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Can women's performance in elections determine the engagement of adolescent girls in politics?

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ABSTRACT

Women are responsible for important results in the public sector, but their participation as politicians is still small. One possible way of correcting this situation in the future will be to increase the degree to which adolescent girls participate in politics. The literature about women's empowerment has identified that adolescent girls participate more in politics when role model women are elected. Unlike this literature, however, we run a regression discontinuity design and we show that the defeat of a woman also leads to other women being discouraged from participating. Our main idea is that the performance of female politicians has an influence on the engagement in politics of adolescent girls. Our measure of this engagement is not generated by measuring the perception of the aspirations of adolescent girls, but is taken from net registration to vote between Brazilian municipalities with victorious and defeated female leaders (mayors). Two mechanisms are important for explaining our results: the exchange of experiences between adolescent girls of different ages, and informal (through the Internet and public Wi-Fi) and formal (through the municipal anti-discrimination program) information.

1. Introduction

Women are under-represented in politics in various places in the world.¹ One of the ways indicated in literature for reversing this situation is to increase the exposure of female (political) leaders² because there is a positive relationship between female leaders and the future "aspirations" of adolescent girls in politics (Beaman et al., 2012; Campbell and Wolbrecht, 2006, 2007). The question of the performance of female leaders, however, was never evaluated in the literature, and this can interfere with the participation of adolescent girls in politics given that victory and defeat are antagonistic results.

Our work demonstrates that when a female leader is elected this increases the registration of adolescent girls to vote in

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¹ The participation of women in politics achieves transformations that are currently very heterogeneous if we observe national representation in different parts of world. For instance, if we consider combined national houses (i.e., Upper and Lower House), American countries have a high percentage of elected women, with 27.6% of the seats, while in European countries (i.e., including Nordic countries) women have 25.6% of the seats, in Asian countries they have 18.8% of the seats, and finally, in Pacific countries they have 16% of the seats. See the national parliamentary (2016) data on the Inter-Parliamentary Union site: <http://www.ipu.org/>.

² See the development of Bandura (1986).

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municipalities with this result, but that when a female leader is not elected the number of registrations in municipalities in which the defeat occurs reduces. Working with an electoral quasi-experiment, we observe these two simultaneous movements in the registration of adolescent girls (Lee, 2001; Ferreira and Gyourko 2015; Brollo and Troiano 2016). The traditional “jump” in registrations observed (in RD figures with a mixed-gender race) when the margin of victory is close to zero is not only the result in municipalities in which a female leader is victorious, but also in municipalities in which a female leader is defeated. The increase in registrations following victory, and the reduction in registrations following defeat occur and appear to be graphically symmetrical when the margin of victory is close to zero. As a consequence, we started to interpret the results from our non-parametric regression discontinuity estimate as a net result of the registration to vote between municipalities: more adolescent girls register to vote in municipalities in which a female leader is victorious, and fewer adolescent girls register (non-registration) in municipalities in which a female leader is defeated. Our measure, which we call “engagement”, is between 1.1 ($SE = 0.005$) and 1.6 ($SE = 0.006$) percentage points.

We use elections for mayor (an important position in politics) in Brazilian municipalities as a laboratory. Unlike India (Beaman et al., 2012), for instance, Brazil is one of those countries in which the situation for women electorally is uncertain, and the number of female candidates and elected women is small (see Table 1). Five other aspects about Brazil attracted our attention and made it distinct from other countries. First, Brazilian federal electoral legislation establishes that the vote is not compulsory for adolescents aged 16 and 17, while it is compulsory for literate individuals between 18 and 70 years old. Worldwide, only Brazil and Argentina have a mixed system, in which adolescents up to 18 years old are not obliged to vote, while the vote is compulsory for all other adults until they reach 70. Second, since the works that have been written on the participation of adolescent girls in different countries where voting is not compulsory use a survey to capture the future participation of adolescent girls, we believe there are no data that evaluate the registration or turnout of adolescent girls, such as the data we use here. Third, the stipulated period for voters to register for the election comes before candidates are defined, including candidates for mayor when they are running for reelection. So, the fact of registering to vote may be less influenced by future candidates than by past candidates.³ This clear separation improves our identification strategy.⁴ Fourth, the large number of municipalities with a mixed-gender race country-wide avoids the common problem of this type of exercise because of our empirical strategy: external validity (see Map 1 for the number of municipalities where a woman is competing against a man, and their distribution in Brazil. Map S1.A and S1.B, with different margins of victory, are shown in the online supplementary material). Fifth, a large number of elections in a short space of time (every two years) allows for an investigation into whether adolescent girls in the lower age band are also influenced.

We explore some of the heterogeneities of the sample and observe that: 1) the result of the engagement of adolescent girls is higher when a high concentration of women are elected as councilors; 2) our result does not extend to include adolescent females who are very young at the time of the quasi-experiment (i.e., children who are 12–13 and 10–11 years old); 3) there is no performance “spillover effect” on nearby municipalities in which the election was decided between men (two male candidates in the first and second places); 4) our result is not restricted to elections in which there is just one female candidate running against one male candidate; our result is for any type of election (i.e., when there is more than one male candidate).

We demonstrate that two possible confounding stories do not affect our main result: the effect of outstanding women at other levels of government, and the difference in policy preferences between men and women mayors.

Finally, we explore possible ways for explaining our main result. We observe that our result occurs in those municipalities in which there is an exchange of experiences between adolescents (measured by contact between younger adolescent girls - 14–15 years old - and older adolescent girls - 16–17 years old - living in the same residence). We then observe that information is also important: informal (information without any filter; via the Internet and public Wi-Fi), and formal (information produced in schools; through the municipal anti-discrimination program).

The remainder of this paper is structured as follows. The next section sets out the point we are making about the link between role model and performance. Section III provides an overview of Brazilian institutions. Section IV discusses the performance of women and the engagement of adolescent girls in mixed-gender elections when the margin of victory is close to zero (data, empirical strategy, graphical analysis, the main results, and robustness). Section V shows our results with regard to the heterogeneities of the sample (extensions). Section VI discusses the influence of possible confounding stories, and finally in Section VII we divide our investigation into two possible lines of explanation, which can justify the results (contact between adolescents living in the same residence and information).

2. Female role models: disregarding their electoral performance

The literature claims that prominent women encourage more adolescent girls to participate in politics in an attempt to reproduce this same position. The development of Bandura (1986) which sustains this idea, is based on the social cognitive theory. In our case, we infer that a woman who occupies a prominent position is a role model for other women who are able to activate internal mechanisms that alter their standard social model in their attempt to achieve a similar position.

Evidence of the role model effect on women has been observed in several works in economic and political literature (Beaman et al., 2012; Jennings, 1983; Atkinson, 2003; Bettinger and Long, 2005; Campbell and Wolbrecht, 2006; 2007; Brookman, 2014; Gilardi, 2015; Lassebie, 2020). Although Brookman (2014) uses the same identification strategy used here to observe the effect of a female role

³ Many of the results that are auxiliary to our development will be in the supplementary material that will be available online. We will indicate the link via which this material will be available.

⁴ Brookman (2014) shows that an unclear separation may make it difficult to estimate the mechanism established between the variables.

Table 1
Female candidates and elected in recent Brazilian elections.

	Percentage of female candidates	Percentage of females elected
Mayor	13.44%	11.94%
Councilor	32.14%	13.47%
Federal Deputies	19.09%	8.77%
State Deputies	25.88%	13.03%

Notes: 1) Information for mayors and councilors corresponds to the 2012 elections. Data for Federal and State Deputies corresponds to the 2010 elections. 2) Municipalities with fewer than 200,000 voters. Source: Election data comes from the Superior Electoral Court (SEC).

Source: Election data comes from the Superior Electoral Court (SEC).

model on female candidates, the literature does not evaluate the importance of the performance of a prominent female leader on the aspirations of adolescent girls in politics (Beaman et al., 2012; Campbell and Wolbrecht, 2006, 2007). This type of investigation is important because women are not always shown as winners in the political arena. “Women as winners” is not a dominant feature of the political world. Institutionally this depends on having a political system in which, for example, there are reserved seats (for instance, reserved seats for women in India). In India, Beaman et al. (2012) find that the election of a female leader shapes adolescent girls’ political aspirations (i.e., those between 11 and 15 years old): an increase of 4.9 percentage points.

Unfortunately, most of the political world for women is of electoral uncertainty about their victory: a gender competition. Women generally compete against men in elections. In political science literature we observed two positive impacts of a woman being elected on the participation of adolescent girls in a situation of electoral uncertainty for female candidates. Campbell and Wolbrecht (2006) find that the number of viable (visible) female candidates (for US positions: House, Senate, and governor) has a correlation of 39 percentage points with political involvement (from responses to questions about whether women should run for office or stay out of politics, and whether men are more qualified to be political leaders than women). Campbell and Wolbrecht (2007) find that the percentage of women elected to be a US national legislator is correlated to a 0.6 percentage point increase in the participation of adolescent girls (responses to questions about active citizens in the future).

In fact, in these results of gender competition, if the performance of prominent women is relevant (when women are defeated or when they are elected), the observed participation of adolescent girls in almost all the mentioned works that deal with gender competition is the result of a role model woman either winning or losing. On the other hand, if performance is not important, the observed participation is purely because a woman has achieved a prominent position in politics. Prominent female candidates, for example, lead to adolescent girls participating in politics, regardless of their result in the election.

In these two possibilities, our objective is to investigate if the electoral performance of prominent women (whether elected or not) in a system with a gender competition is a determining factor for the engagement of adolescent girls in politics. Our idea is that the defeat of a prominent woman can discourage adolescent girls from becoming involved in politics (with lower voting registrations), while the victory of a prominent female encourages adolescent girls to get involved with politics (with higher voting registrations).

