidates

	years from tie to election in neighborhood				
	1 year	2 years	3 years	4 years	5 years
	candidates				
	first-order neighbors				
D(tie)	0.121	-0.027	-0.005	0.022	-0.004
	(0.141)	(0.087)	(0.067)	(0.062)	(0.051)
	first-order & second-order neighbors				
D(tie) (1^{st}-order)	0.116	-0.027	-0.005	0.022	-0.004
	(0.141)	(0.087)	(0.067)	(0.062)	(0.051)
D(tie) (2^{nd}-order)	0.095	-0.006	0.017	0.001	-0.015
	(0.095)	(0.059)	(0.046)	(0.043)	(0.034)
obs.	20,937				

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote.

Table 11 Spillovers: income tax rate

	years from tie to election in neighborhood					
	1 year	2 years	3 years	4 years	5 years	1 year
	income tax rate					turnout
	first-order neighbors					
D(tie)	-0.054**	-0.028*	-0.024**	-0.015	-0.016*	2.286***
	(0.025)	(0.016)	(0.012)	(0.011)	(0.009)	(0.660)
income tax rate						-0.737***
						(0.243)
	first-order & second-order neighbors					
D(tie) (1^{st}-order)	-0.052**	-0.028*	-0.024**	-0.015	-0.016*	
	(0.025)	(0.016)	(0.012)	(0.011)	(0.009)	
D(tie) (2^{nd}-order)	-0.024	-0.009	-0.011	-0.007	-0.008	
	(0.016)	(0.011)	(0.008)	(0.008)	(0.006)	
obs.	18,449					

Notes: D(tie) = dummy variable equal to 1 if an authority is a neighbor of a locality where the election ended in a tie or was decided by one vote. Period of observation: years 2001-2015.

6 Conclusions

This paper has investigated an issue that has surprisingly attracted little interest in the political economy literature to date, that is whether the unusual occurrence of electoral outcomes where a single vote would have been decisive has an impact on voting behavior in subsequent elections. In particular, this paper has focused on the informational spill-overs of stark real-world examples of pivotality in municipal elections on the political process in nearby localities.

To clarify the mechanism linking tight electoral outcomes to voting behavior in the neighborhood, we have first built a theoretical model of costly instrumental voting in sequential elections with private information, where voters update their belief regarding the distribution of political preferences between two parties and the probability of their vote being pivotal upon observing the outcome in earlier elections, and decide whether to turn out to vote according to those beliefs. The model predicts that upon observing the result of the early election, a share of voters will update their beliefs regarding the distribution of the political preferences in the economy, and that such information spill-over will be increasing in the difference between the actual candidate vote shares and the prior ones, and in the turnout rate in the early election. Moreover, the impact of the information spill-over on turnout in neighboring jurisdictions should be stronger in the authorities starting from a more uneven distribution of party preferences.

Empirically, we have exploited the over one-hundred ties and one-vote-difference results that were observed in the Italian municipal elections in the past two decades and relied on the fact that municipalities vote according to a staggered schedule. This makes it possible to test the key empirical predictions of the theoretical model in terms of the direction, size, and determinants of the potential information spill-over on nearby municipalities. Our main results are that the turnout rate in the municipalities that are first-order neighbors of localities experiencing a close outcome and that vote in the subsequent year is higher by between two and three percentage points than in authorities that are not exposed. In line with the model's predictions, we find that the impact of the information spill-over on turnout is larger on the authorities starting from a more uneven distribution of preferences among the two main parties, that can consequently be believed to be hit by a larger informational schock about the distribution of preferences in the electorate. When testing further hypotheses

on potential mechanisms linking the political processes of close-by localities, we find that the number of mayoral candidates is not affected by whether a close outcome occurred in the neighborhood in the preceding years, while we find some evidence that incumbents that are exposed to close outcomes in the neighborhood in the years before their re-election tend to set lower local income tax rates, compatibly with the idea that income tax manoeuvring is used as a vote-buying policy when the electoral race is perceived as increasingly uncertain. However, we still find evidence of a large independent impact of exposure to a tie on turnout even when controlling for the level of the local income tax rate in the turnout determination equation.

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