3. The institutional background

The Brazilian Electoral System: Brazil is a federalist country with three levels of government, namely, federal, state (27 – one of which is the Federal District), and municipalities (5,565). There are three electoral district sizes in the country. For local elections, the district is the municipality (elections for mayor and councilors). For national and state elections (i.e., elections for federal, district, and state deputies, governors and senators), the electoral district is the state. The electoral district of the country as a whole occurs only in presidential elections. Elections occur every two years in Brazil. There are local elections every four years. Although elections for president, governors, senators, and federal, district and state deputies also occur every four years, they are mid-term to local elections. Except senators, who enjoy an eight-year term, all office-holders (i.e., in the Executive and Legislative branch) have a four-year fixed term. Since the 1988 Constitution, mayors have been chosen in a one-round election (majoritarian system) in municipalities with fewer than 200,000 registered voters. Mayors are chosen in run-off elections in municipalities with over 200,000 registered voters if no candidate achieves a majority of valid votes in the first round (50% plus one). The president and governors are also subject to the same run-off election if they do not obtain 50% plus one of the valid votes in their corresponding district (i.e., country and state). We only use data for municipalities below the 200,000-voter threshold. In doing so, we exclude approximately 120 of the largest municipalities from the initial country sample. The reason for this decision is to avoid strategic voting behavior, when voters do not necessarily reveal their preferences in the first round (Fujiwara, 2011). Federal, District, State Deputies, and Councilors are elected by an open-list proportional representation system (i.e., voters can order the list of either candidates or parties). The constitutional amendment of 1997 establishes that mayors, governors and the president can only be reelected once – the term limit rule. However, there is no term limit for legislative members.

Registration of candidates: Brazilian electoral legislation does not allow either independent or nonpartisan political candidates. All candidates need to be nominated by either a party or a coalition of parties to be eligible. Candidates are nominated by parties in June in the electoral year (i.e., in accordance with Law 9,504, 1997, between the 10th and 30th of the month; and the new Law 12,891, 2013 between the 12th and 30th). All parties and coalitions have to register their candidates with the Regional Electoral Court (REC), the Superior Electoral Court (SEC), and an electoral judge (Law No. 9,504, 1997) by August 15. The president and vice-president are

registered with the SEC. Federal, District, and State Deputies, Governor and Vice-Governor are registered with the REC, while mayors and councilors are registered with an electoral judge (i.e., those who represent electoral justice in the municipalities).

Non-Compulsory adolescent registration for voting: Individuals who are 16 and 17 years of age, the illiterate, and individuals over 70 years old are not obliged to vote (Article 14 of the 1988 Constitution). Fifteen-year old adolescents can register to vote in the election if their 16th birthday falls in the election year. The registration of other groups of the population is compulsory (i.e., those over 18 and under 70 years old). The deadline for any individual to register for the election is 151 days before election day (e.g., in first-round elections “the election day” is approximately October 1 – Law 9504/1997). Unlike in the US where each state establishes its own registration law,⁵ electoral law in Brazil is the same for the whole country, as it is in the UK or France.⁶ Although there are penalties for individuals who do not vote but for whom the vote is compulsory (among such penalties, for example, being a small fine, or being unable to obtain or renew a passport), the cost of the punishment for not voting is perceived differently by different groups in society (for example, a rich individual uses a passport and a poor individual does not; thus not voting for a poor individual may not have a cost; see Cepaluni and Hidalgo, 2016). This means that a large number of individuals avoid turning out to vote in Brazil.

Electoral gender quota: Lassebie (2020) shows the importance of gender quotas on the selection of local politicians in France. Braga and Scervini (2017) show the effect of gender quotas on the performance of politicians (quality of life, policy for women and households) in Italian municipalities.⁷ Hicks et al. (2016) show the importance of gender quotas in different countries for increasing the gender composition of national legislatures. Law 9,100, 1995 establishes an electoral gender quota (EGQ) in Brazilian elections for coalitions/parties. There are no reserved seats for councilors or mayors in Brazil. According to the law, individual parties or party coalitions need “to reserve” 20% of their candidate entitlement for women. Law 9,504, 1997 changed the percentage of “reserved for” women candidates from 20% to 30%. Law 12,034, 2009, subsequently changed the word “reserved for” to “filled by” 30% female candidates, the maximum permitted proportion of women being 70%. This change was important because parties and coalitions did not understand the reserve as a “commitment”. The SEC (Resolution No. 23,373, 2011, December) defined that if female candidates do not represent 30% of the candidates of the parties or coalitions, all candidates will be contested (i.e., in practice, the SEC makes an additional enforcement). Institutionally, therefore, the EGQ was valid for the 2012 election. This change in no way affects our quasi-experiment (mayoral elections) for two reasons. First, the effect of EGQ is confined to parties and/or coalitions. The biggest effect of EGQ is on legislative candidates (councilors, and federal/state deputies). We explore the concentration of female councilors elected in municipalities (i.e., a higher and a lower concentration) and show that the percentage of elected female councilors is balanced for the total sample (see Table 3C below). Second, our main result concerning adolescents looks at the period two years later. Looking at our quasi-experiment, the final election (2012) with EGQ should produce results on registration for the 2014 election, but the 2014 election is not in our sample.⁸

Women in Brazilian politics: Although there has been an attempt at institutionally increasing the participation and election of women in politics, recent results show that there are fewer women in the political market (candidates and elected) than in other markets in Brazil (Table 1). In the labor market, for instance, half of the economically active population who are formally registered as employees are women, according to information from the IBGE (2016).

Map 1 shows the evolution of municipal disputes between women and men over time (2000, 2004, 2006, and 2010). We can see the same map with different levels of competition (a 5% margin and a 10% margin) in the supplementary online material (Map S1.A and Map S1.B).

Dark-colored municipalities are the baseline municipalities in our sample (mixed races). The darkest color is for when women win and the lighter color for when women lose (a man wins). White municipalities are not included in our sample, because female candidates are not disputing the election as the first or second candidate.

Visually, the tendency that there is an increase in the number of disputes between women and men in municipalities for the office of mayor over time, regardless of the different levels of competition. Another factor that attracts our attention here is the distribution of disputes over the whole country (different regions in the country), from regions with the biggest populations, basically in the southeast of Brazil, to regions with the poorest municipalities, as in the northeast of the country. One potential criticism of the RD estimate is the local result.⁹ Our sample is dispersed and representative of the whole country.

4. Performance of a female mayor and the engagement of adolescent girls in politics

Data: Our database is replicable because variables were collected from two information websites. Electoral data were extracted electronically from the site of the Superior Electoral Court (SEC).¹⁰ Although the data have been available since 1994, the first election with complete information about mayoral candidates (e.g., gender) and for all states is 2000. Thus, we use four elections for mayor in our exercise (2000, 2004, 2008, and 2012) and four mid-term municipal elections (1996, 2002, 2006, and 2010). The other variables used in our exercise, such as characteristics of the municipalities and population, were obtained from the IBGE (Brazilian Institute of

⁵ Registration can occur 30 days before the election, while other countries may allow voters to register up to and on Election Day.

⁶ See an example in election time (deadline for registration of voters, time of nominated candidates, and elections - Figure S32 in the online supplementary material).

⁷ De Paola et al. (2010) and Baltrunaite et al. (2014).

⁸ We re-calculated the results without the 2012 election and the results are the same. The results can be requested from the authors.

⁹ See the warning of Bhalotra et al. (2017) on this question.

¹⁰ www.tse.gov.br.

Geography and Statistics).

The original data extracted from the available database do not directly serve our interests. We used them to build each variable. The name of each variable and how it was built is shown in [Table 2](#).

[Table 3A](#) reports the descriptive statistics of registrations to vote of two female groups: adolescent girls (aged 16–17) and women (aged 18–59). These results are extracted from a sample with a woman and a man running for mayor, i.e., the first and second places. We use the registration of the group of women (aged 18–59) to make it clear in our main exercise that our effect occurs only with individuals who do not have to register compulsorily (aged 16–17). We observe no difference in the results, on average, in the variables when either a woman or a man is elected. For example, two years after the quasi-experimental election when a man is elected, the average percentage of adolescent girls who register to vote out of the total number of adolescents (girls and boys) registered to vote and who are the same age is 50.7%; and 50.4% when a woman is elected.

Columns 1 and 2 of [Tables 3B](#) and [3C](#) shows the descriptive statistics of the politicians, the elections, and the municipal characteristics when either a man or a woman is elected. The candidate's characteristics are their schooling (completed high school; completed higher education), and party affiliation. Election characteristics are both the percentage of women elected as councilor in the municipality and the share of the vote of a woman elected as councilor. The municipal characteristics are the percentage of houses with access to a sewage system, the percentage of literate people (over 25 years old), the population, log per capita GDP, the percentage of women¹¹ and adolescent girls aged 16–17 in the population, the Theil index, and the percentage of rural dwellers. Finally, we observed the same descriptive statistics in elections for mayor for the years 2000, 2004, 2008, and 2012, the same elections on which the quasi-experiment was built.

We also report information on the RD estimate¹² to check whether there is a balance between the observable characteristics of the politicians, elections and municipalities in elections with a margin of victory close to zero ([Table 3B](#)): women vs. men (Column 3), women vs. women (Column 4), and men vs. men (Column 5).¹³ The balance of the last two dimensions is unusual in gender literature using an RD estimate.¹⁴ We understand that it is important to check whether the characteristics of the winning-losing politicians within their gender group are not very different. This procedure allows us to observe whether the dispute in our main investigation between women and men is not the result of the presence of a “special” woman or man.

The intra-group results are well balanced for all characteristics (Column 4 and 5 of [Table 3B](#)). The characteristics of women and men disputing elections with a margin of victory close to zero (Column 3) are balanced, with one exception: mayors who have higher education. A common misunderstanding of this result is to think that women who win elections have more year's schooling than men. It should not be interpreted in this way. Our results indicate that we have more female winners than men when both candidates have completed their higher education. If female mayors who have completed high school were statistically significant, we could understand that this pre-characteristic of theirs might have an influence on the internal validity of our quasi-experiment. Women have a systematic electoral advantage that comes from their schooling. This is not the case, however, with the results we obtained. [Baltrunaite et al. \(2014\)](#) show evidence that elected men have lower levels of education than elected women in Italy. Specific study is necessary to understand this result, and this lies outside the scope of our investigation here. Observing [Lee's et al. \(2004\)](#) paper, we see that the black population percentage was the only unbalanced covariate in a set of covariates.

Empirical Strategy: To observe the causality of the variables in reduced form without the possibility of bias in our estimations, we apply a sharp RD approach in the same way as [Lee et al. \(2004\)](#). Municipalities in which a woman wins by a large margin are likely to be different from municipalities where a woman loses by a large margin. However, when we narrow our focus to elections in those municipalities in which the margin of victory is close to zero, it becomes more plausible to consider that the electoral position of competitive women is uncertain (not determined by idiosyncratic factors). We focus our investigation on municipalities with races for mayor (with a margin of victory or defeat close to zero) where the two most voted candidates were a woman and a man (a mixed-gender race).

Our treatment variable D_{it} is a dummy variable that equals 1 when a female role model beats a male opponent in municipality i in year t . The control group ($D_{it} = 0$) is formed by the municipalities that elected a man (a defeated role model woman). The running variable is margin of victory ($Margin_{it}$) and the relationship between D_{it} and $Margin_{it}$ can be written as¹⁵

$$D_{it} = \begin{cases} 1 & \text{if } Margin_{it} > 0 \\ 0 & \text{otherwise} \end{cases} \quad [1]$$

The impact of a female role model's electoral position relative to a man on Y_{it+t} , the dependent variable that represents the engagement of adolescent girls (i.e., the main variable of our investigation), is defined by parameter β , which is an average treatment effect near the cutoff and can be written as:

¹¹ Although we use the percentage of women as a covariate, [Table S15](#), column 3 (online supplementary material) shows there is no difference between the two cohorts of municipal populations used here in a mixed election race: adolescents who are 16 and 17 years old and women between 18 and 59 years old.

¹² The RD estimate uses the same methodological procedure as our main results, which are described in the empirical strategy.

¹³ The municipal and electoral characteristics are the same for any group of municipal events (women vs. men, women vs. women, and men vs. men). See Column 3 in [Table 2C](#).

¹⁴ See [Bhalotra et al. \(2017\)](#) and [Brollo and Troiano \(2016\)](#).

¹⁵ See how the “margin” variable was built in [table S1](#) (online supplementary material).

Table 2
Definition and construction of variables.

Definition	Construction
Margin of victory	Difference in the percentage of votes between female and male candidates for mayor, considering the first and second places in the first round of municipal elections in municipalities with up to 200,000 inhabitants.
Engagement (Difference in Adolescent Girls' Registration) ₁₆₋₁₇	Measure of registration for elections two, four, and six years later. The lagged (past) variable is the opposite (before the mayor is elected): two years before Difference in Adolescent Girls' Registration is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.
Difference in Women's Registration ₁₈₋₅₉	Difference in Women's Registration is the difference in the number of women registered to vote over 18 and under 59 years old as a percentage of the total number of individuals registered to vote of same age (women plus men) in municipalities in which women are elected and those in which they are not elected.
Education of mayors	Completed high school Completed higher education
Parties to which the politician belongs	PT (Workers Party) PSDB (Brazilian Social Democracy Party) PFL (Liberal Front Party)/DEM PMDB (Brazilian Democratic Movement Party)
Election year for mayor	2000, 2004, 2008, and 2012 Dummy variables with values equal to 1 if the election for mayor occurs in a specific year and zero otherwise
Concentration of women on the municipal legislative council	Percentage of female councilors elected in the municipality Share of the vote for women councilors Number of female councilors elected as a percentage of the total number of elected councilors (women and men). The Lower and Higher concentrations are municipalities below/above the national median of elected councilors. Number of votes for women councilors as a percentage of the total number of votes for councilors (women and men). The lower and higher concentrations are municipalities below/above the national median of vote share for women councilor.
Definition	Construction
Houses with access to sewage	Number of houses with access to a sewage system as a percentage of the total number houses in the municipality
Literacy – over 25 years old	Numbers of the population over 25 years old who are literate as a percentage of the total population (in percentage points from 1 to 100)
Population	Population of each municipality (in thousands)
Log GDP per capita	Natural logarithm of per capita municipal GDP in thousands
Women	Percentage of women in the total municipal population
Adolescent girls aged 16-17	Percentage of 16 and 17-year old adolescent girls in the total municipal population
Theil index	Theil index of municipality
Rural dwellers	Number of rural dwellers as a percentage of the total population in the municipality - in decimals (0–1)
Contact among adolescent girls	Average percentage of residences with adolescent girls between 14-15 and 16–17 living in the same residence by municipality. There are municipalities with and without this type of residence
Concentration of households with Internet access	Average percentage of households with Internet access by municipality. The lower and higher concentrations are municipalities below/above the national median of households with Internet access.
Public Wi-Fi	Municipalities with and without public Wi-Fi; Dummy variables with values equal to 1 if the municipality has public Wi-Fi and zero otherwise
Anti-discrimination Program	Municipalities with and without an Anti-discrimination Program. Dummy variables with values equal to 1 if the municipality has a municipal Anti-discrimination Program and zero otherwise
Nearby municipalities	Nearby municipalities are those in which two-men are competing (first and second place as candidate) for the office and that are near a municipality in which there is a female winner. We use two neighborhood measures: contiguous municipalities and nearby municipalities using geodetic distances (the shortest distance over the earth's surface) between two latitude/longitude points.

$$\beta = \lim_{Margin \downarrow 0} E\left(Y_{it+\tau} | Margin_{it}\right) - \lim_{Margin \uparrow 0} E\left(Y_{it+\tau} | Margin_{it}\right) \quad [2]$$

Thus, our identification strategy is a “jump” in the treatment variable at the discontinuity point, which can be attributed to the effect of crossing the cutoff point (i.e., a female role model winning in municipality N) because there should be no systematic differences between the characteristics of municipalities, the electorate, etc., when role model women have “just won” or “just lost” in a contest with men. Under certain conditions, therefore, municipalities in which female role models lost by a small margin (i.e., men won) can serve as a reasonable counterfactual for municipalities where they won by a small margin. The great difference in interpretation between the results found here and those in the applied RD literature is that the “jump” may be the net result between the increase and decrease in the number of adolescent girls registering to vote in municipalities with a distinct electoral result; the engagement of adolescent girls in politics in our version.

Table 3A
Descriptive statistic of variables used in our exercise.

	Time of elections when the result is reported	Sample with one woman and one man (first and second places) competing for office	
		When a	
		Man is elected	Woman is elected
		(1)	(2)
Adolescent Girls' Registration ₁₆₋₁₇	Two years before (the last election)	0.498 (0.05) [1529]	0.497 (0.049) [1077]
	Two years later (the next election)	0.507 (0.053) [1899]	0.504 (0.058) [1346]
	Two years before (the last election)	0.495 (0.023) [1529]	0.494 (0.024) [1077]
Women's Registration ₁₈₋₅₉	Two years before (the last election)	0.497 (0.022) [1899]	0.496 (0.023) [1346]
	Two years later (the next election)		

Notes: Columns 1–2 report the descriptive statistics of registration to vote of female groups in municipalities with a dispute by gender. Each variable contains three items of information: the average, standard deviations in parentheses, and the number of observations in brackets. Dependent variables (definition).

Adolescent Girls' Registration is the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents of the same age registered to vote (girls plus boys) in the municipality.

Women's Registration is the number of women over 18 registered to vote and under 59 years old as a percentage of the total number of individuals of the same age registered to vote (women plus men) in the municipality. Source: Data of voters registered to vote are taken from the Superior Electoral Court (SEC).

Source: Data of voters registered to vote are taken from the Superior Electoral Court (SEC).

Table 3B
Baseline Characteristics - Descriptive statistics and balance test of covariates.

	Sample with one woman and one man (first and second places) competing for office				
	When a man is elected	When a woman is elected	RD estimate Women vs. Men	RD estimate Women vs. Women	RD estimate Men vs. Men
	(1)	(2)	(3)	(4)	(5)
<i>Mayor Candidate's Characteristics</i>					
Completed high school	0.332 (0.4712) [1906]	0.309 (0.462) [1361]	-0.036 (0.052) {2015}	-0.053 (0.053) {1829}	0.047 (0.051) {1936}
Completed higher education	0.407 (0.491) [1906]	0.589 (0.492) [1361]	0.226*** (0.050) {2140}	0.033 (0.054) {2006}	0.054 (0.048) {2374}
Belongs to the PT Party	0.081 (0.273) [1906]	0.076 (0.265) [1361]	-0.031 (0.032) {1946}	0.017 (0.024) {2562}	-0.017 (0.03) {2233}
Belongs to the PSDB Party	0.136 (0.343) [1906]	0.146 (0.354) [1361]	0.013 (0.032) {2415}	0.009 (0.032) {2539}	-0.004 (0.035) {1915}
Belongs to the (DEM) PFL Party	0.116 (0.32) [1906]	0.121 (0.327) [1361]	-0.023 (0.034) {1972}	-0.005 (0.033) {2028}	0.027 (0.040) {1761}
Belongs to the PMDB Party	0.197 (0.397) [1906]	0.204 (0.403) [1361]	-0.005 (0.036) {2490}	-0.017 (0.039) {2227}	-0.009 (0.037) {2430}

Notes: 1) Bias-corrected RD estimates with robust variance estimator using [Calonicio et al. \(2014\)](#). Standard deviations are in parentheses (columns 1 and 2). Standard errors are in parentheses (columns 3, 4, and 5). The number of observations is in brackets. The number of effective observations used in the estimate is in braces; 2) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round; 3) The bandwidth used in the RD results is generated endogenously (triangular kernel). 4) Columns 1–2 report the descriptive statistics of each variable. 5) Column 3 reports the RD estimate between municipalities with women and men candidates. 6) Column 4 reports the RD estimate between municipalities with women candidates only. 7) Column 5 reports the RD estimate between municipalities with men candidates only. * Significance at the 10% level, ** at 5% level, and **** at 1% level.

Source: Data of mayor candidate's characteristics are taken from the Superior Electoral Court (SEC).

Table 3C
Baseline Characteristics - Descriptive statistics and balance test of covariates.

	Sample with one woman and one man (first and second places) competing for office		
	Man Elected	Woman elected	RD estimate (Women vs. Men; Women vs. Women; Men vs. Men)
	(1)	(2)	(3)
<i>Election Characteristics</i>			
Percentage of female councilors elected in the municipality	0.139 (0.115) [1905]	0.148 (0.119) [1361]	0.014 (0.013) {2075}
Vote share for women councilors	0.166 (0.074) [1900]	0.172 (0.075) [1344]	0.012 (0.008) {1943}
<i>Municipal Characteristics</i>			
Houses with access to sewage	0.197 (0.277) [1807]	0.203 (0.277) [1294]	0.040 (0.028) {1936}
Literacy – over 25 years old	70.20 (15.616) [1906]	69.60 (15.66) [1361]	0.261 (1.757) {1891}
Population	21310.023 (35568.108) [1883]	19754.48 (29180.4) [1338]	598.834 (2367.849) {1620}
Log GDP per capita	3.976 (5.662) [1883]	3.853 (6.25) [1338]	0.043 (0.371) {1732}
Women (% of Total Population)	0.492 (0.145) [1822]	0.491 (0.014) [1292]	−0.001 (0.002) {1689}
Adolescent girls ages 16–17 (% of Total Population)	0.483 (0.03) [1892]	0.481 (0.003) [1347]	0.001 (0.003) {2412}
Theil index	0.523 (0.011) [1883]	0.525 (0.112) [1338]	0.004 (0.012) {2119}
Rural dwellers (% of Total Population)	0.597 (0.22) [1807]	0.597 (0.21) [1292]	0.007 (0.023) {1886}
<i>The election year</i>			
The 2000 mayor election	0.191 (0.393) [1906]	0.199 (0.4) [1361]	0.022 (0.044) {1753}
The 2004 mayor election	0.2 (0.4) [1906]	0.207 (0.405) [1361]	−0.018 (0.040) {2126}
The 2008 mayor election	0.239 (0.427) [1906]	0.213 (0.409) [1361]	−0.075* (0.039) {2417}
The 2012 mayor election	0.369 (0.483) [1906]	0.381 (0.486) [1361]	0.086* (0.051) {2003}

Notes: 1) Bias-corrected RD estimates with robust variance estimator using [Calonico et al. \(2014\)](#). Standard deviations are in parentheses (columns 1 and 2). Standard errors are in parentheses (column 3). The number of observations is in brackets. The number of effective observations used in the estimate is in braces; 2) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round; 3) The bandwidth used in the RD results is generated endogenously (triangular kernel). 4) Columns 1–2 report the descriptive statistics of each variable. 5) For any group which evolves Women vs. Men, Women vs. Women, and Men vs. Men, the municipal characteristics are the same. * Significance at the 10% level, ** at 5% level, and **** at 1% level.

Source: Data of municipal characteristics are taken from IBGE (Brazilian Institute of Geography and Statistics) and election data come from the Superior Electoral Court (SEC).

As is usual in this literature, we estimate the average treatment effect on the treated using local polynomial regressions of order 1 weighted by triangular kernel functions. Bandwidths are chosen by a mean-squared error minimization. According to [Calonico et al. \(2014\)](#) the choice of the local polynomial of order 1 could lead to asymptotic bias due to error in approximation. These authors propose a way to correct for the bias based on the equation below

$$\hat{\beta}' = \beta - B_n \quad [3]$$

where B_n is the bias, which is estimated by the difference between the second and first order polynomials approach and n is the sample size. [Calonico et al. \(2014\)](#) also propose a correction in the variance of $\hat{\beta}'$ to add to the variance of \hat{B}_n . This implies that our standard errors are greater than those obtained by the conventional procedure.

Our study includes two additional procedures in the main result. The first is the same non-parametric model using the estimator suggested by [Calonico et al. \(2014\)](#), controlled by the baseline covariates shown in [Tables 3B and 3C](#) (characteristics of politicians, municipalities, and the electoral years). The covariates increase the efficiency of the estimate. The second (a robustness), a quantile approach, is the result of quantile regression weighting more observations around the cutoff, as we do in the RD estimation using a triangular kernel.^{16 17}

Validating the Empirical Strategy: We establish three procedures to check whether identification is valid ([Imbens and Lemieux, 2008](#); [Eggers et al., 2013](#)). First, we investigate whether there is an absence of selective sorting around the women's win-lose threshold. To formally test for sorting, we implement the McCrary test ([McCrary, 2008](#)) by collapsing the election data. There are two results (different histograms with different frequencies and McCrary tests) in [Figure S30](#) in the online supplementary material.¹⁸ The McCrary test of density (right-hand figure) does not confirm manipulation (the McCrary t -test is -0.51).¹⁹

Second, we investigate whether all relevant factors besides treatment vary smoothly at the cutoff between a female victory and loss. This assumption would be violated if the outcomes of elections in which the margin of victory is close to zero were determined not by idiosyncratic factors, but by a systematic current advantage of the winners. Column 3 in [Table 3B](#) (results previously discussed in the data section) and 2C examine whether the pre-characteristics of the election and municipality are balanced across the female win-lose cutoff point. We show the graphs of these covariates ([Figures S1 and S2](#)) in the online supplementary material. The electoral characteristics are also balanced (first two results of [Table 3C](#)). The municipal pre-characteristics follow the same tendency (eight covariates). We use dummy electoral years as covariates because we are producing simultaneous results from different elections. The 2008 and 2012 elections are significant and have different signals (negative and positive).

Finally, using the RD estimate, we ran balance tests on the lagged dependent variables of our main investigation. If the outcome of interest is the engagement of adolescent girls vis -à-vis the electoral result, then we would not expect a woman's victory over a man to affect past engagement of adolescent girls. If there is discontinuity in predetermined variables at the cut-off point, then this throws into question the validity of the RD design. The results of the RD estimate for lagged variables are shown in the same table as the main results.

Graphical analysis of adolescent girls' engagement: Our results contain two figures. Panel A ([Fig. 1](#)) reports the engagement of adolescent girls (16–17 age) given the defeat/victory of role model women, the main investigation of our exercise. Panel B ([Fig. 1](#)) reports women's registration (compulsory voters aged between 18 and 59 years old).²⁰

The registration of women is necessary to make it clear that engagement is linked exclusively to the group of adolescent girls ([Steinberg and Monahan, 2007](#); [Gardner and Steinberg, 2012](#)). The figure plots the registration of adolescent girls (women) against women's margin of victory, with a negative margin indicating a male victory (female loss). Each point represents the average registration of adolescent girls (women) in different bandwidths (the confidence interval is 90%). We use evenly-spaced bandwidths, following the procedure established by [Calonico et al. \(2015\)](#). The solid line plots predicted global values from an estimate of the regression of the registration of adolescent girls (women) separately on either side of the female lose-win cutoff (4th degree polynomial). We produce the same figure with a polynomial of the 1st degree in the online supplementary material ([table S29](#)). The discontinuity is the same.

In [Fig. 1](#) (Panel A), while female victories in elections increase the registration of adolescent girls (when the margin of victory is positive and close to zero in municipalities), the defeat of a female leader reduces registration (non-registration in municipalities when the margin of victory is negative, or close to zero). Without the effect of defeat on registration, we do not observe the "decline" on the left side of the cutoff. Thus, engagement is the net effect of registrations to vote and this is what we identify. This is observed without the influence of idiosyncratic factors when the margin of victory is close to zero. In the same figure (Panel B) we observe that women's victories in an election in which the margin of victory is close to zero do not change the registration behavior of women (compulsory voters between 18 and 59 years old; see problems with electoral turnout in [Cepaluni and Hidalgo \(2016\)](#): some individuals, for whom the vote is compulsory in Brazil, perceive the cost of punishment for not voting as low).

Main result: [Table 4](#) shows our main results. They contain four types of information: first, the causal effect of a competitive woman being elected (compared to a woman not being elected; a male victory) on any pre-existing engagement in politics by adolescent girls (Column 1); our intention is to check if the engagement is not pre-existing, since this would invalidate the electoral quasi-experiment; second (Column 2), the causal effect of a woman being elected (or not elected) on the engagement of adolescent girls (non-compulsory voters), which is our main investigation; third (Column 3), the same causal effect including the covariates shown, which was discussed in the previous section; and fourth (Column 4), the same investigation using a quantile approach (results for the median). All results are

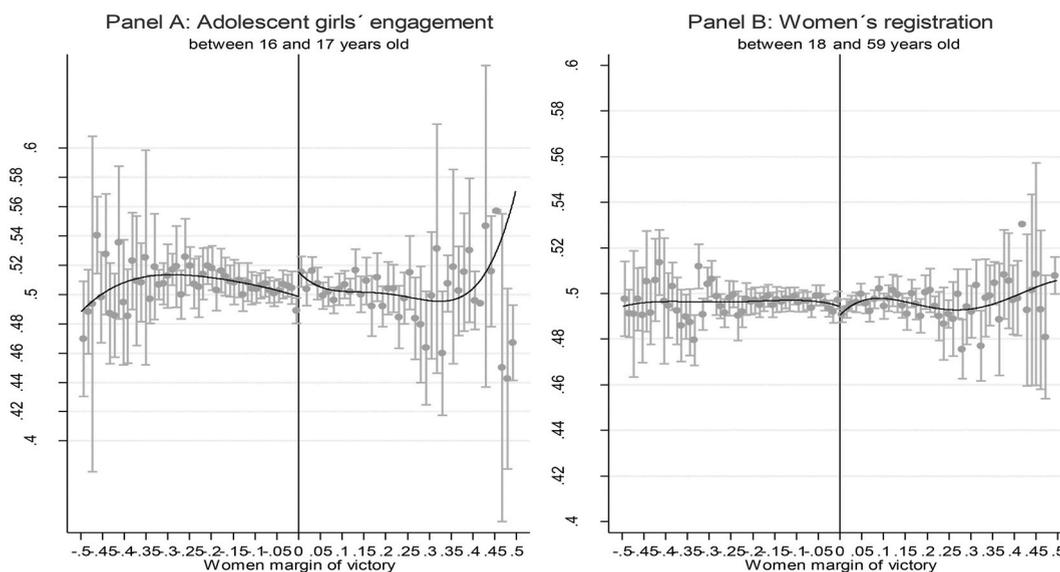
¹⁶ See the recommendations of [Gelman and Imbens \(2019\)](#) on the use of non-parametric and parametric models in RD estimates.

¹⁷ The second procedure does not extend to all results in sequence. They can be requested from the authors.

¹⁸ We process independent results for each election (2000, 2004, 2008, and 2012) and they are similar. See [figures S24, S25, S26, and S27](#) in the online supplementary material. The left-hand figure contains three different histograms with different frequencies (women losing is left of the cutoff margin zero and women winning is right of the cutoff margin zero). A set of histograms with different bins: 2%, 1%, and 0.5%.

¹⁹ Rejects the null hypothesis for the difference in density estimates just to the left and just to the right of the cutoff (margin zero).

²⁰ We consider 59 years old because the majority of individuals retire at 55 in Brazil. See report on site (<https://www.bbc.com/portuguese/brasil-46866691>).



Notes: This figure plots adolescent girls' (women's) registration against women's margin of victory, with a negative (positive) margin indicating a female loss(win). Each point represents the average adolescent girls' (women's) registration in different bandwidths. We use evenly-spaced bandwidths following the procedure established by Calonico et al. (2015). The solid line plots predicted global values from a regression of adolescent girls' (women's) registration estimate separately on either side of the women's loss-win cutoff point (4th degree polynomial). Engagement is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

Fig. 1. Engagement-related women performance RD Figures.

Notes: This figure plots adolescent girls' (women's) registration against women's margin of victory, with a negative (positive) margin indicating a female loss(win). Each point represents the average adolescent girls' (women's) registration in different bandwidths. We use evenly-spaced bandwidths following the procedure established by Calonico et al. (2015). The solid line plots predicted global values from a regression of adolescent girls' (women's) registration estimate separately on either side of the women's loss-win cutoff point (4th degree polynomial). Engagement is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

also shown for women's registration. The first three columns will use a standard format for all subsequent results. In the table, we show a line containing the bandwidth considered in each non-parametric estimate.

Any pre-existing engagement of adolescent girls and women's registration is not statistically significant for explaining a woman being elected/not elected in an electorally uncertain situation. The engagement of adolescent girls, therefore, does not come from any change in their past behavior. When a woman is elected mayor, this does not lead to any difference in the registration of women, but our main result suggests that an elected woman does increase the registration of adolescent girls. There is, however, a simultaneous effect that reduces the registration caused by the non-election of a woman. The performance of role model women interferes with the registration of adolescent girls. Observing Fig. 1 and the results shown, engagement, which is the result of simultaneous events, is between 1.1 ($SE = 0.005$) and 1.6 ($SE = 0.006$) percentage points. Thus, the positive effect of the registration of adolescent girls resulting from a role model woman being elected is small. Brazil's registration numbers are an effective measure of the political action of adolescent females and males, given that they have the opportunity of choosing whether to participate in politics or not.²¹ Unlike the literature (with reserved seats: Beaman et al., 2012 or with electoral uncertainty: Campbell and Wolbrecht, 2006, 2007), our result is based on performance (victory and defeat), not just on the role model.

Robustness: We carried out additional investigations without changing the main results: a) excluding outlier points around the threshold since they may be conditioning the results²²; b) working with the same main result for different bandwidths²³; c) working with other "fake" cutoffs on the margin of victory²⁴; d) extending our result to a less restricted sample (with higher margins of victory)²⁵; e) demonstrating that the effect comes from adolescent girls and not from adolescent boys since our main measure involves the sum of the registrations of adolescent girls and boys in the denominator (we investigate the effects only on adolescent boys using

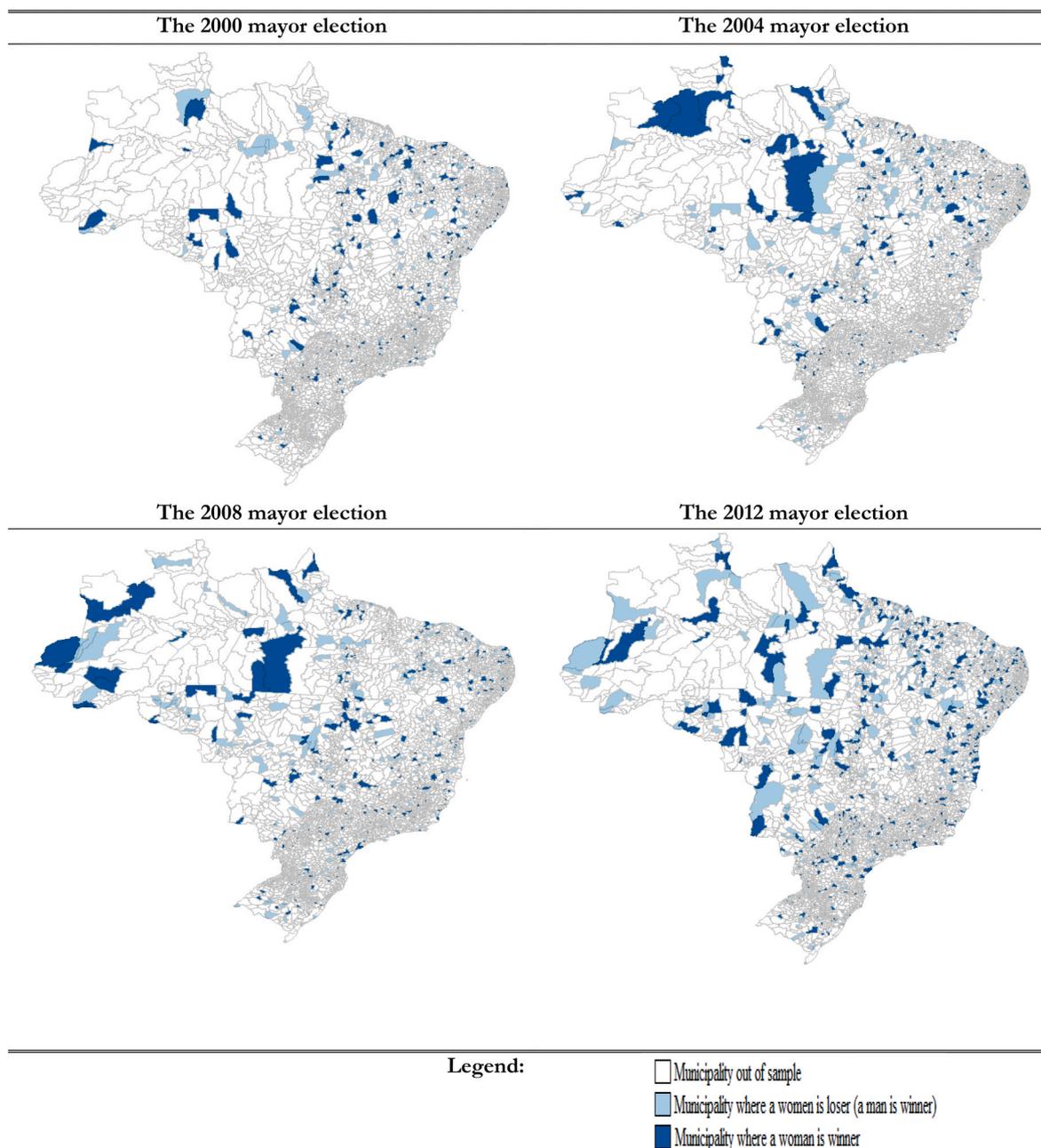
²¹ We know of no works that adopt a regression discontinuity approach that observes simultaneous effects close to the cutoff point (see recent works, for example, such as those by Avdic and Karimi, 2018; Curto-Grau et al., 2018; and Li et al., 2020; Lassebie, 2020).

²² See Figure S31 in the online supplementary material. This measure of exclusion corresponds to 2.5 percentage points of the observations to the left and right of the cutoff. We did the same exercise with 1.5 and 3 percentage points. The results are similar.

²³ See Table S15 in the online supplementary material.

²⁴ We re-did the graph of the engagement of adolescent girls testing different discontinuities (-10% and 10% margins) as robustness to show that discontinuity occurs only with a zero margin. See in the online supplementary material (Figure S28).

²⁵ See Table S1 in the online supplementary material. We use a parametric RDD.



Map 1. Maps showing where women win-lose to men when the electoral dispute involves both male and female candidates (i.e., the first and second candidates in the election).

the same methodology; the effects are null)²⁶; f) showing that there is no difference between the two cohorts of municipal populations used here in a mixed-gender electoral race: adolescents who are 16 and 17 years old and women between 18 and 59 years old²⁷; g) producing Table 4's (first three columns) results with heteroscedasticity-robustness nearest the neighbor variance estimator with at least 3 neighbors²⁸; and h) re-doing the results correcting for autocorrelation.²⁹

²⁶ See Table S16 in the online supplementary material.

²⁷ See Table S14 in the online supplementary material.

²⁸ See Table S27 in the online supplementary material.

²⁹ The results may be solicited from the authors.

Table 4
Effect of electoral performance of women as mayor on the engagement (registration) of adolescent girls (women).

Specific cohort of population		Two years before (the last election)	Two years later (the next election)		
		RD estimate	RD estimate	RD estimate	Quantiles (median result)
		(1)	(2)	(3)	(4)
Non-Compulsory Voters	Engagement (Difference in Adolescent Girls' Registration) ₁₆₋₁₇	0.000 (0.006)	0.015** (0.006)	0.016** (0.006)	0.011** (0.005)
	Effective number of observations	1768	2033	1754	1839
Considered bandwidth		0.165	0.154	0.142	–
Compulsory Voters	Difference in Women's Registration ₁₈₋₅₉	0.001 (0.003)	–0.003 (0.003)	–0.002 (0.002)	–0.004 (0.003)
	Effective number of observations	1515	1637	1663	1839
Considered bandwidth		0.134	0.11	0.131	–
Included covariates?		No	No	Yes	Yes

Note: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014). Standard errors are in parentheses. We show the number of effective observations used in the estimates. The total number of observations may be seen in the descriptive statistics (men plus women); 2) Municipalities with more than 200,000 electors are excluded from the sample to avoid strategic possibilities in the second round; 3) Covariates are the mayoral candidates' characteristics (completed high school, completed higher education, and belongs to the PT, PSDB, PFL/DEM, PMDB parties), municipal characteristics (percentage of houses with access to sewage, percentage of literate people – over 25 years old, population, log GDP per capita, women (% of Total Population), adolescent girls ages 16–17 (% of Total Population), Theil index, and rural dwellers(% of Total Population), and electoral years (2002, 2004, 2008, and 2012). 4) Quantile regressions are weighted by the distance of observations to the cutoff. As in the RD estimates, weights are calculated using a triangular kernel; 5) The bandwidth used in the RD results is generated endogenously (triangular kernel); * Significance at the 10% level, ** at 5% level, and **** at 1% level.

Dependent variables (definition).

Engagement (Difference in Adolescent Girls' Registration) is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

Difference in Women's Registration is the difference in the number of women registered to vote who are over 18 and under 59 years old as a percentage of the total number of individuals registered to vote of the same age (women plus men) in municipalities in which women are elected and those in which they are not elected.

5. Extensions

We explore some of the heterogeneities of the sample to answer important questions of empirical literature.

Differences between municipalities with a high (vs. low) concentration of women elected to the municipal legislative body (councilors): Duflo and Topalova (2004), and Beaman et al. (2012)³⁰ show the importance of seats being reserved for a group of elected women on the observed aspects of female life (i.e., the aspirations of adolescent girls, public policy, welfare, the quality of politicians, etc.).^{31 32}

Even knowing that the electoral environment is uncertain for women and that the proportion of women elected as mayor is small in the country (as we showed previously in Table 1), we decided to investigate whether the number of elected women should have an influence on our main result. We choose the percentage of women elected as councilors as a measure of this dimension. First of all, it is necessary to mention that this investigation does not compromise the internal consistency of our quasi-experiment, since the percentage of female councilors elected in the municipality is balanced (see Table 3C, Column 3).³³ The division between municipalities with a higher/lower concentration of women elected as councilor is given by the national median of those elected. Table 5 contains results for both groups.

The results show that our measure of engagement occurs in municipalities that have a higher concentration of women elected as councilor. The victory/defeat of role model women leads to an engagement of adolescent girls of between 1.3 ($SE = 0.008$) and 1.9 (SE

³⁰ One third of the top positions in village councils in India are randomly reserved for a woman.

³¹ Baskaran and Hessami (2018) showed that a female mayor increases the position in the ranking list of female candidates for councilor in Germany. On the other hand, Arvate et al. (2017) showed that a female mayor has no impact on the number of votes for females running for councilor in Brazil.

³² The great majority of countries prefer an *ex-ante* uncertain electoral environment (adopting quotas for women candidates or not adopting a specific type of safeguard to increase the participation of women in politics) to an environment of electoral certainty (reserving seats for women in politics) for electing women. Among the arguments that are contrary to the environment of electoral certainty for women in politics are those that object to any legislation changes that favor women: the principle of equal opportunity for individuals, lack of democracy given that voters have to choose someone they do not want, and the lack of qualifications of the elected candidates. See the site from Inter-Parliamentary Union (<http://www.ipu.org>). See also the site from Institute for Democracy and Electoral Assistance (<https://www.idea.int/data-tools/data/gender-quotas/quotas>).

³³ We re-did all the procedures for concentration using the vote share for women as councilor. In the same Table 2C (election characteristics), we have a similar result.

= 0.008) p.p. This result is a little higher than the result obtained in the main results (between 1.1 ($SE = 0.005$) and 1.6 ($SE = 0.006$) p.p.). As previously, women's registration is not significant. Even in an uncertain electoral environment, the engagement of adolescent girls is influenced by a collective pro-female electoral result. Complementary results of the exercise are shown in the online supplementary material (Tables S13, S14A, and S14B; Figures S19, S20, and S21).^{34 35}

Does the electoral experiment extend to include groups of younger adolescents? An important extension of our main results is to know how many cohorts of "adolescent girls" are influenced by the electoral quasi-experiment. Future elections can give us an idea of the extension of our quasi-experiment to include younger age groups (under 14), because future registration captures the influence of the quasi-experiment on cohorts of younger adolescents. For example, when a woman is elected/not elected, those who become engaged are not in the electoral group of adolescent girls in the 16–17 age band in the electoral year, but in a younger group (14–15 age). They choose to register (or not) for the next election, i.e., two years later. Extending this reasoning to the election four years after (the next election for mayor), adolescents aged 16 and 17, who were observed at that moment in time, were 12 and 13 years old at the time of the quasi-experimental election. Six years after (the second mid-term election after the election for mayor), the same observed group of adolescents, who were affected by the performance of a woman (elected/not elected) in the quasi-experiment, were 10 and 11 years old. If psychology literature is valid,³⁶ this difference in age imposes a non-existent differential on engagement. Beaman et al. (2012) find that the election of a female leader shapes the political aspirations of adolescent girls (i.e., between 11 and 15 years old) in India.

Excluding the investigation into any pre-existing tendency (two years before, on the dependent variable), with the same empirical strategy as in the main results, and without covariates as control, we show that adolescent girls do not become engaged (with less or more register for voting) with elections with significant result four and six years after the quasi-experiment. Table S21 in the online supplementary material shows this result (including the result for the compulsory vote group: 18–59).

An inhospitable environment for women: nearby municipalities with two men competing (first and second place) for office: Since Brookman (2014), Gilardi (2015), and Baskaran and Hessami (2018) investigate the possibility that elite and potential female candidates might learn from women's electoral victories in nearby municipalities, we decided to extend our investigation to measure the engagement of adolescent girls in nearby municipalities where no female candidates are running for election. We choose to investigate the effect of our quasi-experiment (victory/defeat) for observing engagement on nearby municipalities that are completely unfavorable for observing the engagement effect. We consider a nearby municipality to be one in which the election was disputed by two men (first and second place). In short, we are comparing municipalities with elected women (i.e., running against men) vis-à-vis nearby municipalities with elected men, in which there are no women running for election.

Table S22 (in the online supplementary material) contains the results with different measures of distance. First, we show the results in all races in contiguous municipalities. Second, we show the results in which the distance between the municipality where the quasi-experiment occurs and the nearby municipality is lower/higher than the national median distance between these groups of municipalities. To our knowledge, this type of investigation has never been reported in economic literature.

The results of investigations into nearby municipalities in political science literature is mixed. Gilardi (2015) obtains a positive correlation between a woman elected in a given municipality in Switzerland and new female candidates in neighboring municipalities: 10 percentage points. On the other hand, using a closed election quasi-experiment (like Lee, 2001) involving US state legislators (women in opposition to men), Brookman (2014) detected no effect on nearby jurisdictions (i.e., districts) when a woman was elected.

We observe no robust results relating to the engagement of adolescent girls in nearby municipalities.

Selected elections (one woman and one man competing): Brollo and Troiano (2016) investigate the effect of an elected woman with regard mainly to patronage, using just two Brazilian elections for mayor (2000 and 2004). They find evidence of non-random sorting around the threshold (cut-off with a zero margin of victory/loss for women) when mixed-gender races have more than one male candidate. Given this, all their empirical evidence was constructed using municipal elections in which just one man was standing against one woman for the office of mayor.

Although we have no evidence of non-random sorting around the threshold, using four elections in Brazilian municipalities (2000, 2004, 2008, and 2012) and working with more than one male candidate in the sample³⁷ we re-worked the main results for a mixed-gender race using this more restricted sample. We found no previous result for this restricted sample. There is no significant result of engagement for this group of elections. The main results for this sample can be found in the online supplementary material (Tables S23, S24A, S24B, and S25).

6. Discussion of potentially confounding stories

Outstanding women at other levels of government: In any national investigation it is possible that the engagement observed at

³⁴ We re-did all results using a different measure of concentration (vote share for women on the municipal legislative body). See Tables S19, S20, S.21A, S-21B; Figures S22 and S23). If we observe the conditions of internal validity (pre-conditions) and robustness, the results for a higher concentration of vote share for women on the municipal legislative body are very similar to the results for the higher concentration of elected women for councilor.

³⁵ We re-did the results with different levels of concentration (above 80%, and 90% with the vote share) without controls (RD estimate). The results are practically the same. See table S22 in the online supplementary material.

³⁶ Steinberg and Monahan (2007) and Gardner and Steinberg (2012).

³⁷ We observed no electoral manipulation (see Figures S24, S25, S26, and S27 in the online supplementary material).

Table 5
Municipalities in which there are lower/higher concentrations of women on the Municipal Legislative.

Specific cohort of population		Two years before (the last election)	Two years later (the next election)	
		RD estimate	RD estimate	RD estimate
		(1)	(2)	(3)
<i>Panel A. Lower concentration of women on the Municipal Legislative</i>				
Non-Compulsory Voters	Engagement (Difference in Adolescent Girls' Registration) ₁₆₋₁₇	-0.010 (0.012)	0.016 (0.010)	0.013 (0.010)
	Observations	663 {337}	1023 {603}	955 {555}
Compulsory Voters	Difference in Women's Registration ₁₈₋₅₉	0.011* (0.006)	0.000 (0.004)	-0.002 (0.002)
	Observations	663 {368}	1023 {610}	955 {686}
Included covariates?		No	No	Yes
<i>Panel B. Higher concentration of women on the Municipal Legislative</i>				
Non-Compulsory Voters	Engagement (Difference in Adolescent Girls' Registration) ₁₆₋₁₇	0.004 (0.007)	0.013* (0.008)	0.019** (0.008)
	Observations	1943 {1218}	2222 {1495}	1999 {1189}
Compulsory Voters	Difference in Women's Registration ₁₈₋₅₉	-0.002 (0.003)	-0.005 (0.003)	-0.002 (0.002)
	Observations	1943 {1168}	2222 {1066}	1999 {1120}
Included covariates?		No	No	Yes

Notes: 1) Bias-corrected RD estimates with robust variance estimator using [Calonico et al. \(2014\)](#). Standard errors are in parentheses. The number of effective observations used in the estimates is in braces; 2) Municipalities with more than 200,000 electors are excluded from the sample to avoid the strategic possibilities in the second round; 3) Covariates are mayoral candidates' characteristics (completed high school, completed higher education, and belongs to the PT, PSDB, PFL/DEM, PMDB parties), municipal characteristics (percentage of houses with access to sewage, percentage of literate people – over 25 years old, population, log GDP per capita, women (% of Total Population), adolescent girls ages 16–17 (% of Total Population), Theil index, and rural dwellers(% of Total Population), and electoral years (2002, 2004, 2008, and 2012). 4) Lower and Higher concentrations are municipalities below/above the national median of elected councilors; 5) The bandwidth used in the RD results is generated endogenously (triangular kernel); * Significance at the 10% level, ** at 5% level, and **** at 1% level.

Dependent variables (definition).

Engagement (Difference in Adolescent Girls' Registration) is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

Difference in Women's Registration is the difference in the number of women registered to vote over 18 and under 59 years old as a percentage of the total number of individuals registered to vote of the same age (women plus men) in municipalities in which women are elected and those in which they are not elected.

the municipal level may be the effect of a woman who is elected to an office that is more visible than that of mayor. In other words, a female president, governor, senator or deputy might explain the results of the engagement of adolescent girls. Brazil had a recent experience when Dilma Rousseff was elected president in 2010 and women were subsequently elected as governors and senators in our sample. Dilma Rousseff is a homogenous interference. Female governors and senators are a homogenous interference in the state, but heterogeneous between states. One woman out of 28 was elected as governor in 1998, two in 2002, three in 2006 and two in 2010; for senator, there was one out of 28 in 1998, seven out of 56 in 2002 (these elections were for two elected senators per state), four out of 28 in 2006, and seven out of 56 in 2010 (also two elected senators per state).

In our understanding, the result of the validity of the experiment allows us to disregard this story. Since elections for these more important offices are not simultaneous, the influence of women in such offices on the engagement of adolescent girls will be captured before the quasi-experiment elections. The results of our quasi-experiment with regard to any pre-existing engagement were massively non-significant (including heterogeneities). On the other hand, considering that the relationship between politicians is with political parties, when we look at the four big parties in the country in the period (PT, PSDB, PMDB, and PFL/DEM), we observe no persistent evidence in our quasi-experiment (including heterogeneities) of party strategy; neither do we observe any difference for or against elected women in the elections of 2000, 2004, 2008, and 2012 (Tables 3C and 4). Thus, we believe that the engagement of adolescent girls is the result of the municipal election of women as mayor.

Difference in policy preferences between men and women mayors: Can the influence of a difference in public policy between male and female mayors explain the results? The design of a municipal structure that specifically considers women (planning policies, councils, a specialized police force for women) and pro-women public goods (daycare facilities or vaccines) in the short term when a woman is elected may make it difficult to explain the results of the engagement of adolescent girls. First-round elections occur in October and the deadline for registration is 18 months later (May in the year of the next election). The budget of the new government, which assumes office on January 1 in the year after the election, is not prepared by the new local leader. The first year of the budget was prepared and approved by the previous government. For instance, the 2010 election occurred in October, and the new mayor assumed in January 2011. He/she prepared the 2012 budget with their own preferences, but not the 2011 budget. The 2011 budget

was prepared by the previous government. Thus, the budget of the new government only has five months in which to have an effect on engagement - a very short amount of time. We also investigated different pro-women structure and public policy variables (Table S26 in the online supplementary material) and observed no robust differences when a woman is elected vis-à-vis a man: municipal planning with female policies, a municipal council of women's rights, a women's police station, a municipal center for women's assistance, a municipal daycare facility, and the number of per capita vaccines (free immunization) for those under 1 year old. Ferreira and Gyourko (2015) found no policy differences between female and male mayors in the US. The survey of the literature found in Hessami and Fonseca (2020) shows that female representation increases education and health in developing countries. Svaleryd (2009) shows the importance of women's representation in shaping policy choices in Swedish municipalities.

7. A tentative explanation for the main results

We deepened our investigation to understand our main result and found two possible lines of explanation which may justify it: 1) an exchange of experiences between adolescent girls of different ages; and 2) information (though the Internet and public Wi-fi and formal information about schools).

Exchange of experiences between adolescents of different ages: There is a tradition in psychology literature showing that adolescents are more susceptible to the peer effect of their group and are less resistant to reviewing their position than other groups of the population (see, for instance, Steinberg and Monahan, 2007 and Gardner and Steinberg, 2012).

Our empirical strategy for showing the importance of the exchange of experiences between adolescent girls is to demonstrate that our main results depend on the existence of contact between older and younger adolescent girls living in the same residence. It also shows that there is a different motivation in older adolescent girls (the influencers) that can be transmitted to younger adolescent girls.

We investigate, therefore, whether there is difference in the results in municipalities in which older adolescent girls (aged 16–17) and younger adolescent girls (aged 14–15) live in the same residence, vis-à-vis municipalities in which this is not the case. By observing the census (2000), it is possible to know the total number of residences by municipality where this type of cohabitation exists. Only the 2000 census has this information. We built two samples: 1) one sample with municipalities that have residences in which adolescents (aged 16–17 and aged 14–15) cohabit³⁸, and 2) another sample for municipalities that do not have this type of residence. The average percentage of residences with this characteristic in the total sample is very low: 1.4% of municipal residences have older and younger adolescent girls living together (the maximum found for a municipality was 6%). By using the same empirical strategy as in the main results, Table 6 shows the results observed for each one of samples:

The results show that our main result only occurs in municipalities with this type of residence. The additional results of our quasi-experiment can be found in the online supplementary material (see descriptive statistic: Table S2, balancing of variables: Tables S3A and S3B; non-electoral manipulation for municipalities where there are residences in which there is contact between adolescent girls of different ages: Figure S4; covariates balance (mayor, municipality, and election year for municipalities in which there are residences in which there is contact between adolescent girls of different ages): Figure S5 and S6.

In order to capture the different motivations of older adolescent girls with regard to elections, we decided to observe their turnout in mixed-gender elections compared to other types of election. Unfortunately, we only have turnout data for two elections: 2008 and 2012. Based on these results we can build our hypothesis about the decision of adolescent girls. Older adolescent girls participate more in a mixed-gender race than other types of election and, when they live in the same residence as younger adolescent girls, they transmit their electoral experiences to these younger girls and this will influence the latter to register: older adolescent girls transmit the defeat of women to younger girls, which influences the latter not to register; when women win, the opposite happens.

Information: Our intention is to show how important information is in our results. Information is important in the decisions taken by adolescent girls (social media). Thus, we investigate the importance of informal information (Internet access and the existence of public Wi-Fi in municipalities) and formal information (an anti-discrimination program offered by municipal governments to adolescents). Our results are shown in Table 7.

7.1. Internet access

Although literature shows the negative effects of the Internet on adolescents in a score test (Quintelier and Vissers, 2007; Malamud and Pop-Eleches, 2010; Vigdor and Ladd, 2010), which can compromise the accumulation of human capital, we choose to investigate whether our results are sensitive to Internet access in homes in municipalities. Younger generations are more connected to the Internet than older generations (Twenge, 2017). Information can influence the engagement of adolescents in politics, and particularly of adolescent girls.

We investigated the percentage of houses with Internet access in municipalities (the 2010 census - IBGE), and the percentage of houses that had at least one PC connected to the Internet. Only the 2010 census has this information. Our result (Table 7; first block of results) is stronger in municipalities in which the percentage of houses with Internet access is above the national median: the difference is around 2.3 ($SE = 0.011$) p.p.

Our complementary results in the quasi-experiment can be found in the online supplementary material (see descriptive statistic: Table S5, balancing of variables: Tables S6A and S6B; Figure S7 shows that Internet access is balanced for all municipalities; non-

³⁸ We also observe that a mixed-gender race is more attractive (turnout) to adolescent girls (see Table S4 in the online supplementary material).

Table 6
Municipalities in which there is contact between adolescent girls (adolescent girls between 14–15 and 16–17) living in the same residence.

		Two years before (the last election)		Two years later (the next election)				
Type of municipality								
		No contact between adolescent girls	Contact between adolescent girls	No contact between adolescent girls	Contact between adolescent girls	No contact between adolescent girls	Contact between adolescent girls	Contact between adolescent girls (high frequency of municipalities in the sample -see 4 and 6)
		<i>RD estimate</i>	<i>RD estimate</i>	<i>RD estimate</i>	<i>RD estimate</i>	<i>RD estimate</i>	<i>RD estimate</i>	<i>RD estimate</i>
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Non-Compulsory Voters	Engagement (Difference in Adolescent Girls' Registration) ₁₆₋₁₇	-0.028 (0.033)	0.004 (0.005)	-0.054 (0.034)	0.019*** (0.006)	-0.085** (0.038)	0.022*** (0.007)	0.021*** (0.007)
	Observations	161 {86}	2445 {1809}	191 {100}	3054 {1859}	165 {81}	2789 {1624}	2748 {1611}
	Considered bandwidth	0.095	0.196	0.114	0.146	0.109	0.133	0.134
	Included covariates?	No	No	No	No	Yes	Yes	Yes

Note: 1) Bias-corrected RD estimates with robust variance estimator using Calonico et al. (2014). Standard errors are in parentheses. The number of effective observations used in the estimates are in braces; 2) Municipalities with more than 200,000 electors are excluded from the sample to avoid the strategic possibilities in the second round; 3) Covariates are mayoral candidates' characteristics (completed high school, completed higher education, and belongs to the PT, PSDB, PFL/DEM, PMDB parties), municipal characteristics (percentage of houses with access to sewage, percentage of literate people – over 25 years old, population, log GDP per capita, women (% of Total Population), adolescent girls 16–17 (% of Total Population), Theil index, and rural dwellers(% of Total Population), and electoral years (2002, 2004, 2008, and 2012). 4) The average percentage number of residences with adolescent girls between 14–15 and 16–17 living in the same residence by municipality is 1.4% (standard deviation equal to 0.09%). The maximum value of sample is 6%. 5) There are municipalities with and without this type of residence; 6) High frequency of municipalities in the sample are municipalities in which the frequency of the percentage of adolescent girls between 14–15 and 16–17 living together is high: between 0% and 4%; 7) The bandwidth used in the RD results is generated endogenously (triangular kernel); * Significance at the 10% level, ** at 5% level, and **** at 1% level.

Dependent variable(definition).

Engagement (Difference in Adolescent Girls' Registration) is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

Table 7

The effect of a woman elected as mayor on the engagement of adolescent girls (internet access, Public Wi-Fi, and anti-discrimination program).

Specific cohort of population		Two years before election			Two years after election			Two years before election			Two years after election		
		RD estimate			RD estimate			RD estimate			RD estimate		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)			
Panel A. Lower concentration of households with internet access				Panel A: Without Public Wi-Fi				Panel A: Without anti-discrimination program					
Non-Compulsory Voters	Difference in Adolescent Girls' Engagement ₁₆₋₁₇	0.003 (0.007)	0.007 (0.007)	0.007 (0.007)	0.006 (0.015)	0.008 (0.016)	-0.006 (0.018)	0.009 (0.008)	0.014 (0.01)	0.010 (0.010)			
	Observations	[1293]	[1612]	[1488]	[327]	[433]	[285]	[621]	[672]	[607]			
Compulsory Voters	Difference in Women's Engagement ₁₈	-0.001 (0.004)	-0.003 (0.004)	-0.001 (0.002)	-0.003 (0.006)	-0.006 (0.005)	-0.006* (0.006)	-0.003 (0.004)	-0.002 (0.003)	-0.001 (0.002)			
	Observations	[1293]	[1612]	[1488]	[285]	[326]	[327]	[660]	[767]	[727]			
Included covariates?		No	No	Yes	No	No	Yes	No	No	Yes			
Panel B. Higher concentration of households with internet access				Panel B: With Public Wi-Fi				Panel B: With anti-discrimination program					
Non-Compulsory Voters	Difference in Adolescent Girls' Engagement ₁₆₋₁₇	-0.002 (0.009)	0.023*** (0.01)	0.022** (0.011)	-0.001 (0.006)	0.016*** (0.006)	0.022*** (0.007)	-0.005 (0.007)	0.015* (0.008)	0.018* (0.008)			
	Observations	[1310]	[1630]	[1463]	[1420]	[1659]	[1329]	[1182]	[1428]	[1237]			
Compulsory Voters	Difference in Women's Engagement ₁₈	0.003 (0.004)	-0.005 (0.004)	-0.007*** (0.002)	0.001 (0.003)	-0.003 (0.003)	-0.001 (0.002)	0.004 (0.004)	-0.004 (0.003)	-0.003 (0.002)			
	Observations	[1310]	[1630]	[1463]	[1283]	[1408]	[1522]	[972]	[1043]	[1060]			
Included covariates?		No	No	Yes	No	No	Yes	No	No	Yes			

Note: ***p < 0.01, **p < 0.05, *p < 0.1; 1) Bias-corrected RD estimates with robust variance estimator using [Calonico et al. \(2014\)](#). Standard errors are in parentheses. The number of effective observations used in the estimate in braces; 2) Municipalities with more than 200 thousand electors are excluded to avoid the possibilities of second term. 3) [Imbens and Lemieux \(2008\)](#) suggests moving the cutoff point as a form of sensitivity analysis. We show that for great majority of population cohort (i.e., compulsory voters) does not have a significant difference of engagement. Covariates are mayor's candidates characteristics (with complete high school, with complete higher education, and belongs to the PT, PSDB, PFL (DEM), PMDB parties), municipal characteristics (percentage of houses with access to sewage, percentage of literate – older than 25 years old, population, log GDP per capita, women (% of Total Population), adolescent women ages 16–17 (% of Total Population), Theil index, and rural dwellers(% of Total Population), and electoral years (2002, 2004, 2008, and 2012).

Dependent variables (definition).

Engagement (Difference in Adolescent Girls' Registration) is the difference in the number of 16 and 17-year old adolescent girls registered to vote as a percentage of the total number of adolescents registered to vote of the same age (girls plus boys) in municipalities in which women are elected and those in which they are not elected.

Difference in Women's Registration is the difference in the number of women registered to vote over 18 and under 59 years old as a percentage of the total number of individuals registered to vote of the same age (women plus men) in municipalities in which women are elected and those in which they are not elected.

electoral manipulation for municipalities in which the percentage of houses with Internet access is above the national median: [Figure S8](#); covariates balance (mayor, municipality, and election year for municipalities in which the percentage of houses with Internet access is above the national median): [Figures S9 and S10](#).

7.2. Another proxy of communication: the existence of public Wi-Fi in municipalities

We did the same exercise with information about the existence of public Wi-Fi in municipalities, since adolescents may not have access to the Internet in their homes. Our information on the existence of municipal public Wi-Fi was obtained from the 2012 *MUNIC* (*Survey of Basic Municipal Information*, produced by *IBGE*). Following the same procedures used with the Internet access exercise (see the online supplementary material: [Tables S7, S8, S9A, and S9B](#); [Figures S11, S12, S13, and S14](#)), we investigate whether our main result comes from municipalities with or without public Wi-Fi. Our results are taken from municipalities that have public Wi-Fi, not those without it (see the second block of results in [Table 7](#)).

Information as policy (the existence of an anti-discrimination program in municipal schooling): Formal information may be an important factor. Thus, we investigate whether the existence of an anti-discrimination program for adolescents in the municipal school system has an influence on our main results. Elementary schooling is mandatory for children between 6 and 14. However, according to information from the federal government (*INEP, the National Institute of Educational Studies and Research*), the age-grade distortion is around 20% (2011) for the last year of elementary school. Certainly, a great number of 15-year old adolescents may be still in elementary school. Our adolescent females are in the 14–15 age band at the time of the election. Municipal governments are responsible for elementary schools. Our information was obtained from the 2011 *MUNIC* (produced by *IBGE*). Following the same procedures used for the Internet access exercise (see additional result in the online supplementary material: [Tables S10, S11A, and S11B](#); and [Figures S15, S16, S17, and S18](#)), we observe that our result occurs when the municipality has an anti-discrimination program (the last block of results in [Table 7](#)).

Based on the set of results, both informal and formal information has an influence on our main results.

8. Summary of conclusions

The main objective of our work is to demonstrate that a non-elected female leader causes a reduction in the registration of adolescent girls to vote, which is a result that goes beyond the measure of political aspirations observed in surveys in the literature ([Beaman et al., 2012](#); [Campbell and Wolbrecht, 2006, 2007](#)). In reality, working with an electoral quasi-experiment we observe two simultaneous movements that are provoked by the performance (victory/defeat) of female leaders on the registration of adolescent girls in municipalities ([Lee, 2001](#); [Ferreira and Gyourko 2015](#); [Brollo and Troiano 2016](#)). The traditional “jump” in registrations observed (in RD figures with a mixed-gender race) when the margin of victory is close to zero is not only because of the victory of a female leader in the municipality in which it occurs, but also in municipalities in which a female leader was defeated. Registrations to vote increase following a victory, reduce following a defeat, and seem to be graphically symmetrical when the margin of victory is close to zero. Thus, as a consequence, we started to interpret the results from our non-parametric regression discontinuity estimate as a net result of the registration to vote between municipalities: a higher registration of adolescent girls in municipalities in which a female leader was victorious, and a lower registration (non-registration) of adolescent girls in municipalities in which a female leader was defeated. Our measure, which we call engagement, is between 1.1 ($SE = 0.005$) and 1.6 ($SE = 0.006$) percentage points.

Exploring some of the heterogeneities of the sample, we observe that the concentration of women elected to the municipal legislative body is important to our results. Younger adolescent girls (children of 12–13 and 10–11 years old) are not influenced by the quasi-experiment and there is no effect on nearby municipalities, in which the election was decided between men (two male candidates). Finally, the effect does not depend on women running exclusively against a male candidate. It is valid for any type of election (with more than one male candidate, for example).

Additional investigations enabled us to avoid two confounding stories: the effect of outstanding women at other levels of government, and the difference in policy preferences between male and female mayors on the production of public goods.

Our main results can be explained in two ways as: 1) an exchange of experiences that are expressed by way of contact between adolescent girls of different ages; adolescent girls aged 14–15, who will register for the next election, living in the same residence as adolescent girls aged 16–17. The turnout of adolescent girls aged 16–17 is greater in a mixed-gender race than in any other type of election and they transmit their electoral experience to adolescent girls aged 14–15. Our hypothesis is that when older adolescent girls observe the defeat/victory of women they have an influence on the engagement of younger adolescent girls in the next election by transmitting their experience to them; 2) information: informal by way of the Internet and public Wi-Fi, and formal by a municipal anti-discrimination program in schools.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejpolco.2021.102045>.

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